PROCEEDINGS OF SINN UND BEDEUTUNG 27

2023

edited by

Maria Onoeva,
Anna Staňková,
and Radek Šimík

Sinn und Bedeutung 27 took place from September 14–16, 2022
and was hosted at the Charles University Prague.

Proceedings of Sinn und Bedeutung 27

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Foreword

It is our pleasure to present the *Proceedings of Sinn und Bedeutung 27*. The conference took place on 14–16 September 2022 at Charles University in Prague, Czech Republic, making it the first edition of Sinn und Bedeutung in a country of the former Eastern Bloc.

Of the 185 submissions, 38 were accepted as talks – presented in two parallel sessions – and 20 as posters, featuring altogether more than 100 authors. A total of 90 registered participants took part in the conference. The conference included a welcoming lecture by Eva Hajičová and four invited talks – by Mojmír Dočekal, Nicole Gotzner, Pritty Patel-Grosz, and Uli Sauerland. Most of the presentations have made it into these proceedings, which consist of 46 papers. It is worth noting that while these papers were not subject to centralized review, authors were encouraged to seek relevant peer feedback and incorporate it into their revised versions.

Sinn und Bedeutung 27 was primarily an in-person event, with units of authors opting for online presentations, mainly in the form of posters. The hybrid mode, supported by a conference Slack, proved to be a challenge. A post-conference online questionnaire, completed by 30 participants, revealed that, despite overall high satisfaction with the conference, the experience was notably less favorable for online participants. Apart from the difficulties imposed by the institutional technical limitations (suboptimal conference hardware), the majority of in-person participants (almost 90%) reported minimal or no interaction with online participants. The results of the questionnaire are summarized here.

The conference would not have been possible without the financial and administrative support of the Faculty of Arts, Charles University, as well as two of its departments – the Institute of Czech Language and Theory of Communication (with which the editors are affiliated) and the Department of English Language and ELT Methodology. More particularly, we are grateful to Eva Lehečková, Ivan Kafka, Kateřina Bělehrádková, Kateřina Hrdinková, Tatiana Kupková, Petr Louda, and Daniela Marková, whose organizational support was indispensable. Thanks also go to Daniel Gutzmann, who kindly designed the cover page for these proceedings, Jelena Preiser and Regine Eckardt, for managing the publication in the Konstanz archive, and, finally Thomas Ede Zimmermann, who approached us in 2019 with the idea of holding Sinn und Bedeutung 27 in Prague.

Last but not least, we would like to extend our appreciation to the global semantics community, and, notably, the 189 reviewers who generously invested their time in reviewing the abstracts.

Maria Onoeva, Anna Staňková, and Radek Šimík (editors)
Prague, October 2023

Parallel and Differential Contributions from Language and Image in the Discourse Representation of Picturebooks[1]

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Mats ROOTH — *Cornell University*

Abstract. This paper proposes an account in Discourse Representation Theory of children's picturebooks, combining language and image. The focus is on works where the language and image have a different pragmatic status, with the linguistic part of the book being prosaic and understated by comparison with the pictorial part. The effect of wryness and incongruity is analyzed in pragmatic terms.

Keywords: children's literature, discourse representation theory, event semantics, implicature, narration, picturebooks, possible worlds semantics, superlinguistics, temporal relations, understatement

1. Introduction

Children's picturebooks combine language and images, and have narrative structure that involves temporal progression and identification of discourse referents across language and images. This paper formulates discourse representations (DRSs) for common discourse structures in picturebooks, with emphasis on works where the language and the images have a different pragmatic status. To combine information from pictorial and linguistic media, we rely on earlier work that uses a uniform dynamic possible world semantics for language and image (Abusch 2012; Maier 2019; Rooth and Abusch 2019; Greenberg 2019; Abusch 2021; Abusch and Rooth 2022). The two media contribute information that is represented using the same possible-worlds toolkit, and pictorial and linguistic information have nearly the same semantic type. Hence information from the two sources can be combined conjunctively. The dynamic part of the framework includes a mechanism for discourse referents, and so it is possible to index individuals and events across the media. A basic discourse relation between language and image in picturebooks is *co-temporal juxtaposition*, where the eventualities (events and states) described by the language on a single page or two-page spread temporally overlap the eventualities described by the accompanying picture. Typically some events are described by both of them, and typically some individuals are described by both of them.

Differential informational status for language and image in children's picturebooks was studied in Maria Nikolajeva and Carole Scott's *How Picturebooks Work*, referring to a rich variety of examples (Nikolajeva and Scott 2006). Here are three of them. Pat Hutchins's *Rosie's Walk* describes and illustrates a hen Rosie walking around a farmyard (Hutchins 1967). Exceptionlessly, language and image on a page or two-page spread are in co-temporal juxtaposition. The language mentions no threatening events, while images show a fox stalking the hen. See the middle column of (1) for the text, and (2) for examples of complete two-page spreads, sometimes with text and image, and sometimes with an image only. Nikolajeva and Scott comment: "In *Rosie's Walk*, words and pictures contradict each other. The visual narrative is more compli-

[1]We thank participants in Sinn und Bedeutung 27 in Prague for their comments. Thanks also to Masha Esipova and Radek Šimík for comments and assistance connected with the document.

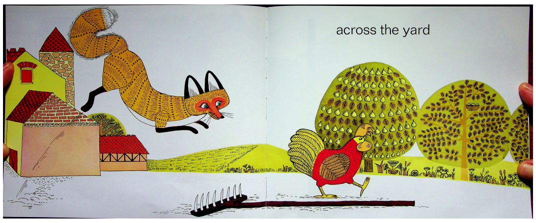
cated and exciting than the verbal one, which comprises a single, twenty-five-word sentence." The impression of the pictures telling a different or markedly extended story is enhanced by every other two-page spread in the central part of the book having no text, and those pages showing the fox suffering some mishap after leaping at the hen, such as in the third spread being banged by a rake.

(1)

spread	text	mishap for fox
1	Rosie the hen went for a walk	
2	across the yard	
3	*none*	banged by rake
4	around the pond	
5	*none*	lands in pond
6	over the haystack	
7	*none*	sinks in haystack
8	past the mill	
9	*none*	covered by flour
10	through the fence	
11	*none*	lands in wagon
12	under the beehives	
13	*none*	chased by bees
14	and got back in time for dinner.	

(2)

2-page spread



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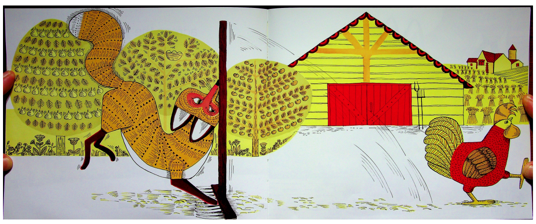

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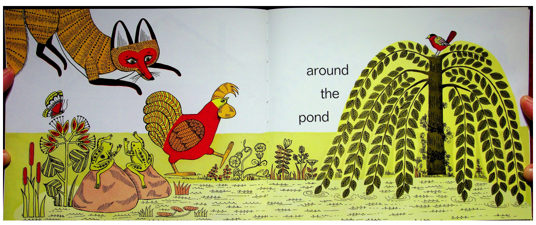
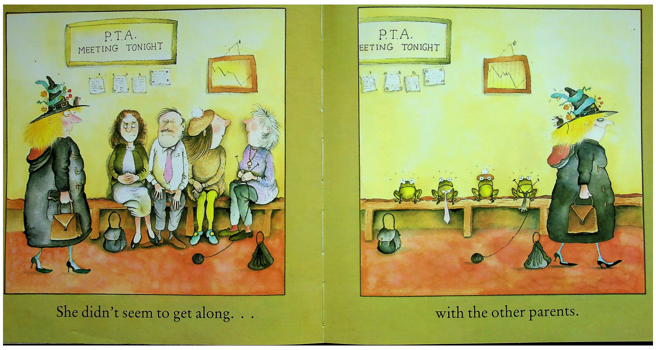


4

Babette Cole's *The Trouble with Mum* is a story with a first-person narrator whose mother is a witch (Cole 1983). This fact is evident in the pictures throughout the book, but not in the language, with the effect that the language is wryly understated by comparison with the images.

In the spread (3), the picture shows Mum having turned the other parents into frogs, while text merely mentions not getting along.

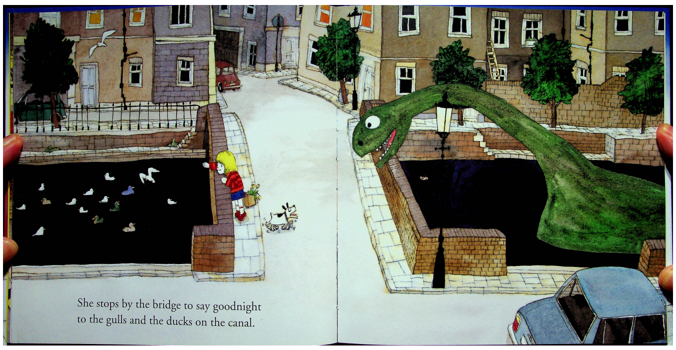
(3)



She didn't seem to get along
with the other parents.

Lily Takes a Walk describes a girl Lily and a dog Nicky taking a walk through a city (Kitamura 1987). The language is prosaic, but the images veer into hallucination, with Nicky seeing monsters, see (4).[2]

(4)



She stops by the bridge to
say goodnight to the gulls
and the ducks on the canal.

The point of the current paper is to formulate the examples brought up by Nikolajeva and Scott in the framework of super-semantics, which applies techniques of possible worlds semantics and discourse representation theory that were developed in linguistic semantics to materials such as comics and film. It will come out that the contradiction in *Rosie's Walk* is pragmatic rather than semantic. Moreover, the three examples introduced above have substantially different discourse representations, which however share the feature of textual information being understated compared to the pictorial information.

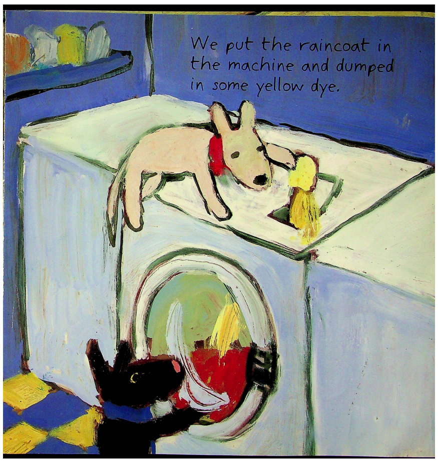
2. DRS framework

Previous super-semantic research on multimodal materials uses a unitary discourse representation based on semantic primitives of worlds, individuals, and viewpoints. Some of this literature uses a linear representation where hidden material is interleaved into a sequence of pictures, in order to cover anaphora, and sometimes with hidden embedding operators included (Abusch and Rooth 2017; Abusch 2021; Abusch and Rooth 2022). Other literature uses the box notation of discourse representation theory (Abusch 2012; Maier and Bimpikou 2019; Maier

[2]Images that are quoted from the cited works are used for educational and critical purposes, and are property of the respective owners.

2019; Schlöder and Altshuler 2022). We follow the second strategy here, formulating logical forms in the formal language of discourse representation theory (Kamp and Reyle 1993). Logical forms are thus discourse representation structures (DRSs), which are syntactic objects that are associated in a grammatically formalized way with information-bearing units such as sentences in story, sequences of shots in film, and juxtapositions of language and pictures in a picturebook. (6) is a simplified DRS for the page (5) from *Gaspard and Lisa's Christmas Surprise* (Gutman 1999). There are discourse referents for two characters, two objects, and two events. Discourse referents coming from language are handled in the standard way of discourse representation theory: nominal phrases introduce discourse referents such as x, y and z, and constraints on them such as $\mathbf{raincoat}(y)$. The verbs *put* and *dump* introduce event discourse referents e_1 and e_2, which are incorporated as arguments of the basic relations in the atomic formulas $\mathbf{putIn}(e_1,U,y,x)$ and $\mathbf{dumpIn}(e_2,U,z,x)$.[3] Turning to visual information, the picture enters into the DRS syntactically, as the picture p_1. In the notation $t,v{:}p_1$, picture p_1 is accompanied by a discourse referent t for a time, and a discourse referent v for a geometric viewpoint. The intended interpretation is that $t,v{:}p_1$ constrains a described world to look like p_1 from viewpoint v at time t.

(5)



We put the raincoat in the machine and dumped in some yellow dye.

(6)

$$\left[\begin{array}{l|l} U\ x\ y\ z & \mathbf{machine}(x) \wedge \mathbf{raincoat}(y) \wedge \mathbf{dye}(z) \wedge \mathbf{yellow}(z) \wedge \\ t\ v & \mathbf{putIn}(e_1,U,y,x) \wedge \mathbf{dumpIn}(e_2,U,z,x) \wedge \\ e_1\ e_2 & t,v{:}p_1[a_1{:}u'\ a_2{:}u''\ a_3{:}x'\ a_4{:}y'\ a_5{:}z'] \wedge \\ u'\ u''\ x'\ y'\ z' & U = u' \oplus u'' \wedge x = x' \wedge y = y' \wedge z = z' \\ & t \sqsubset \tau(e_1 \oplus e_2)] \end{array}\right]$$

x	washing machine from text	x'	washing machine as depicted
y	raincoat from text	y'	raincoat as depicted
z	dye from text	z'	dye as depicted
u'	Lisa as depicted	u''	Gaspard as depicted
e_1	putting event	e_2	dumping event
v	viewpoint for picture	t	projection time
U	we (Gaspard and Lisa)		

[3] An alternative is notation such as $e_1{:}\mathbf{putIn}(U,y,x)$, where an event dref is juxtaposed with a formula that describes it, potentially a non-atomic one. This is what is found in Chapter 5 of Kamp and Reyle (1993).

The complex of information repeated in (7) introduces discourse referents u', u'', x', y', and z' for depicted individuals. For instance x' is a discourse referent for the washing machine as depicted in picture p_1, and u' and u'' are discourse referents for the protagonists Gaspard and Lisa as depicted in picture p_1. Following the approach suggested in Abusch (2012), discourse referents for depicted individuals are introduced geometric points that are within the depiction of the individual.[4] So for instance a_3 in the DRS is a specific geometric point in the two-dimensional picture p_1 that is within the projection of the washing machine in the picture. This constrains a witness for the discourse referent x' to look like the depiction of the washing machine at time t from viewpoint v. In the notation a:d, a is a specific geometric point such as (0.5,0.5), and d is the discourse referent it constrains. See Abusch (2021) for the formulation in possible worlds semantics of this way of introducing discourse referents for depicted individuals.

(7) $t, v{:}p_1[a_1{:}u'\ a_2{:}u''\ a_3{:}x'\ a_4{:}y'\ a_5{:}z']$

With discourse referents for depicted individuals introduced, they can be equated with discourse referents introduced by language. For instance the equality $x = x'$ at the bottom of the DRS expresses that a witness for the machine mentioned in the linguistic part is constrained to be identical to a witness for an individual depicted in the vicinity of a_3 in the picture. The full set of equalities, repeated in (8), match up the depicted dogs with the group of mentioned dogs, the depicted dye with the mentioned dye, the depicted machine with the mentioned machine, and the depicted raincoat with the mentioned raincoat.

(8) $U = u' \oplus u'' \wedge x = x' \wedge y = y' \wedge z = z'$

A feature of this analysis is that "indexing is analyzed at the semantic level, where the media are not distinguished" (Rooth and Abusch 2019). As a result there is no puzzle of how indexing can cross the boundary between linguistic and pictorial media.[5] More generally, an approach using a unitary DRS for pictures and language integrates information from the two sources. The semantic content of the DRS (6) is a multi-place relation with some argument slots for individuals, some slots for events, one slot for a world, one slot for a time, and one slot for a viewpoint. At this semantic level, there is no distinction between pictorial and linguistic information.

3. Separating linguistic and pictorial content

Given the observations about the differential status of language and image in *Rosie's Walk*, *The Trouble with Mum*, and *Lily Takes a Walk*, the semantic approach from the previous section seems to go too far. If information coming from language and information coming from pictures are integrated into a single DRS, the interpretation of which is a relation constructed in possible worlds semantics, how is it possible to discuss the phenomenon of linguistic information being understated, and how is it possible to analyze it pragmatically? This problem is a

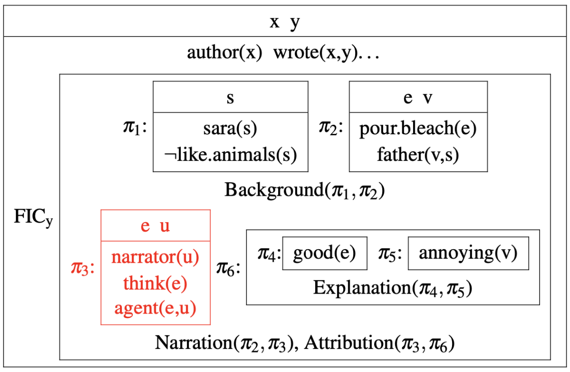
[4]Research in AI and machine vision typically uses bounding boxes or segmentation maps in place of points. See for instance Wang et al. (2016). Abusch (2012) in fact referred to segmentation maps.

[5]The study in Greenberg (2019) of pictures with localized linguistic tags makes the same point, using a different technical construction.

genuine one. We will end up addressing it by making available separate interpretations of the discourse representation that correspond to linguistic and pictorial content. Before getting into this, it is in order to point out some differences among the picturebooks being discussed.

The text part of *Gaspard and Lisa* is construed as first-person narrative. It can be worked out that the narrator is Lisa, the white dog.[6] This is seen in the use of the plural first-person pronoun *we* in the washing machine spread, and elsewhere of first-person pronouns. The language is in past tense, as if the story were being related retrospectively. The narrator Lisa is as well a character who is referred to with nominal phrases in the linguistic part, and who is depicted in the pictorial parts. In terminology of narrative theory, Lisa is an intradiegetic narrator, a narrator who is an individual who exists in worlds consistent with the narrative (Pier 2014). A standard way of treating this is to introduce narration events in the discourse representation, of which the intradiegetic narrator is the agent. This was developed in a DRS framework by Altshuler and Maier in their study of imaginative resistance (Altshuler and Maier 2022). They introduced the DRS (10) for passage (9). The sub-DRS on the lower left that is shown in red describes a thinking event, the agent of which is the narrator u. The sub-DRS on the right describes the content of the thinking event. The two are linked by the formula $Attribution(\pi_3, \pi_6)$. The point of this in Altshuler and Maier's discussion is that the jarring evaluation "good thing that she did ... annoying" is attributed to the narrator, rather than being characterized as true in a described world.

(9) Sara never liked animals ... she poured bleach in the big fish tank ... Good thing that she did, because he was really annoying.

(10)


From Altshuler and Maier (2022)

For our purposes the central point is that narration events are included in the DRS. For the linguistic part of example (5), an event discourse referent e_4 is included, the agent of which is the narrator Lisa, as expressed by the formula **narration**(e_4, l, q_4). The dref l is the discourse referent for Lisa. q_4 is the narrated content, which is described with an embedded DRS.[7] This results in the structure indicated in (11).[8]

[6]Evidence for identifying the narrator with an individual named "Lisa" is that quoted speech uses the phrases "I" and "Gaspard", but not the phrase "Lisa". Evidence for identifying the name "Lisa" with the white dog is more indirect. Pages with quoted narration where only one dog is depicted tend to show the white dog.

[7]Alernatively one can apply the notation **narration**(e_4), **agent**(e_4, l), and **theme**(e_4, q_4).

[8]This takes the theme of narration q_4 to be semantic. One could alternatively claim that the story presents the linguistic information as being narrated with a specific syntax, including an LF that takes the form of a DRS, say K_4. In this case the theme of the narration should be the syntactic object K_4. The equivalent of q_4 is still available

$$(11)\quad \left[\begin{array}{l|l} e_4 & \textbf{narration}(e_4, l, q_4) \\ q_4 & \multirow{2}{*}{q_4:} \left[\begin{array}{l|l} U\ x\ y\ z & \textbf{machine}(x) \wedge \textbf{raincoat}(y) \wedge \textbf{dye}(z) \wedge \textbf{yellow}(z) \wedge \\ e_1\ e_2 & e_1{:}\textbf{putIn}(U,y,x) \wedge e_2{:}\textbf{dumpIn}(U,z,x) \end{array}\right] \\ l & \end{array}\right]$$

On this account, the linguistic part is treated as narrated, in a way that is made explicit in the discourse representation. What about the pictorial part? Nikolajeva and Scott (2006) suggest in one passage that there is an essential difference between pictorial and linguistic parts of picturebooks: "The function of pictures, iconic signs, is to describe or represent. The function of words, conventional signs, is primarily to narrate." Our basic approach does not make this distinction, since the semantics of multi-media constructs is designed to map pictures and language to the the same kind of information. Nevertheless, in works where the linguistic part is narrated, as it clearly is in *Gaspard and Lisa's Christmas Surprise*, it has to be determined whether the pictorial part is narrated as well. If it is not, pictorial information should be entered in the DRS without embedding. (12) adds pictorial information on the second line at the top level, without embedding via an event of narration (or displaying) of the picture. As before, the part beginning with $t,v{:}p_1$ uses the picture p_1 to place a constraint of the appearance of the described world from viewpoint v at time t. This is accompanied by introductions of discourse referents u', u'', x', y' and z' for depicted objects, exactly as before.

$$(12)\quad \left[\begin{array}{l|l} e_4 & \textbf{narration}(e_4, l, q_4) \\ q_4 & t,v{:}p_1[a_1{:}u'\ a_2{:}u''\ a_3{:}x'\ a_4{:}y'\ a_5{:}z'] \\ l & \\ u'\ u'' & q_4{:} \left[\begin{array}{l|l} U\ x\ y\ z & \textbf{machine}(x) \wedge \textbf{raincoat}(y) \wedge \textbf{dye}(z) \wedge \textbf{yellow}(z) \wedge \\ e_1\ e_2 & e_1{:}\textbf{putIn}(U,y,x) \wedge e_2{:}\textbf{dumpIn}(U,z,x) \wedge \\ & x = x' \wedge y = y' \wedge z = z'' \\ & U = u' \oplus u'' \end{array}\right] \\ x'\ y'\ z' & \end{array}\right]$$

Clearly this DRS separates out the linguistic content via the discourse referent q_4. Given this representation, it is possible to reason about the linguistic content separately from the combined content. The linguistic content is simply the information q_4.

On this scheme, the DRS of a picturebook with intradiegetic narration includes a sequence of narration events $e_1, \ldots, e_n$, each of which occurs in any world consistent with the content of the book. These events occur in the same world as the one where (in the Gaspard and Lisa story) there is an event of pouring dye into a washing machine, and which from a certain viewpoint at a certain time, looks like the picture of Lisa pouring dye into a washing machine. The circumstances of these narration events, and where they occur in a timeline, is only weakly constrained. They could be events of Lisa narrating the text to some listener. They could be events of Lisa narrating internally. This indeterminacy is not a defect—the picturebook is simply non-committal about the circumstances and time for the narration events. All that can be said is that the narration events follow the events related in the story, since the narration is in past tense, and that the narration events follow one another in the order $e_1 < \ldots < e_n$, since default axioms for ordering events apply. This possibility of interpreting tense counts as motivation for the setup with explicit narration events.

The picturebook *The Trouble with Mum* also has intradiegetic narration. The ginger-haired nar-

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as the content of K_4.

rator is shown on the first page, introducing the narrator, and the second page is picked out with a first-person pronoun. The way these combine with visual and textual information indicate that the narrator is the child of the depicted woman. The DRS representation is parallel to (12), with discourse referents for narration events $e_1, e_2, ...$, and for the corresponding contents $q_1, q_2, ...$. As before, the linguistic content is separated out with the discourse referents $q_1, q_2, ...$. So it is possible to reason pragmatically about this linguistic content being understated.

What about books where there is no indication of intradiegetic narration? This is the case with *Rosie's Walk*. Here there is the option of positing a DRS without narration events, parallel to (6). If the DRS is like this, the linguistic content is not separately available. We consider two solutions to this. One is to provide separate linguistic and pictorial interpretations of the unitary DRS. The method for this is straightforward. The linguistic interpretation uses True as the interpretation of $t, v : p$, thus trivializing the content of picture p in the linguistic content of the DRS, in effect removing the pictorial content from the linguistic interpretation. Symmetrically, the pictorial interpretation uses True as the interpretation for atomic formulas such as **machine**, thus trivializing the condition derived from language in the pictorial content, in effect removing the linguistic content from the pictorial interpretation. See (13). The semantics $[\![\cdot]\!]^L$ and $[\![\cdot]\!]^P$ above the atomic level is standard. Then $[\![\phi]\!]^P$ is the pictorial content of a DRS ϕ, and $[\![\phi]\!]^L$ is the linguistic content. These are available together with a combined content $[\![\phi]\!]$.

(13) $[\![\mathbf{machine}(x)]\!]^P \triangleq \mathit{True}$
$[\![t, v{:}p]\!]^L \triangleq \mathit{True}$

An alternative is to structure the DRS into several conjunctive parts from the beginning. Consider again the simplified DRS (6) for the page from *Gaspard and Lisa*. It includes some discourse referents and formulas coming from the language, some discourse referents and a pictorial condition coming from the picture, and some equalities that identify discourse referents across language and image representations. (14) divides these structurally into three component DRSs. The parts are combined with an operation written "$\oplus$" of dynamic DRS conjunction, which is treated as semantic. So, instead of a single DRS for a multi-modal page, we postulate a structured DRS of the form $\phi_i \oplus \psi_i \oplus \xi_i$, where ϕ_i is the linguistic DRS, and ψ_i is the pictorial one. This does not change the overall semantics $[\![\phi_i \oplus \psi_i \oplus \xi_i]\!]$. But we postulate that not just the conjoined content $[\![\phi_i \oplus \psi_i \oplus \xi_i]\!]$ is available to pragmatic interpretation, but also the purely linguistic content $[\![\phi_i]\!]$, and the purely pictorial content $[\![\psi_i]\!]$.

(14)
$$\left[\begin{array}{c|l} U\ x\ y\ z & \mathbf{machine}(x) \wedge \mathbf{raincoat}(y) \wedge \\ e_1\ e_2 & \mathbf{dye}(z) \wedge \mathbf{yellow}(z) \wedge \\ & \mathbf{putIn}(e_1, U, y, x) \wedge \\ & \mathbf{dumpIn}(e_2, U, z, x) \wedge \end{array}\right] \oplus$$
$$\left[\begin{array}{c|l} u'\ u'' & \\ x'\ y'\ z' & t,v{:}p_1[a_1{:}u'\ a_2{:}u''\ a_3{:}x'\ a_4{:}y'\ a_5{:}z'] \end{array}\right] \oplus$$
$$\left[\begin{array}{c|l} & U = u' \oplus u'' \wedge x = x' \wedge \\ & y = y' \wedge z = z' \\ & t \sqsubset \tau(e_1 \oplus e_2) \end{array}\right]$$

Summing up, whether the linguistic part of a picturebook is represented using narration events or not, it is possible to get access in the DRS formulism to a separate linguistic content. This will be used in the following section.

Above was considered a DRS representation for *Rosie* that included no narration events. An alternative is to include narration events also in stories that are not intradiegetically narrated. This accords with the common assumption in narrative theory that works of fiction are always narrated. And in the philosophy of language, Lewis (1978) proposed that the described worlds for works of fiction include events of the same content being narrated accurately. On this account, the DRS for *Rosie* should also include narration events.[9] This assimilates the DRS of any fiction to the DRS of fictions with intradiegetic narration, with the DRS including narration events.

Suppose the stance is adopted of systematically including narration events in the DRSs of fictions. Is there then justification for treating visual information differently in the DRS of multi-modal artifacts such as picturebooks? Just as events of narrating the linguistic parts are included, events of "narrating" or displaying the pictures could be included, as if the narrator were presenting a slide show with verbal accompaniment. This presents the worry of where the slides come from in worlds where the linguistic material is narrated truthfully.

We prefer to allow for discourse representations where the pictorial information is merely information about the appearance of the described worlds at certain times and from certain viewpoints, and does not imply the inclusion in those worlds of anything like events of subsequently displaying that information, as in a slide show. And for stories as simple as *Rosie*, we are inclined to extend this, with DRSs not representing narration events for linguistic material either.

4. Characterizing understatedness

In the examples gathered by Nikolajeva and Scott, there is a systematic phenomenon of the linguistic material being weak in comparison with the pictorial information. In *Rosie*, the pictures show a fox stalking the hen, and the words to not mention a fox. In *Trouble*, the pictures show a witch and extreme events including parents being turned into frogs, while the text does not describe such events. In *Lily*, the pictures show the monsters of the dog Nicki's imagination, while the text does not mention them.

We reason in this section with the assumption that the semantics makes available a pictorial content $[\![\phi]\!]^P$, a linguistic content $[\![\phi]\!]^L$ and a combined content $[\![\phi]\!]$ for the DRS ϕ mapped from a picturebook, in the way described in the Section 3. $[\![\phi]\!]^L$, $[\![\phi]\!]^P$, and $[\![\phi]\!]$ all have the status of literal semantic contents. We aim at characterizing the pragmatic effect of *Rosie* as being one of understatement in the linguistic part. Here is a case that is in some ways parallel. (15) is a scenario of overt understatement. Suppose A and B know each other and know that they share aestheic standards pertaining to architecture. Let W_{15} be the literal content

[9] Lewis's account is stated as a semantics of the construction "In fiction f, ϕ":

> A sentence of the form "In the fiction f, ϕ" is non-vacuously true iff some world where f is told as a known fact and ϕ is true differs less from our actual world, on balance, than does any world where f is told as a known fact and ϕ is not true.

The worlds referenced in the definition include narration events for f. In our construal, these are split up into narration events for the individual LFs of f.

of A's utterance. Asserting W_{15} generates by R-implicature an implicature along the lines of the architecture of the development being painfully banal. Let Q_{15} be this implicature. In this scenerio, the information that the development is banal is available to the speakers from their environment, and Q_{15} is not new information. Instead A's utterance merely thematizes the strengthened information. The effect of wryness is related to the literal content W_{15} being unremarkable, the strengthened content $W_{15} \wedge Q_{15}$ expressing a negative sentiment, and Q_{15} not being directly asserted.[10]

(15) (A and B are touring a blatantly banal real estate development.)

A:	The architecture is not distinguished.	W_{15}
Implicature:	The architecture is banal.	Q_{15}

Here is another case, which is topically and pragmatically similar to the Rosie story, while being purely pictorial. (16) is a lithograph of a polar bear in a snowy landscape, sniffing some parallel tracks in the snow. A viewer works out that the polar bear is stalking or beginning to stalk the human on skis who made the tracks. The effect is ominous, and is more wry and humorous than would be the case if the skier were depicted directly. This is amplified by the information that the artist is the explorer Fridtjof Nansen, who crossed parts of the Arctic on skis, and who therefore can conjecturally be identified with the individual being stalked.

(16)

Fridtjof Nansen
Lithograph, 1922
Nansen International
Children's Centre, Oslo

The information about the skier in (16) is implicated. It is recognized by viewers, and the artist intended for viewers to recognize it. Call this implicated information Q_{16}, and let W_{16} be the basic content of the polar bear lithograph. The combined content $W_{16} \wedge Q_{16}$, is alarming, since it describes a situation where a human is threatened with injury and death. This parallels the alarming nature of the pooled linguistic and pictorial content in the Rosie story, where a hen is threatened with attack by a fox. While the basic pictorial content W_{16} is not prosaic, it is not alarming in the same way.

The examples suggest this schematization. There is a weak content W that is presented in a

[10]As discussed in Horn (1984, 1989), R-implicature has additional pragmatic functions, including hedging and politeness. In this case A does not wish to hedge the assertion, or to be polite.

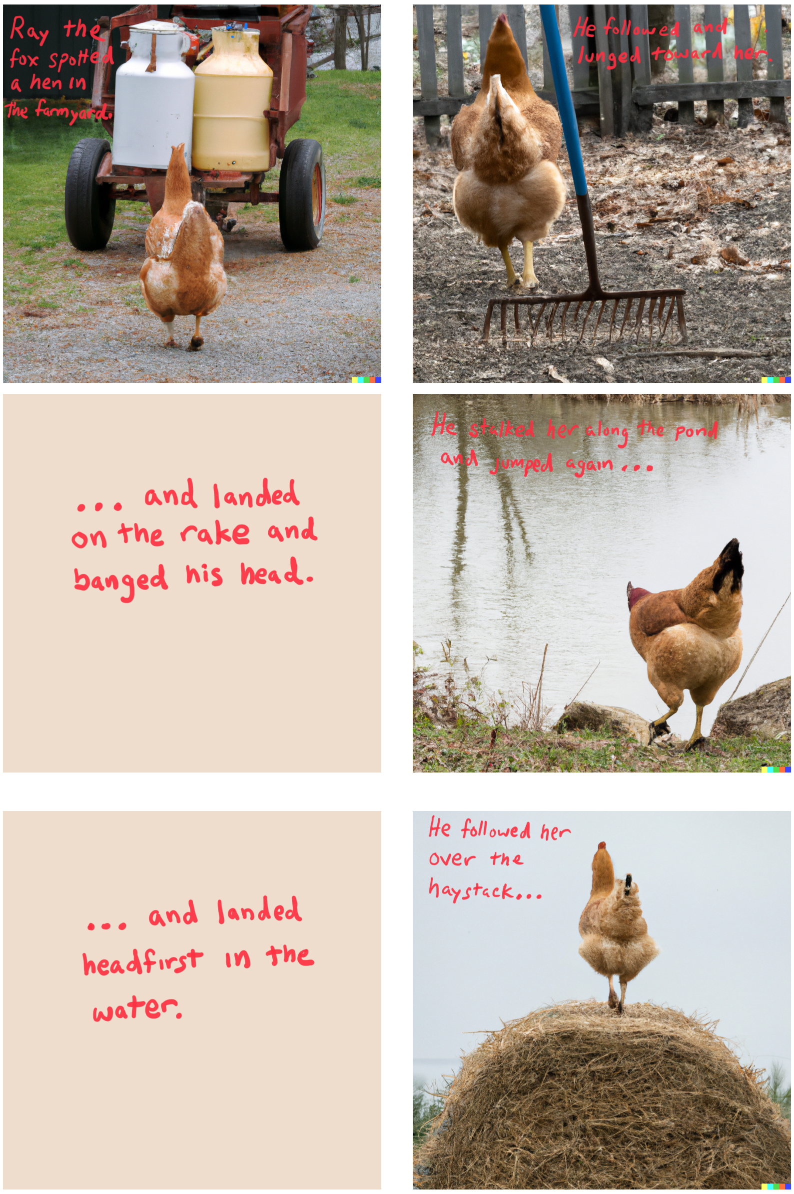
direct way, in the picturebooks by the linguistic material, in (15) by A's utterance, and in (16) as the content of the drawing. There is additional content Q that is presented in a different way, in the picturebooks as pictorial content (the fox), in (15) as implicature (the banality) and in (16) as implicature (the skier). The combined content $W \wedge Q$ is extreme in a way that W by itself is not, either because the combined content is alarming, or because it expresses a strongly negative sentiment. As a result W is understated by comparison with $W \wedge Q$.

The passage from Nikolajeva and Scott quoted earlier states that in such cases the linguistic content contradicts the pictorial content. This is not a matter of contradiction in the semantic sense, which would entail that no possible world satisfies both the linguistic content $[\![Rosie]\!]^L$ and the pictorial content $[\![Rosie]\!]^P$ in the case of *Rosie's Walk*. The text and pictures are consistent or semantically compatible because we can describe a sequence of events that satisfy both. What is said in the text and what is depicted can happen in one world, where Rosie is walking and the fox follows her. In general, in the examples, W is consistent with Q. There is however a way of deriving a contradiction at the pragmatic level. The linguistic parts of *Rosie* and *Lily* are prosaic in that they describe an unremarkable sequence of events in which a hen walks through a farmyard, or a girl walks through a town. These prosaic stories can be held to implicate by a process of relevance and quantity reasoning that nothing very remarkable happened during the walk. Let $\hat{P}$ be some additional linguistic information that describes a stalking fox, while $\hat{W}$ is the original linguistic part. Then $\hat{W} \wedge \hat{P}$ is a linguistic LF that competes with $\hat{W}$. Given that $\hat{P}$ was not narrated, this generates the negation of $\hat{P}$ as a quantity implicature. Then since the corresponding content $\neg P$ (entailing that there was no fox) is inconsistent with $W \wedge Q$ (the combined content including the pictorial information about a fox), there is a contradiction at the pragmatic level, when the nothing-remarkable quantity implicature is computed from the linguistic part of the story.

In the examples (15) and (16), the information W is literal content, and Q is implicated, yielding a stronger conveyed content $W \wedge Q$. The information W is primary because it is literal content, while the additional information Q is implicated. This raises the question whether the linguistic part of a storybook is in some sense primary, and the pictorial content secondary. A reason for this might be found in the situation of a parent reading a storybook to a child, where the linguistic material is read out, making it common ground that worlds consistent with the story satisfy the linguistic content. The status of the pictorial information is not the same, because the child needs to seek out pictorial information by looking. Also, children can have different perceptual acuity than adults, so that it cannot be assumed that they will extract the same information when they look. For both reasons, what pictorial information has been picked up by the child and what pictorial information has been picked up by the parent is not common ground between them. This gives the pictorial information a secondary status, comparable to the implicated information in (15) and (16).

This discussion raises the question whether the informational status found in the *Rosie*, *Lily*, and *Trouble* stories could be reversed, with the pictorial information being understated compared to the linguistic information. We do not know of any examples of this in children's picturebooks. But Figures 1 and 2 present *Ray's Chase*, a constructed inverted version of *Rosie's Walk*, where information about the fox is found in the text and not the pictures. The rhythm is retained, with alternate pages containing only text, and describing the mishaps of the fox, just as alternating two-page spreads of *Rosie* show the mishaps of the fox purely pictorially. Intuitively we think

Verso | Recto | Text



1. Ray the fox spotted a hen in the farmyard.
2. He followed and lunged toward her ...
3. ... and landed on the rake and banged his head.
4. He followed her along the pond and jumped again ...
5. ... and landed headfirst in the water.
6. He followed her over the haystack ...

Figure 1: Pages 1-6 of *Ray's Chase*, a picturebook that reverses *Rosie's Walk* by putting information about the fox exclusively in the text. Starting with page 2, alternating pages have text only, and describe the mishaps of the fox.

that *Ray's Chase* coheres as a narrative. But we think it does not exhibit the wryness and understatement observed for *Rosie*. The pictures function as relatively low-information additions to the verbal narrative, but the low information (not depicting the fox) does not generate an implicature that conflicts with the linguistic narrative. To formalize this, we suggest that while the linguistic content $[\![\phi]\!]^L$ is available by itself for generating implicatures, the pictorial content $[\![\phi]\!]^P$ is not. This might follow from the pictorial information by itself being secondary, in the way discussed above. In *Rosie's Walk* one can get a no-fox implicature from $[\![\mathit{Rosie}]\!]^L$, in *Ray's Chase* one cannot get a no-fox implicature from $[\![\mathit{Ray}]\!]^P$. This does not stop implicatures from being generated from the *combined* content. In *Rosie* there is an implicature that the hen

Verso Recto

Text

7. And sank into it so only his head and tail stuck out.
8. He followed past the flour mill and jumped again ...
9. ... and landed on the flour sack which broke, with flour up to his head.
10. He followed to the beehives ...
11. ... where the bees attacked and stung him.
12. The hen is called Rosie. She made it back in time for dinner.

Figure 2: Pages 7-12 of *Ray's Chase*. Images were generated with DALL-E.

does not notice the fox. This is an implicature, because it can be cancelled: a final page could be added that shows Rosie turning around, and announcing "You silly fox, I saw you the whole time. You are wasting your time trying to catch me." The Rosie-did-not-know implicature is generated by the same kind of quantity and relevance reasoning that is outlined above, from the combined content $[\![$*Rosie*$]\!]$. While the combined content has information about the fox, it does not have the information that the hen is aware of the fox. Since Rosie being aware of the fox is not narrated, an implicature is generated that she was not aware of the fox.

A complicating factor is that pictures in *Ray's Chase* can be parsed as point of view shots, assuming the geometric visual point of view of the fox. If the pictures are point-of-view shots, this might undermine the relevance of the example. On the analysis from Abusch and Rooth

(2022), point of view shots include in their LF a discourse referent for the viewing agent. The LF from that paper is as in (17), where the picture is embedded under a seeing predicate, and x is the agent. With this LF, pictorial part of the LF includes a discourse referent for the viewing agent. The pictorial part does not identify the viewing agent as a fox, but it does carry the information that the hen is being observed. This is not true of the linguistic part of *Rosie*.

(17) $S_x(p)$

5. Characterizing temporal juxtaposition

This section looks at the discourse relation of co-temporal juxtaposition in picturebooks. In this construction, the language and the image on a single page or a two-page spread describe the same events, in a sense that needs to be clarified. In the DRS, the notation t,v:p includes a time dref t, which is taken to be a time point. It is a time when the described world looks like picture p from viewpoint v. Let $e_1,...,e_n$ be the event discourse referents introduced by the linguistic part of a page or spread. Each event e_i has a temporal projection $\tau(e_i)$. Often the interpretation is such that the time t is within one of the temporal projections. An example of this is the page (5) from *Christmas Surprise*, where the discourse representation (6) has an event dref e_1 of putting a shower curtain into a washing machine, and an event dref e_2 of dumping yellow dye into the machine. The picture portrays a time point that is construed as falling within the temporal projection of e_2. This is expressed by the formula $t \sqsubseteq \tau(e_2)$. Another example from the same book is the initial two-page spread, which includes the text "it was almost Christmas", and shows a street scene with the two dogs near a Christmas display in a shop window. The linguistic material introduces a state discourse referent s, and the time t for the picture is construed as falling within it, $t \sqsubseteq \tau(s)$.

Where $p_1,...,p_n$ are the pictures in the picturebook, they are accompanied in the DRS by projection times $t_1,...,t_n$. All the books we are analyzing seem to satisfy strict temporal progression, $t_1 < t_2 < ... < t_n$. Temporal progression is part of the interpretation of the construction of incrementing an initial sequence of pages or spreads with an additional page or spread.[11] There is an interesting complexity in *Rosie* in the syntax-semantics interface. That story has fourteen pictures $p_1,...,p_{14}$, see the overview in (1). They enter into the DRS as in (18). To this should be added a formula $t_i \sqsubseteq \tau(e_i)$, for the pages 1,2,4,6,8,10, and 14 where there is text. However the linguistic part of the Rosie story has only a single verb, which is on the first two-page spread. It is not implausible though that in the path motion predication, the conjoined path PPs *across the yard* through *under the beehives* introduce motion sub-events $m_1...m_{14}$, together with drefs for component paths of motion $r_1...r_{14}$.[12] Then individual time alignments $t_i \sqsubseteq \tau(m_i)$ can be included.

(18)
$$\left[\begin{array}{l|l} p_1\ t_1\ v_1\ ...\ p_{14}\ t_{14}\ v_{14} & t_1 < t_2 \wedge ... \wedge t_{13} < t_{14} \wedge \\ x'_1\ y'_1\ ...\ x'_{14}\ y'_{14} & t_1{,}v_1{:}p_1[a_1{:}x'_1\ b_1{:}y'_1] \wedge ... \wedge t_{14}{,}v_{14}{:}p_{14}[a_{14}{:}x'_{14}\ b_{14}{:}y'_{14}\ ] \\ u'\ u''\ x'\ y'\ z' & x'_1 = x'_2 \wedge ... \wedge x'_{13} = x'_{14} \wedge \\ & y'_1 = y'_2 \wedge ... \wedge y'_{13} = y'_{14} \end{array}\right]$$

[11]See Abusch (2021) for such a principle applied to linear pictorial narratives. There, strict progression is weakened to temporal non-regression, $t_i \leq t_{i+1}$.
[12]Compare Abusch (2005); Zwarts (2005).

The DRS framework introduced so far does not involve discourse referents for depicted events. For the cases mentioned so far, one can claim that the picture introduces a discourse referent for an event, and that this gets equated with one of the event drefs introduced by the language. This parallels the treatment of individuals, where discourse referents are introduced by both language and image, and the drefs from the two sources are linked up with equalities in the DRS. Many of the events referenced in picturebooks are concrete physical ones, and for these a spatial projection at a time could be postulated. Then discourse referents for events can be introduced by the same syntax as that which introduces discourse referents for individuals. The notation (19) introduces a discourse referent x_e of individual type, and a discourse referent e_v of event type.[13] The interpretation of the second part is that at time t the directed line from v through point a_2 in the picture plane passes through the volumetric spatial projection of event e_v.

(19) $t,v : p[a_1{:}x_e,\ a_2{:}e_v]$

This approach referring to depicted events seems unobjectionable for concrete events. It does involve the complication of the model structure having to specify spatial projections of events. And this specification is potentially redundant. For a concrete event such as Lisa pouring dye into a washing machine, the spatial projection presumably bears a close relation to the sum of volumes of space occupied by Lisa, the dye, and the washing machine at the same time. Already discourse referents for individuals are introduced and identified across language and image, and the event dref with a linguistic source is a co-argument with individual drefs with a linguistic source, in formulas such as $\mathbf{dumpIn}(e_2, U, z, x)$ from (6). If z' (the depicted dye) and x' (the depicted machine) are equated with z (the mentioned dye) and x (the mentioned machine) respectively, then z' and x' are co-arguments of event e_2, and are depicted in the picture. This is hard to distinguish from positing an event e_2' that is depicted and equated with e_2.[14]

(20) is another page from *Christmas Surprise*. While the language describes an event of putting a chair in the bathtub, the picture shows the chair in the bathtub. The picture depicts the post-state/result-state of the mentioned putting event. In literature on discourse representation theory, it is common to include result states in the DRSs of sentences with main predicates describing change. A simple move is to include a state dref as an additional argment of the basic relation in a formula like $\mathbf{putIn}(e, s, U, y, x)$. Here e is the event argument, s is the result state, and U, y, and x are the individual arguments. This results in a DRS like (21). The temporal dref for the picture, rather than being temporally embedded in the putting event, is embedded in the result state s.

[13] v is the type label for events. This has nothing to do with the discourse referent v for viewpoints. Just as the event discourse referent e has nothing to do with the type label e.
[14] But again, postulating spatial locations for concrete events seems innocuous. On a Davidsonian analysis, it is in fact involved in prepositional location modifiers as in (i).
(i) Lisa danced in the courtyard.

(20) 

We put a chair in the bathtub.

(21)
$$\left[\begin{array}{l|l} U\ x\ y\ z & \textbf{bathtub}(x) \wedge \textbf{chair}(y) \wedge \textbf{dye}(z) \wedge \textbf{putIn}(e,s,U,y,x) \wedge \\ t\ v & t,v{:}p_1[a_1{:}u'\ a_2{:}u''\ a_3{:}x'\ a_4{:}y'\ a_5{:}z'] \wedge \\ e\ s & U = u' \oplus u'' \wedge x = x' \wedge y = y' \wedge z = z' \\ u'\ u''\ x'\ y'\ z' & t \sqsubseteq \tau(s) \end{array}\right]$$

So far this section has developed the hypothesis that on a page or spread of a picturebook, the time dref for the picture is temporally embedded in one of the event drefs introduced in the text. How should this be formulated? One option is to include mechanics (perhaps in a feature constraint formalism) for collecting the eventuality drefs $e_1,\ldots,e_n$ introduced by the linguistic material, and to mechanically require that the time dref t for the picture is temporally embedded in one of the e_i. We prefer to state this in a more general way, which anticipates what comes below. The temporal constraint is treated as a presupposition. It involves the time for the picture, and an eventuality dref that, rather than being chosen from the collection of eventuality drefs projected from the linguistic syntax, is an eventuality pronoun that comes with a requirement to find a salient antecedent. Salience is assumed to be modeled as in centering theory, where the context provides a ranked list of available, typed antecedents. The analysis is summarized informally in (22). The notation $e_?$ indicates an eventuality pronoun that needs to find a salient antecedent. In (6), the antecedent is the main event of dumping. In example (21), the antecedent is the result state of the chair being in the bathtub.

(22) $[t,v|t,v{:}p[\ldots] \wedge t \sqsubseteq e_?]$

(23) is another spread from the same book. While the text mentions cutting, this is in a conditional context, and arguably it is in an embedded context of free indirect discourse. This is so because the passage beginning with "the raincoat was too small ..." describes Lisa's thought or statement. It follows that the DRS for the linguistic material does not make available an accessible antecedent for a cutting event. However the passage is interpreted as accommodating the information that Lisa formed the plan to cut holes in the hood, and then executed it. This accommodated information does make an event dref available, which is the antecedent $e_?$ in (22). Here the general formulation has an advantage, since it allows for accommodated material to provide the event antecedent. In fact the presupposition can be seen to contribute to triggering the accommodation.

(23)

Then my best idea yet came to me. The raincoat was too small for Mrs. Dupont, but if we cut two holes in the hood, it would be just right for Pierre.

.

This discussion is continuous with theorization about temporal relations in purely linguistic narratives (e.g. Kamp and Rohrer 1983, Lascarides and Asher 1993, Bittner 2014). What has been said in this section is only a small step in investigating how this should be extended to the case of juxtapositions of language and image in picturebooks. The area of inquiry is fascinating because of the way it ties in with the analysis of language. Importantly, narrative language and images are more in balance than they are in comics and film, so that the linguistic interpretation of narrative can be expected to make as much of a contribution as the pictorial material. Another dimension of the enterprise is the application of discourse relations in the framework of segmented discourse representation theory to pictorial materials and to mixed materials such as picturebooks, an issue studied in Schlöder and Altshuler (2022).

6. Conclusion

This paper has looked at the semantic and pragmatic interpretation of children's picturebooks, in a framework where the information content of both language and pictures is expressed in discourse representation structures that are interpreted in possible worlds semantics. While the discourse representation of a picturebook integrates linguistic and pictorial information, it was argued that the linguistic information was accessible independently to pragmatic interpretation. This requirement was met in a couple of technically straightforward ways. An effect of understatement was attributed to the combined content of a picturebook conflicting with a 'nothing-remarkable' implicature of the text part. Section 5 looked at the discourse relation of co-temporal juxtaposition between information coming from language and image on a single page or two-page spread of a picturebooks. It is common for the time constrained by the picture to be construed as temporally contained in the temporal projection of one of the event discourse referents introduced by the language. But temporal relations can also be mediated by accommodated information.

The semantics and pragmatics of children's picturebooks is an exciting arena for investigation using supersemantic methodology, comparable to comics and film. As illustrated here, semantic modeling using possible worlds, individuals, times, and events, and discourse representation structures is applicable. There is a superb basis of empirical observation and theorization in research on children's literature. To this, supersemantic methodology can contribute formalization of the interface to semantics and pragmatics, modeling of content in possible worlds semantics, careful attention to the distinction between literal semantic content and implicated content and other aspects of pragmatics, and a methodology for representing modality and intensionality.

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Putting plural definites into context[1]

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Abstract. Theories of plural definites differ with respect to 'non-maximal readings' of plural definites in positive and negative sentences. The implicature approach predicts an inherent asymmetry where plural definites allow for non-maximal readings in positive sentences but not in negative ones. The non-implicature approach makes symmetric predictions that non-maximal readings should be available to the same degree in positive and negative sentences. Previous experimental work found evidence for an asymmetry between positive and negative cases, but since they did not control for potential contextual effects, it remains to be a possibility that positive and negative sentences were judged against different implicit contexts that had different effects on the availability of non-maximal readings. In this paper, we report on two experiments using a picture-sentence verification task, testing the effect of context on the non-maximal readings of plural definites in positive and negative sentences. We tested sentences containing the plural definite '*his/her presents*' under a positive quantifier '*every boy/girl*' and two negative quantifiers '*no boy/girl*' and '*not every boy/girl*,' manipulating what was relevant in the context. Our results indicate that while non-maximal readings under all three quantifiers are modulated by context, the effect size is smaller for *no* than for the other two quantifiers. We argue that these findings pose challenges for both types of theories, and discuss possible amendments of each approach in order to account for our findings.

Keywords: plural definites, homogeneity, non-maximality, implicatures, relevance

1. Introduction

Sentences containing a plural definite expression like *his presents* exhibit two main properties, *homogeneity* and *non-maximality*. Homogeneity has to do with true-value gaps (Schwarzschild 1994; Löbner 2000; Breheny 2005; Gajewski 2005; Magri 2014 among others). Specifically, while (1) tends to be interpreted akin to its universal counterpart in (2), its negation in (3) does not merely suggest the negation of (2), but rather something stronger, similar to the paraphrase in (4).

(1) Frank opened his presents.

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(2) Frank opened all of his presents.

(3) Frank didn't open his presents.

(4) Frank didn't open any of his presents.

Non-maximality has to do with the fact that the truth-conditions of sentences containing plural definites are not as rigid as those containing quantifiers, at least in some speech contexts (Krifka 1996; Brisson 1998; Lasersohn 1999; Breheny 2005; Malamud 2012; Križ 2015 among others). For example, in a context in which all we care about is whether Frank opened any presents at all – say because it was important to keep every present closed before the guests arrived – (1) can be judged true even if Frank opened some but not all of his presents.

In the theoretical literature it is debated whether homogeneity and non-maximality arise from some core property of plural definites, but regardless of this question, any theory of plural definites has to tell us where these two properties come from (see Malamud 2012; Križ 2016; Križ and Spector 2021; Magri 2014; Bar-Lev 2018, 2021 for discussion). For the purposes of the present paper, we will broadly classify current theories of plural definites into implicature and non-implicature approaches. We will briefly sketch both views below.

1.1. The implicature approach

The implicature approach (Magri 2014; Bar-Lev 2018, 2021) captures homogeneity by appealing to a basic existential semantics for plural definites. To illustrate the idea, consider a context in which the relevant presents are commonly known to be a, b and c, and nothing else. In such context, the literal meaning of (1) is analysed as in (5): Frank opened at least one of a, b and c.

(5) $\exists x \in \{a, b, c\}(\mathsf{opened}(f, x))$

(5) is obviously too weak to capture the intuitively perceived interpretation of (1), but its negation immediately accounts for the observed reading of (2).

(6) $\neg\exists x \in \{a, b, c\}(\mathsf{opened}(f, x))$

In order to capture the positive case, the implicature approach argues that the basic existential semantics is strengthened by an implicature. The details of how the implicature strengthening works are not crucial for our purposes here, and we refer the interested reader to Magri (2014) and Bar-Lev (2021). What matters for us is that the strengthened meaning corresponds to the maximal reading we are after as in (7). For expository purposes, we will assume that implicatures (of the relevant kind) arise due to a phonologically silent operator EXH.

(7) $[\![$EXH(Frank opened his presents)$]\!] \Leftrightarrow \forall x \in \{a, b, c\}(\mathsf{opened}(f, x)))$

No such strengthening applies to the negative sentence, because EXH normally cannot appear in the direct scope of negation.

Finally, as suggested by Bar-Lev (2018, 2021) non-maximality can be assimilated to the contextual modulation of implicatures. He assumes that the strengthened meaning of the positive example above is obtained by quantifying over the alternatives whose literal meanings are given in (8).

(8) $\exists x \in \{a, b, c\}(\mathsf{opened}(f, x))$
$\exists x \in \{a, b\}(\mathsf{opened}(f, x))$
$\exists x \in \{b, c\}(\mathsf{opened}(f, x))$
$\exists x \in \{a, c\}(\mathsf{opened}(f, x))$
$\exists x \in \{a\}(\mathsf{opened}(f, x))$
$\exists x \in \{b\}(\mathsf{opened}(f, x))$
$\exists x \in \{c\}(\mathsf{opened}(f, x))$

Bar-Lev assumes that in some contexts, some of these alternatives can be ignored, or pruned, and such pruned sets of alternatives can give rise to weaker truth-conditions, which amount to non-maximal readings. For instance, the strengthening of (1) over the alternatives whose literal meanings are in (9) gives rise to a meaning paraphrasable as Frank opened at least two of a, b, and c.

(9) $\exists x \in \{a, b, c\}(\mathsf{opened}(f, x))$
$\exists x \in \{a, b\}(\mathsf{opened}(f, x))$
$\exists x \in \{b, c\}(\mathsf{opened}(f, x))$
$\exists x \in \{a, c\}(\mathsf{opened}(f, x))$

In sum, the implicature approach postulates an existential literal meaning for plural definites, which straightforwardly accounts for negative sentences, and derives the stronger truth-conditions of positive sentences with implicatures. In Bar-Lev's version of the theory, non-maximal readings arise in context where some alternatives can be pruned.

1.2. The non-implicature approach

The non-implicature approach is either based on families of interpretations or a trivalent semantics, and also involves a pragmatic mechanism for contextual modulation (Križ 2015, 2016; Križ and Spector 2021). To briefly illustrate, we sketch Križ's (2016) trivalent theory, which captures homogeneity by analysing sentences like (1) and (2) as receiving a truth-value gap unless Frank opened all or none of his presents.

(10) *Frank opened his presents* is $\begin{cases} \textsc{true} & \text{if Frank opened all of his presents} \\ \textsc{false} & \text{if Frank opened none of his presents} \\ \# & \text{otherwise} \end{cases}$

(11) *Frank didn't his presents* is $\begin{cases} \textsc{true} & \text{if Frank opened none of his presents} \\ \textsc{false} & \text{if Frank opened all of his presents} \\ \# & \text{otherwise} \end{cases}$

In order to account for non-maximal readings, Križ (2016) proposes that perceived truth-values can differ from the semantic truth-values in certain contexts. That is, when a sentence that has a non-trivially trivalent meaning is used against a context where it denotes #, it can be judged as effectively true or effectively false, if # is enough to achieve the immediate conversational goal.

By way of illustration, consider a context in which we are trying to answer the question of whether Frank opened any of his presents. In other words, we would like to know if the possible world we are in is one where where Frank opened none of his presents or one where he opened some or all of his presents. Suppose now that you know that Frank opened some but not all of the presents. Križ's theory allows you to use the sentence in (1) to inform the interlocutors that the true answer to the question under consideration is positive, meaning Frank opened at least one of the presents, despite the fact that the truth-value the sentence denotes is #, because in the current context, we do not really care about the difference between the possible worlds in which (1) denotes TRUE and those in which it denotes #.

Imagine now that the question under discussion is whether or not Frank opened all of his presents. In this case, a sentence like (1) will be judged as effectively false, because now we do not care about the difference between the possible worlds in which the sentence denotes # and those in which it denotes FALSE.

The same holds for the negative case in (3) but in the opposite direction: (3) would be judged as effectively false in the first context above, and effective true in the second.

In sum, under the non-implicature approach, definite plurals give rise to non-bivalent meaning, which feeds pragmatics in such a way that non-classical truth-values can be deemed to be effective true and effectively false, depending on the interlocutors' interests.

1.3. Divergent predictions

The two approaches make divergent predictions with respect to the non-maximal readings of plural definites in positive and negative sentencesBar-Lev (2021); Križ and Spector (2021). As explained above, the implicature approach predicts an inherent asymmetry. That is, since non-maximality is linked to the mechanism for contextual modulation of implicatures, only plural definites in positive sentences are predicted to allow for non-maximal readings. On the other hand, the non-implicature approach makes symmetric predicitons that plural definites in both positive and negative sentences should be able to receive non-maximal readings.

Previous experimental studies raise some suggestive data regarding these divergent predictions. Križ and Chemla (2015) tested plural definites against various different grammatical contexts. Specifically, in addition to the simple positive and negative sentences like (1) and (3), they tested plural definites in quantified sentences like (12) and (13) below. The advantage of moving to quantified sentences like (12) and (13) is that, in the intended bound reading, they better control for the scope of the plural definite with respect to negation.

(12) Every boy opened his presents.

(13) No boy opened his presents.

Križ and Chemla presented such sentences with visual contexts representing 'non-maximal scenarios', where the sentence needs to be read non-maximally to be judged to be true (e.g., every boy opened some or all of his presents). In their results, they found that plural definites in sentences with *every* received intermediate truth-value judgments more often than plural definites in sentences with *no*. When taken at face value, this is more in line with the predictions of the implicature approach. However, they also observed that plural definites in negative sentences generally can receive non-maximal readings. Furthermore, given that their study did not specify what conversational context the sentences were meant to be judged against, it is possible that participants accommodated different contexts for different sentences. This is in fact not unlikely, given previous findings suggesting that negative sentences generally require more contextual licensing (see Tian and Breheny 2019 and references therein), and that could well have had somehow affected the availability of the non-maximal reading.

Tieu et al. (2019) is an acquisition study that tested plural definites occurring in positive and negative sentences against non-maximal scenarios. While child participants accepted positive sentences more often than negative sentences, which squares well with the results reported in Križ and Chemla (2015), adult participants accepted positive sentences more often than negative sentences. In addition, their experiments also did not specify the intended conversational context and therefore their results also leave open the possibility that different contexts were likely to be assumed for positive and negative sentences.

2. The experiments

We report on two web-based experiments that use a picture-sentence verification task. The design of the experiments largely follows Križ and Chemla (2015) with one crucial difference, namely, we presented explicit conversational contexts. Experiment 1 compared plural definites occurring in the scope of *every* and *no*, while Experiment 2 compared sentences containing *every* with sentences containing another negative quantifier, *not every*. Concretely, we tested the following sentences.

(14) $$\left.\begin{array}{l}\text{Every}\\ \text{No}\\ \text{Not every}\end{array}\right\} \left\{\begin{array}{c}\text{boy}\\ \text{girl}\end{array}\right\} \text{opened} \left\{\begin{array}{c}\text{his}\\ \text{her}\end{array}\right\} \text{presents.}$$

In both experiments, we manipulated the intended conversational context. We prepared two contexts. The Universal context is purported to make salient the question whether all presents were open, as it is expected in the context that each boy opens all of his presents. In the Existential context, on the other hand, it is expected that no boy opens any of his presents, whereby making salient the question whether any presents were open. Participants were instructed to judge how well the sentences described the scenarios shown in the picture on a five-point Likert scale ranging from ‘completely true’ to ‘completely false’.

The predictions of the two approaches with respect to our experimental manipulation are summarised in Table 1. Both approaches predict that plural definites in the scope of *every* should be able to receive maximal readings, the maximal readings are more readily available in the Existential context than in the Universal context. For plural definites under negative quantifiers (*no* and *not every*), on the other hand, the two approaches make different predictions. The non-implicature approach predicts a similar difference in judgments but in the opposite direction, i.e., the sentences should be judged better in the Universal context than in the Existential context. Under the implicature approach, on the other hand, plural definites in such negative sentences should not receive non-maximal readings, so should give rise to low acceptability in both contexts.

2.1. Experiment 1

2.1.1. Methods

In our first experiment, we compared sentences involving the quantifiers *every* and *no* with a plural definite in their scope. Each sentence was accompanied by one of three types of

	every		*no, not every*	
	EXISTENTIAL	UNIVERSAL	EXISTENTIAL	UNIVERSAL
Implicature	HIGH	LOW	LOW	LOW
Non-implicature	HIGH	LOW	LOW	HIGH

Table 1: Predictions of the two approaches. Difference in predictions is highlighted in gray.

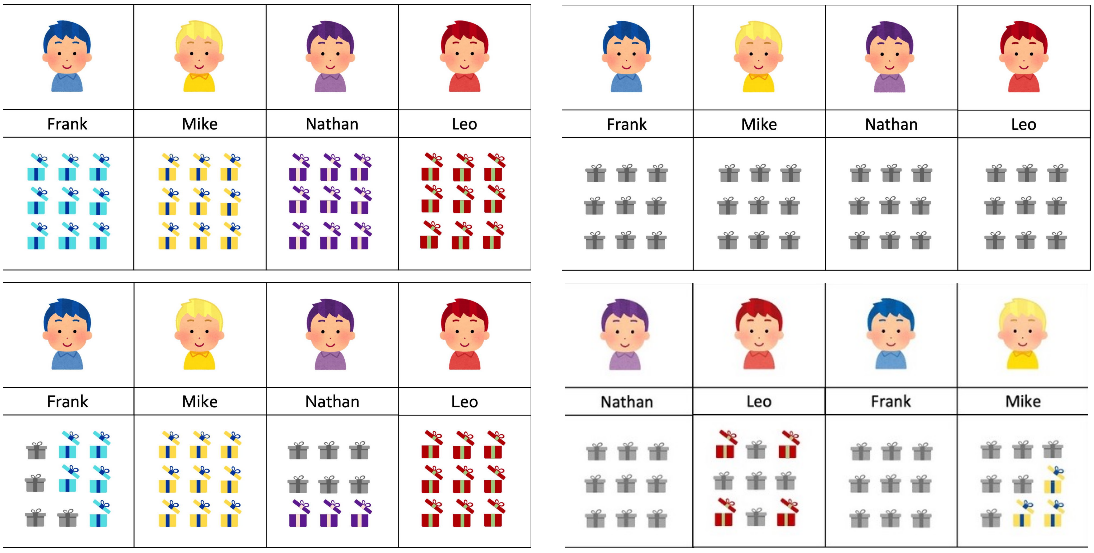
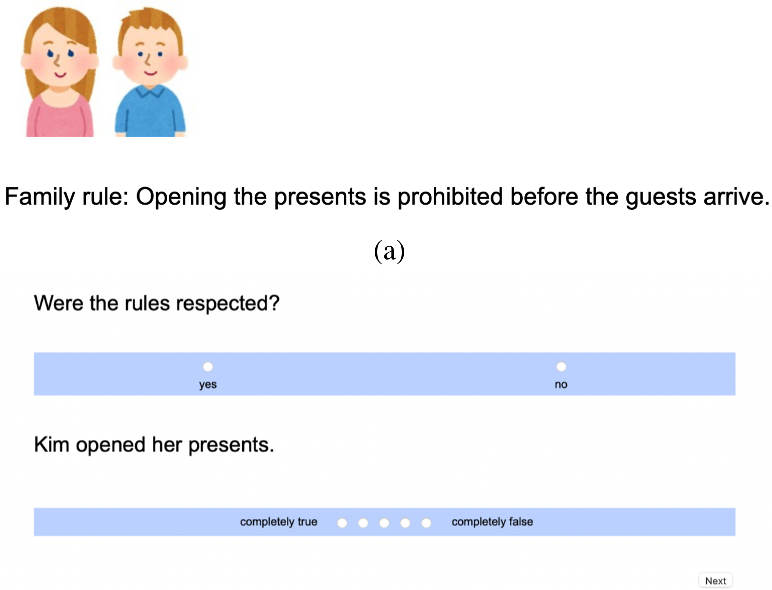


Figure 1: Examples of pictures used in Experiment 1. The top two pictures are items in the CONTROL conditions. The bottom left picture was a target item for *every* and the bottom right picture was a target item for *no*.

pictures. Each picture showed four boys/girls, each with nine presents each, as in the examples in Figure 1. The pictures in the CONTROL conditions depicted uniform situations, either with all the presents closed (indicated by grey), or with all the presents open, and therefore the sentences should receive clear true or false responses. Note that the control pictures that should elicit true responses for sentences with *every* should elicit false responses for sentences with *no* and vice versa.

The pictures in the TARGET condition depict non-maximal scenarios, where two of the four children opened some but not all of their presents. We prepared two types of TARGET pictures that differ with respect to what the other two boys did, namely, pictures where the other boys opened all of their presents and pictures where the other boys opened none of their presents. While we tested both sentences with *every* and sentences with *no* against both types of target pictures, we later noticed that their non-maximal readings are true in different target pictures. We only included in the analysis data from those pictures that could make the sentences true.

At the beginning of the experiment, the participant was introduced to either the EXISTENTIAL context or the UNIVERSAL CONTEXT, together with a practice session. Both contexts were about particular rules about opening presents in some hypothetical family with either four boys or four girls. In the UNIVERSAL context, the children were instructed by their parents to open the presents they have received from their grandparents before they arrive to their house. In the



(a)

(b)

Figure 2: An example display from Experiment 1. The parents of the family and the family rule were displayed on the top of the screen as in (a), followed by a picture of the boys with their presents, which in turn was followed by the secondary and primary questions as in (b).

Existential context, the children are instructed to wait until their grandparents arrive, before they can open the presents.

In order to make sure that the participants paid attention to and remembered the context, we administered a secondary task to be answered before each sentence-picture judgment trial. This secondary task was to judge on each trial whether the family rule ('Opening the presents is prohibited' or 'Opening the presents is required') was respected or not by clicking on *yes* or *no*. Figure 2 contains an experimental display for one example trial. On the top of each display, participants were reminded of the family rule with a picture of the boys' parents together with the description of the rules. Directly below this picture, the experimental picture for the picture sentence verification task was shown (control or mixed).

The experimental factors manipulated were Context (Existential or Universal), Picture (Target, Control-True, Control-False) and Polarity (Positive = *every* or Negative = *no*). Among these, Context was a between-subject factor. We also counterbalanced the position of the *Yes* and No buttons for the primary task, the order of the end points of the Likert scale, and the gender of the children (boys or girls).

The experimental sentences were spread over 8 lists. Each list contained 24 experimental items, half with the positive quantifier *every* and the other half with the negative quantifier *no*. For each sentence, there were 4 Control-True items, 4 Control-False items, and 4 Target items. As mentioned above, 2 of the Target items would not make the sentence true regardless of the availability of a non-maximal reading, so we excluded them from the analysis. The experimental items appeared in a randomized order for each participant.

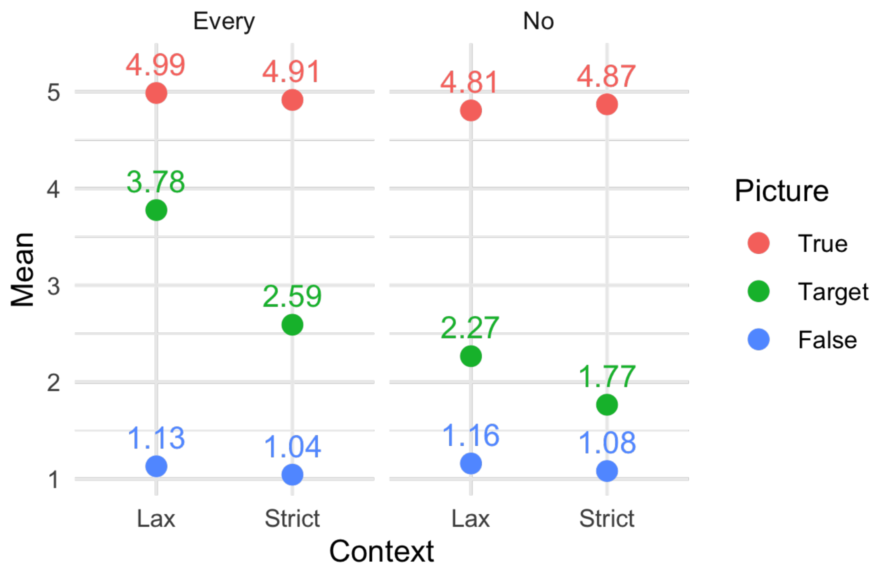


Figure 3: Mean acceptability ratings in Experiment 1. CONTEXT is recoded as LAX (favors non-maximality) or STRICT (favors maximality).

192 native speakers of English were recruited from Prolific (`www.prolific.co`) and paid 1.50 GBP for their participation. Seven were excluded for low (<75%) accuracy on the main judgment task on the CONTROL items, where responses above 3 for CONTROL-FALSE and responses below 3 for CONTROL-TRUE were considered to be errors).

2.1.2. Results and discussion

Figure 3 shows the mean acceptability ratings for the different conditions after recoding CONTEXT into LAX (EXISTENTIAL for *every*, UNIVERSAL for *no*) and STRICT (UNIVERSAL for *every*, EXISTENTIAL for *no*). LAX contexts should improve the acceptability in the TARGET condition, while STRICT contexts should not.

For statistical analysis, we carried out a cumulative logistic mixed-effects model analysis (Christensen 2022) on mixed conditions with CONTEXT (sum-coded), POLARITY (treatment-coded with *no* as baseline) and their interaction as fixed effects, and random by-subject intercepts and slopes. While we would have ideally included the CONTROL conditions in the model, floor and ceiling effects led to convergence issues in the ordinal logistic regression. However, since performance on the CONTROL conditions is near-perfect, no information is lost from their non-inclusion. The model revealed a significant simple effect of CONTEXT (CONTEXT had an effect on *no*; $\chi^2(1) = 49$; p $<$ .001) and a significant main effect of POLARITY (*every* is more acceptable than *no*; $\chi^2(1) = 93$; p $<$ .001), as well as a significant interaction (*every* is more sensitive to CONTEXT than *no*; $\chi^2(1) = 11$; p $<$ .001).

This high performance shows that the participants did not have difficulties with the experimental task. The interaction effect between CONTEXT and POLARITY is compatible with the implicature approach, but poses a challenge for the non-implicature approach. However, the presence of non-maximal readings for *no* is challenging for the implicature approach, at least in the version

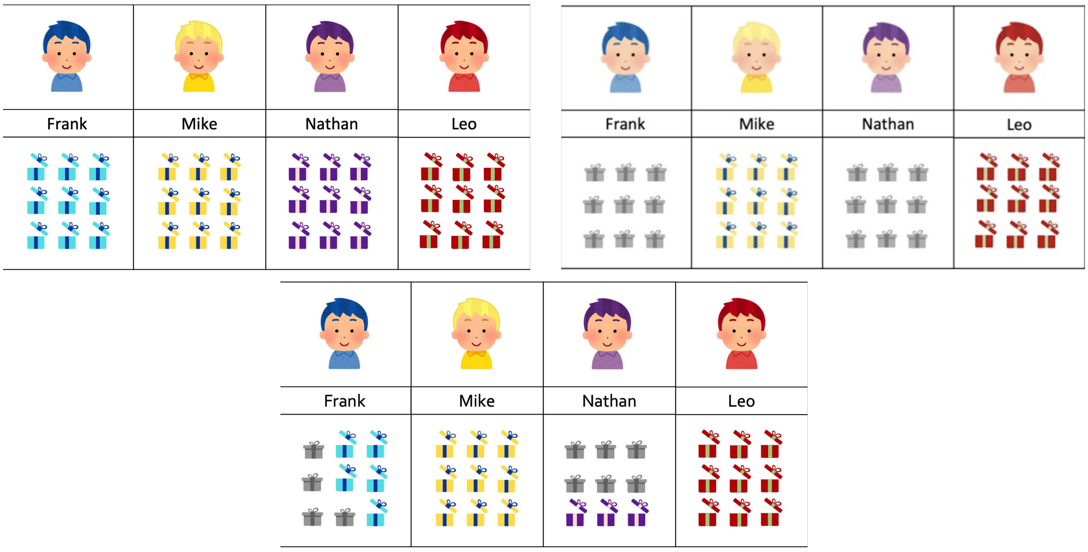


Figure 4: Examples of pictures used of Experiment 2. The top two pictures are items in the CONTROL condition and the bottom picture were is an item in the TARGET condition.

we presented above. We will discuss Bar-Lev's (2021) idea that could make the implicature approach compatible with the simple effect of CONTEXT later.

2.2. Experiment 2

2.2.1. Methods

The design of Experiment 2 is essentially parallel to that of Experiment 1, with the negative quantifier being replaced by *not every*. One consequence of this change is that the same TARGET pictures could be used for both sentences. For all the items in the TARGET condition, two children opened some but not all of their presents, while the other two opened all of their presents. The CONTROL and TARGET pictures are illustrated in Figure 4.

The experimental sentences were spread over 8 lists. Each list contained 32 items as a whole, with 24 experimental and 8 filler items. Half of the experimental items contained the positive quantifier *every* and the other half the negative quantifier *not every*. For each experimental sentence, there were 4 CONTROL-TRUE items, 4 CONTROL-FALSE items, 4 TARGET items. Filler items were included in this experiment, because in the other conditions, the correct answer to the secondary *yes/no* task was uniformly 'No' in the EXISTENTIAL condition. The filler items consisted of four pictures in which none of the boys opened any of his presents. Pictures were accompanied with sentences containing proper names in place of the quantifiers. 4 of these sentences were positive and 4 of them were negative as in (15).

(15) a. Frank opened his presents.
     b. Frank didn't open his presents.

192 native speakers of English were recruited from Prolific (`www.prolific.co`) and paid 1.50 GBP for their participation. Ten were excluded for low ($< 75\%$) accuracy on the control items.

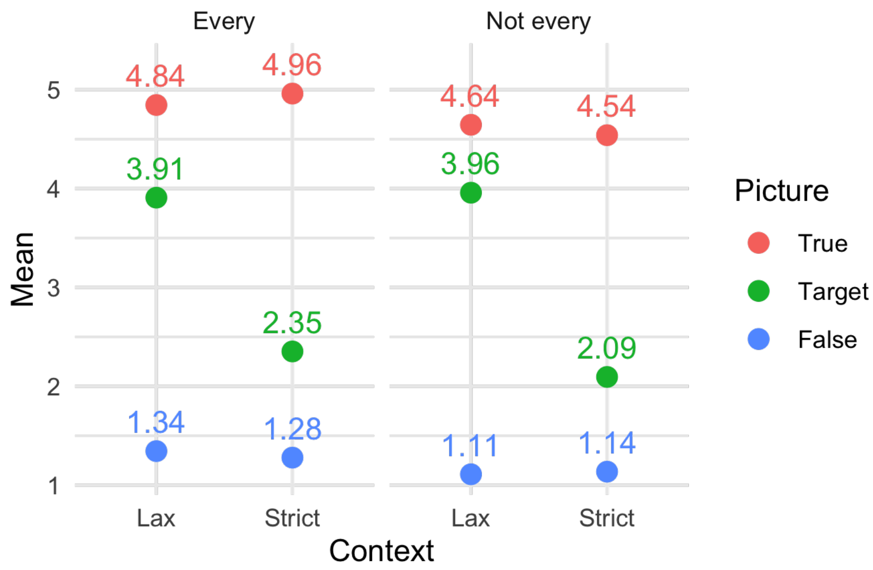


Figure 5: Mean acceptability ratings in Experiment 2. CONTEXT is recoded as LAX (favors non-maximality) or STRICT (favors maximality).

2.2.2. Results and discussion

Figure 5 shows the results of Experiment 2. As the figure indicates, some of the control conditions had less-than-perfect accuracy. An ordinal logistic mixed-effects model on the CONTROL-TRUE and CONTROL-FALSE conditions revealed effects of PICTURE and POLARITY, but crucially no effect of, or interaction with CONTEXT ($\chi^2(3) = 0.46, p = .93$). This means that when analysing the mixed conditions, main effects of POLARITY may not be interpretable, but we can be confident that any effect of CONTEXT is specific to the TARGET conditions and not an overall artifact of the task.

The results in the Target condition were analysed as in Experiment 1. The cumulative logistic mixed-effects model revealed a simple effect of CONTEXT (LAX is more acceptable; $\chi^2(1) = 89, p < .001$), no main effect of POLARITY (*every* is as acceptable as *not every* in mixed condition, but see caveat above; $\chi^2(1) = .02, p = .90$), and, crucially, no significant interaction between CONTEXT and POLARITY ($\chi^2(1) = 2.1, p = .15$).

As in Experiment 1, high performance in the CONTROL conditions shows that participants did not have difficulties with the experimental task. This time, in the TARGET conditions, we found no evidence for an interaction between CONTEXT and POLARITY. The EXISTENTIAL context made *every* more acceptable to the same extent that the UNIVERSAL context made *not every* more acceptable. Thus, non-maximal readings of the *not-every* sentences were found to be as context-dependent as with *every*-sentences. The symmetry in the contextual effect and the overall similar acceptance of the positive and negative quantifiers is very much in line with the non-implicature approach this time, but challenging for the implicature approach.

3. General discussion

To summarise the main findings, in Experiment 1, we found evidence for an asymmetric effect of our contex manipulation for positive and negative sentences. This is in line with the implicature approach, but not straightforwardly predicted by the non-implicature approach. However, we observed an effect of context on *no*, which is not straightforwardly expected under the implicature approach. In Experiment 2, we observed a symmetric effect of CONTEXT for positive and negative sentences, which is more in line with the non-implicature approach and poses a challenge for the implicature approach. Thus, the results of our experiments pose issues for both approaches to plural definites. In the following, we sketch possible directions and amendments of each approach.

3.1. Prospects for the implicature approach

There are two challenges to the implicature approach: (i) to account for the effect of context for negative sentences (both *no* and *not every*) and (ii) to account for why the case of *not every* gave rise to non-maximal reading as much as their positive counterpart and was equally sensitive to contextual effects, in contrast with *no*.

Bar-Lev (2021) acknowledges the first challenge based on introspective judgments, and suggests that non-maximal readings in negative sentences should be explained by a different mechanism than pruning of alternatives, which has to do with (non-trivial) covers and only has truth-conditionally detectable effects in non-positive contexts. Putting aside the details (the interested reader is referred to Bar-Lev 2021), on the assumption that the availability of this mechanism is context-sensitive (as Bar-Lev 2021 in fact assumes), the effect of context on the availability of non-maximal readings can be explained.

In addition, if we also assume that the additional mechanism in question is more restricted and less available than pruning of alternatives, we could explain the asymmetry between *every* and *no*, but the symmetric results of Experiment 2 would still remain to be puzzling, given that *not every* would be predicted to pattern with *no*.

In order to explain the difference between the two negative quantifiers, *no* and *not every*, we suggest the possibility that *not every* is not 'genuinely downward entailing.' That is, when evaluating whether a sentence is downward entailing, for the purpose of the distribution of implicatures, we should also take into account the implicatures the sentence can give rise to.[2] In fact, (16) does very robustly suggest that some boys did open their presents. Once this implicature is added to the literal meaning the resulting overall environment is not downward entailing, but non-monotonic.

(16) EXH[Not every boy opened his presents].
$\rightsquigarrow$ *some boys opened their presents*.

If we add the assumption that implicatures can appear more easily in non-monotonic contexts, it would give the implicature approach another route to non-maximality through an embedded implicature. This embedded implicature would make the sentence equivalent to (17), thus true

[2] Compare the so-called 'intervention effects' of universal quantifiers for NPI licensing in sentences like **I didn't give every boy any present*, which are considered to be due to indirect scalar implicatures turning the positions of NPIs non-monotonic (Chierchia 2004, 2013).

in a non-maximal situation. Finally, this mechanism would correctly not extend to *no*, thus predicting the difference between *not every* and *no*.

(17) EXH[Not every boy$_x$ EXH[x opened his presents]].
$\rightsquigarrow$ *not every boy opened all of his presents*
$\rightsquigarrow$ *Some boys opened all of their presents*

This response for the implicature approach would capture our results, but makes an immediate prediction that implicatures should generally arise more easily in the scope of *not every* than that of *no*. For instance, (18) should more easily be read with the indicated implicatures than (19). Said differently, (18) should be accepted more easily in a context in which some of the boys opened both presents, (while the others opened only one of the two), than (19) in a context in which all the boys opened both.

(18) Not every boy opened the present on their left or on their right.
? $\rightsquigarrow$ *not every boy opened one or the other but not both*
? $\rightsquigarrow$ *some boys opened one or the other but not both*

(19) No boy opened the present on his left or on his right.
? $\rightsquigarrow$ *no boy opened one or the other but not both*

We leave this as an open question for future research, but it should be remarked that provided that something like Bar-Lev's (2021) is necessary for the implicature approach and it will affect the interpretation of definite plurals under *not every*, meaning there will be two ways of getting non-maximal readings under *not every*, the symmetric results between *every* and *not every*, under the current hypothesis, should not carry over to the case of regular scalar implicatures.

3.2. Prospects for the non-implicature approach

The main challenge to the non-implicature approach is that *no* gave rise to non-maximal readings much less than both *every* and *not every*. A possible response is to assume that the effect size of context manipulation negatively correlates with the strengths of prior associations between context and sentences, and that sentences with *no* come with stronger prior associations with contexts that disallow non-maximal readings than sentences containing *every* or *not every*.

Certainly, independent evidence for the prior associations needs to raised, which we leave for future research but we would like to mention that sentences with non-monotonic quantifiers like (20) offer possible testing grounds.

(20) Exactly two boys opened their presents.

For such sentences, we can separately test the availability of non-maximal readings in the positive part of the meaning (i.e., *two of the boys opened their presents*) and the negative part of the meaning (i.e., *none of the other boys opened their presents*), while keeping the prior bias associated with the sentence constant, by assessing judgments against mixed scenarios for the positive part of the meaning (Two of the boys opened some but not all of their presents and the others opened none), and mixed scenarios for the negative part of the meaning (Two boys opened all of their presents and two opened some but not all). If the asymmetry we found in Experiment 1 is specific to *no*, we should find symmetric behaviour here. We also leave this to future research.

4. Conclusion

We reported on two experiments using a picture-sentence truth-value judgment task, testing the predictions of the implicature versus non-implicature approaches to plural definites. Our results provided evidnece for an asymmetry between plural definites in the scope of *every* and *no* sentences but a symmetry between plural definites in the scope of *every* and *not every*. We argued that taken together, these results are challenging for both approaches to non-maximal readings of plural definites. We discussed possible directions each approach can explore in order to account for our results.

Lastly, we would like to remark that there are similar debates in the current theoretical literature between implicature and non-implicature accounts concerning other empirical domains, such as free choice inferences (Tieu et al. 2019), strong vs. weak donkey pronouns (Sun et al. 2020), and counterfactual conditionals (Marty et al. 2020), and for these cases too, comparing positive and negative sentences with the explicit contextual manipulation will be informative in adjudicating between theoretical options.

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On the semantics of multiple wh-exclamatives in Bangla[1]

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Abstract. The scope of this paper addresses multiple wh-exclamative structures in Bangla (a.k.a. Bengali; Eastern Indo-Aryan). Though exclamatives are widely studied, the phenomenon of multiple wh-exclamatives is rarely cited. At the onset of analysing multiple wh-exclamatives, this paper revisits the proposition-set theory approach (D'Avis 2002; Zanuttini and Portner 2003; Chernilovskaya 2010) that views wh-exclamatives as having a question-based semantics, and the degree approach (Miró 2006; Rett 2008a, 2011) that claims wh-exclamatives bear a degree component in their domain which is responsible for the surprising element of the clause. However, the degree approach rejects the idea of exclamatives with multiple wh-words (Rett 2008a, 2011). This paper proposes a new unified framework that accounts for the syntax-semantics of Bangla multiple wh-exclamatives and wh-exclamatives in general.

Keywords: multiple wh-exclamatives, question approach, degree approach, Type 1/2 exclamatives, QUD, Bangla.

1. Introduction

Elliott (1974) identifies the following clause type in English and termed it absolute exclamation. Elliott's (1974) theory on exclamations explains that exclamations involve transformational rules, through which the identical meaning between (1a) and (1b) is conveyed.

(1) a. She is such an attractive woman!
    b. What an attractive woman she is!
    c. How beautiful these flowers are! (Elliott 1974: 232)

However, further studies in exclamations notice semantic differences and distinguish (1a) from (1b) and (1c). The former is labelled as proposition exclamation which has proposition as its illocutionary force in the domain, whereas the latter group is termed as exclamatives (Rett 2008a, b, 2011). Though both have the same value of expressing surprise, exclamatives as opposed to proposition exclamations have a degree property as its illocutionary force (Rett 2008a, b, 2011). A citing difference between proposition exclamations and exclamatives is that the presence of an overt wh-word is necessary to form exclamative structures (such as (1b) and (1c)). In contrast, wh-words need not be present to form proposition exclamations (1a).

Unlike English matrix wh-exclamatives that limit themselves to *what-a* or *what* and *how* structures (1b)-(1c), Bangla is flexible and exhibits a range of wh-words in its exclamative repertoire. Therefore, while English matrix exclamatives can be appropriately analysed along the

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line of Miró (2006); Rett (2008a, b, 2011) i.e., exclamatives express surprise at a higher degree, Bangla wh-exclamatives do not fit in the same framework. Due to a variety of uses of wh-words in exclamatives, Bangla displays both degree and non-degree readings. As an alternative to the degree approach, question-based approaches as espoused in D'Avis (2002); Zanuttini and Portner (2003); Chernilovskaya (2010), cannot successfully accommodate all the cross-linguistic instances of wh-exclamatives either.

This paper offers a revised framework. The proposal is built on the widening account of Zanuttini and Portner (2003) for wh-exclamatives and develops unique semantics by adding certain modifications to the existing theory. Though this paper restricts itself to the instances of multiple wh-exclamative structures in Bangla, the proposed framework can account for cross-linguistic evidence of wh-exclamatives from a compositional view.

We begin the paper by introducing exclamative clauses and further divide it into five sections. §2 explains the influential theories and their limitations in analysing multiple wh-exclamatives in Bangla. This section also presents the necessary modifications to the existing widening account that help to extend the analysis in Bangla. §3 evinces Bangla multiple wh-exclamative structures and their intricacies. §4 puts forward a compositional analysis for Bangla multiple wh-exclamatives, and finally, §5 concludes the paper.

2. Background

Wh-exclamatives are either analysed as having a degree semantics (Miró 2006; Rett 2008a, b, 2011) or a question semantics (D'Avis 2002; Zanuttini and Portner 2003; Chernilovskaya 2010). Before we build our analysis, this section briefly discusses the existing theories and their drawbacks in analysing cross-linguistic variations in wh-exclamatives.

2.1. A degree semantics for wh-exclamatives

Rett in her analysis on English wh-exclamatives follows Austin's (1962) *Speech Act Theory* in claiming that exclamatives are performative speech acts, and they express surprise at a degree higher than the contextually relevant standard. The degree approach bases itself on exclamatives having a degree force (2) as their illocutionary force operator, which states that the domain of an exclamative contains a degree and it is expressively correct if the DEGREE E-FORCE holds in a context C of a degree d that exceeds the standard s, and the speaker expresses surprise at it.

(2) DEGREE E-FORCE($\mathscr{D}_{<d,<s,t>>}$) is expressively correct in context C iff $\mathscr{D}$ is salient in C and $\exists d, d>s$ [the speaker in C is surprised that $\lambda w.\mathscr{D}(d)(w)$] (Rett 2008a, b, 2011)

It is well-known that each utterance can be associated with only one illocutionary force operator. Therefore, DEGREE E-FORCE will have only one free degree complement (Rett 2008a, b, 2011). Though it works for English wh-exclamatives as they do not include utterances like (3), following this approach will lead us to a licensing failure for multiple wh-exclamative clauses spotted cross-linguistically. Huddleston (1993) points out that exclamatives like (3) are ungrammatical in English as they do not receive a degree interpretation, and it works in favour of Rett's theory. However, a Bangla equivalent of (3) (see example (18) in §3.1) is completely acceptable and grammatical. Hence, accounting for the cross-linguistic evidence of multiple wh-exclamatives through the degree approach is unsuitable in this concerned language.

(3) *Who married which person! (Rett 2008a: 610)

Apart from the above reason, Banerjee (2022) mentions another case where accepting the degree approach for Bangla wh-exclamatives is ill-suited. Let us go through it quickly.

Along with offering DEGREE E-FORCE as the illocutionary force operator for exclamatives, Rett advocates the degree restriction and the evaluativity restriction on wh-exclamatives. The prior one restricts exclamatives to always having a degree reading and dismisses the idea that non-degree readings of wh-exclamatives exist. The latter defends the idea that exclamatives exceed the contextually standard scale, expressing surprise at a higher degree. The evaluativity restriction says – in a context where Rajiv did not expect Sima to be 4 ft. tall, but he finds out Sima to be actually 4.6 ft. tall, he cannot express surprise in this case. This is because 4.6 ft. is considered to be a short height universally. Therefore, the evaluativity restriction claims that an exclamative utterance that is expressively correct must surpass the contextually set standard.

As for the degree restriction, follow the English example in (4). It is uttered in a context where the speaker expresses surprise at the number of languages Mimi speaks. Though it lacks an overt numeral degree morphology, (4) will have an amount or quantity reading (Rett 2008a, b, 2011). Rett builds her ground of analysis by proposing a null QUANTITY[2] operator (Cresswell 1976) which covertly supplies the degree reading of quantity for (4).

(4) (My,) What language(s) Mimi speaks! (Rett 2008a: 604)

(4) in Rett's theory also gets a gradable interpretation in a context where the speaker is surprised to know that the languages Mimi speak are exotic to a higher degree. This gradable interpretation of (4) is achieved by assuming that (4) has a covert gradable predicate $\mathbb{P}$, the value of which is contextually assigned (Milner 1978; Gérard 1980; Gutiérrez-Rexach 1996; Villalba 2003; Miró 2006). This theory, however, rejects the idea that exclamatives can have individual reading i.e., (4) cannot be uttered to express surprise in a context where Mimi speaks a specific language (say Spanish). However, Banerjee (2022) cites that Bangla wh-exclamatives do receive an individual reading depending on the context. Another point noted in Banerjee (2022) is that the degree theory does not consider the manner readings of how-exclamatives. *How* in English ranges over both manner and evaluatives.[3] However, Rett claims that since manners do not receive a degree interpretation, they cannot occur in exclamative contexts. Therefore, while uttered in an exclamative context, (5) will only receive an interpretation where Buck rode his horse beautifully, dangerously etc., but never bare-backed or saddled.

(5) How Buck rode his horse!
✗**manner:** *bare-backed, saddled*

[2] $[\![\text{QUANTITY}]\!] = \lambda P \lambda d \lambda Q \exists X[P(X) \wedge Q(X) \wedge \mu(X) = d]$
where QUANTITY associates plural individuals with degree arguments corresponding to their quantity and μ measures the size of a plural individual X (Rett 2008a: 604).
[3] *How* also ranges over gradable degrees such as, *How short you are!* (Rett 2008a: 607).

✓**evaluatives:** *beautifully, dangerously, clumsily* (Rett 2008a: 607)

In contrast to Rett's claim, Bangla wh-exclamatives show manner readings of how-exclamatives (see Banerjee 2022). Therefore, we see that the degree account on exclamatives is inadequate in numerous ways to capture the different instances of wh-exclamatives available in Bangla.

Now we turn to the question-based account on exclamatives.

2.2. A question semantics for wh-exclamatives

As both wh-exclamatives and wh-questions always carry an overt wh-operator, the proponents of this approach view wh-exclamatives as mirror images of wh-questions. There are two sects in this approach. While D'Avis (2002) and Chernilovskaya (2010) explain exclamatives embracing Heim's two notions of answerhood (1994), Zanuttini and Portner (2003) conceptualised a sentential force called widening, which they claimed to be responsible for the interpretation of wh-exclamatives.

D'Avis's (2002) and Chernilovskaya's (2010) analyses of exclamatives follow Karttunen's view on questions i.e., questions denote set of true answers – exclamatives as a resemblance of questions also denote set of true answers, upon which Heim's answerhood operator acts (D'Avis 2002; Chernilovskaya 2010). However, D'Avis (2002) proposes the following two felicity conditions that exclusively hold for exclamatives – (i) the speaker's expectations entail the negation of $answer_1(w)$, and (ii) the speaker knows $answer_2(w)$ (D'Avis 2002; Chernilovskaya 2010). What distinguishes exclamatives from questions is that exclamatives express surprise at a particular answer to the wh-clause. Consider the German example in (6). In (6) the speaker expresses surprise where (s)he expected Maria to invite only John, but Maria invited Bill as well. The semantic representation of the wh-clause in (6) is outlined in (7).

(6) Wen Maria eingeladen hat!
whom Maria invited has!
'Whom has Maria invited!' (Chernilovskaya 2010: 2)

(7) $[\![\text{wh-clause}]\!](w) = \{p : \exists x[p = \lambda w'.[\![\text{invited}]\!](w')(m)(x) \wedge [\![\text{invited}]\!](w)(m)(x))]\}$
$= \{\lambda w'.[\![\text{invited}]\!](w')(j)(m), \lambda w'.[\![\text{invited}]\!](w')(b)(m)\}$ (Chernilovskaya 2010: 2)

Following D'Avis's and Chernilovskaya's proposal, Heim (1994)'s answerhood operator acts on the wh-clause giving us $answer_1$ (= weak exhaustive answer) and $answer_2$ (= strong exhaustive answer) in (8). Adhering to the two felicity conditions outlined above, (6) qualifies as an exclamative because the speaker did not expect $answer_1$ i.e., Maria invited Bill, and the speaker knows $answer_2$ i.e., who Maria exactly invited.

(8) a. $[\![answer_1]\!](w) = \bigcap[\![\text{wh-clause}]\!](w)$
$= \{w' : [\![\text{invited}]\!](w')(j)(m) \wedge [\![\text{invited}]\!](w')(b)(m)\}$
b. $[\![answer_2]\!](w) = \{w' : answer_1(w') = answer_1(w)\}$
$= \{w' : [\![\text{invited}]\!](w')(j)(m) \wedge [\![\text{invited}]\!](w')(b)(m)$
$\wedge \forall x \notin \{j, m\} \neg [\![\text{invited}]\!](w')(x)(m)\}$ (Chernilovskaya 2010: 2)

Though (6) as an exclamative denotes a non-degree reading and D'Avis (2002) successfully captures it, it falls short when it comes to the degree reading of exclamatives as in (9).

(9) How tall John is! (Chernilovskaya 2010: 2)

(9) expresses the speaker's surprise in a situation where the speaker did not expect John to be more than 4 ft. tall but John appeared to be 6 ft. tall.[4] Chernilovskaya (2010) provides a solution to this issue. She uses the downward monotone property of gradable predicates like *tall* [5] such that, $\forall w, x, d, d'(d' < d \wedge [\![\text{tall}]\!](w)(d)(x) \rightarrow [\![\text{tall}]\!](w)(d')(x))$. Now, uttering (9) is only felicitous in a context where John appears taller than what the speaker has expected. In this context, $answer_1$ includes a set of worlds where John is at least 6 ft. tall. Thus, the speaker's expectation entails the $\neg answer_1(w)$. And, the speaker knows $answer_2(w)$, i.e., John is exactly 6 ft. tall.

Although Chernilovskaya's analysis accounts for both degree (9) and non-degree (6) instances of wh-exclamatives, it raises an interesting point where we use exclamatives as compliments (cf. Zanuttini and Portner 2003). There are cases where the speaker's expectation is not negated. As an example we have the following scenario from Zanuttini and Portner (2003), where the speaker expected the house to be nice, uttering *what a nice house!* will not negate the speaker's expectations. The current system does not give an explanation for such instances. The present paper addresses this issue by accepting the concept of expectation set (ES) (Rett 2011; Rett and Murray 2013). The concept of ES is later elaborated on in this section.

Zanuttini and Portner (2003) view exclamatives as inherently scalar. The theory holds a two-part component i.e., exclamatives denote a set of alternatives, just like questions. However, what distinguishes exclamatives from questions is that exclamatives are factive (Zanuttini and Portner 2003). Following Sadock and Zwicky's (1985) interpretation of clause types i.e., a clause type is a combination of grammatical form and conversational use, Zanuttini and Portner formalise a concept of widening which they claim to be the conversational use of an exclamative. As they claim, widening is responsible for the 'surprising' element of exclamatives. It is a fundamental concept similar to a force of a proposition. The claim is that while the illocutionary force of an exclamative is exclaiming, the sentential force of an exclamative is widening[6] (Zanuttini and Portner 2003). Widening is not hardwired in the syntax of an exclamative, it is rather acquired by pragmatic reasoning. The principle of widening, as mentioned in (10), is to widen the domain of quantification denoted by the wh-operator.

(10) *Widening* = For any clause S containing $R_{widening}$, widens the initial domain of quan-

[4]However, (9) can be uttered in a situation where John is only 3 ft. tall. In this situation, it will be a case of rhetorical exclamative i.e., unlike a standard exclamative where the asserted proposition is true, in a rhetorical one it would be false (Patricia 2011).

[5]Chernilovskaya's analysis can be extended to capture absolute gradable adjectives (like *dry* in *How dry the cake was!* (Kennedy 2007)) by reinterpreting them as a relative adjective.

[6]All clause types are associated with two forces viz. sentential force and illocutionary force. The former represents a sentence's form in a conversation (Chierchia and McConnell-Ginet 1990), whereas the latter represents the intention of a speaker in an utterance (Searle 1969). In the case of exclamatives, the sentential force is widening, however, any clause can have exclamation as its illocutionary force.

tification for $R_{widening}$, D_1, to a new domain D_2, such that:
a. $[\![S]\!]_{w,D_2,\prec} - [\![S]\!]_{w,D_1,\prec} \neq \emptyset$
b. $\forall x \forall y[(x \in D_1 \ \& \ y \in (D_2 - D_1)) \rightarrow x \prec {}^7 y]$ (Zanuttini and Portner 2003: 15)

The Zanuttini and Portner (2003) account on exclamatives also bases itself on the Karttunen set.[8] Let us follow the Paduan example in (11) to understand the framework of widening.

(11) che roba che l magna!
what stuff that he eats
'The things he eats!' (Zanuttini and Portner 2003: 12)

(11) is uttered in a context where the speaker expresses surprise about the spicy peppers one eats. In this situation, the wh- *che* 'what' refers to a set of peppers such as poblanos, serranos, jalapeños that are ordered in an increasing likelihood scale[9] of spiciness in the initial domain or D_1. Now, $R_{widening}$, which is a quantificational operator, acts on this set of alternatives and widens it to a new domain D_2, where the widened D_2 set includes even spicier peppers such as habanero, carolina reaper etc. along with the previous ones. Zanuttini and Portner (2003) claim that widening the domain is only possible when the additional elements in the widened set are extreme on the relevant scale, and it is an essential meaning component of exclamative clauses.

Along with $R_{widening}$, factivity acts as the other active meaning component for exclamatives. The factivity component of exclamatives is drawn from the notion of Common Ground (Stalnaker 1978). The following denotes the factivity relation in exclamative clauses:

(12) *Factivity* = For any clause *S* containing $R_{factivity}$ in addition to $R_{widening}$, every $p \in [\![S]\!]_{w,D_2,\prec} - [\![S]\!]_{w,D_1,\prec}$ is presupposed to be true. (Zanuttini and Portner 2003: 17)

The widening approach, though successful in capturing both degree and non-degree instances of wh-exclamatives, needs modification to extend the analysis in cross-linguistic contexts. While accounting for wh-exclamatives in Telugu and Kannada, Balusu (2019) points out that basing $R_{widening}$ on Karttunen set creates a problem for a data like (13).

(13) *Heinz is amazed at who Uma married.* (Balusu 2019: 112)

(13) is uttered in a monogamous society where the speaker expresses surprise at Uma marrying Kiran since the speaker expected Uma to marry Ravi. In this context, following Karttunen set would already give us the true answer (i.e., Kiran) in D_1, and therefore, widening D_1 to D_2 with respect to a context like (13) cannot take place. Balusu (2019) proposes an alternative resort to this. He suggests using Hamblin (1973) alternatives i.e., questions denote a set of possible answers, instead of Karttunen's. Now, D_1 with respect to (13) will only include possible answers, and widening D_1 to D_2 will give us the true answer at which the speaker expresses surprise.

[7] $\prec$ is an ordering relation, with respect to which any domain of quantification is $\prec$-inclusive. That means, if *x* and *y* are in *D* and $x \prec z \prec y$, then *z* is also in *D*.
[8] The option for using Hamblin's (1973) and Groenendijk and Stokhof's (1984) denotations for questions is also open.
[9] In case of gradable contexts such as *How tall John is!* the alternatives will be ordered in a degree scale.

Balusu (2019) addresses a second problem in the existing theory. For data like (11) the wh-referents are ordered in an increasing likelihood scale for spiciness, as the context defined in (11) is a scalar context. However, (13) is uttered in a non-scalar context, where we are not attributing any scalar property such as tall, short, beautiful, ugly etc. to it. The ordering of the alternatives in the case of (13) thus remains undefined. In order to resolve this issue, Balusu (2019) embraces the concept of expectation set (ES), where the speaker's expectations are encoded as sets of possible worlds (Rett 2011; Rett and Murray 2013). Now, instead of wh-alternatives, the ordering will take place with respect to the propositional alternatives. Therefore, in (13) the ordering will be like this – *Uma marrying Kiran* is less likely than *Uma marrying Ravi*. With these modifications in hand, let us mention the revised versions of $R_{widening}$ and $R_{factivity}$ (Balusu 2019: 121).

(14) For any clause S containing an exclamative operator, widen the initial domain ES to a new domain D_2 such that:
a. $[\![S]\!]_{w,D_2 \prec_{\text{likelihood/degree}}} - [\![S]\!]_{w,D_{\text{ES}} \prec_{\text{likelihood/degree}}} \neq 0$
b. $\forall x \forall y[(x \in D_{\text{ES}}\ \&\ y \in (D_2 - D_{\text{ES}})) \rightarrow x \prec_{\text{likelihood/degree}} y]$ and;
c. $\exists p \in [\![S]\!]_{w,D_2 \prec_{\text{likelihood/degree}}} - [\![S]\!]_{w,D_{\text{ES}} \prec_{\text{likelihood/degree}}}$ is presupposed to be true.

Accepting ES into our analysis also helps in resolving the issue of non-surprising exclamative[10] utterances noted earlier in this section. It suggests that in cases of the exclamative expressions (such as the one addressed earlier – *what a nice house!*) that do not express surprise, the ES is based on a normative scale i.e., ES_{NORM}. When compared to the exclamatives expressing the speaker's surprise (such as the one in (13)), the ES is said to be based on the perspective of the speaker i.e., ES_{SPKR}.

Our analysis uses this refined version of widening along with the exclamative operator which is responsible for the semantics of exclamatives, in analysing the multiple wh-exclamative instances of Bangla. Let us now look at the overview of multiple wh-exclamative utterances in Bangla.

3. Overview of Bangla wh-exclamatives

Bangla exhibits both Type 1 or gradable/degree and Type 2 or non-gradable[11] readings in wh-exclamative clauses. The wh-words in Bangla begin with a k-morpheme and, following Banerjee (2022), this paper also refers to Bangla wh-exclamatives as k-exclamatives.

While English licenses only *what* and *how* in its wh-exclamatives, Bangla uses *where*, *who*, *whom*, *how*$_{manner}$ apart from *what* and *how* in the same. The Type 1 k-exclamatives are mostly uttered with *ki* 'what' and *koto* 'how', as in (15) where Rahul is more than 6 ft. tall and the speaker expresses surprise at his height. Other wh-words such as *ki*[12] 'what', *kake* 'whom', *ke*

[10]See Badan and Cheng (2015) for non-surprising exclamatives in Mandarin.
[11]Exclamatives that express surprise at the individual singled out by the wh-phrase are termed Type 1 (or i-level) exclamatives, and exclamatives that express surprise at the event that the wh-referent takes part in are termed Type 2 (or e-level) exclamatives. See Nouwen and Chernilovskaya (2015) for further discussion on Type 1/2 exclamatives.
[12]It is worth mentioning that Bangla has two types of *ki* 'what' in its exclamative structure (Banerjee 2022). The

‘who’, *kothae* ‘where’ etc., though typically appear to have Type 2 readings, can also receive a degree interpretation depending on the context. Follow (16) – it can be uttered in a non-degree context where the speaker is surprised at the event of Rahul visiting the Himalayan region (as the speaker is aware that Rahul has altitude sickness). It can also be uttered in a context in which the speaker can express surprise that Rahul visited a dangerous place. In the latter context, (16) receives a degree interpretation whereas, in the former one it only has a Type 2 or non-gradable reading. Albeit the typical Type 2 k-words can occur in degree contexts, it does not work contrariwise i.e., the Type 1 *ki* and *koto* in exclamatives behave only as a modifier and does not occur in non-degree situations.

(15) Rahul ki/koto lomba!
Rahul what/how tall
‘How tall Rahul is!’

(16) Rahul kothae gache!
Rahul where went
‘*Where Rahul went!’

We now take up the instances of multiple k-exclamatives in Bangla.

3.1. Evidence of multiple k-exclamatives

The range of k-words used in Bangla exclamative structures allows them to co-occur with each other in forming multiple wh-exclamatives. Consider the following examples from Bangla:

Type 1 Reading

(17) koto loke koto khabar khacche!
how many person how much food eat.PROG.PRS.3
Lit: ‘How much food how many persons are eating!’

Type 2 Reading

(18) kon chele kon meye-ke biye koreche!
which boy which girl.ACC marriage do.PRF.PRS.3
Lit: ‘Which boy married which girl!’

(17) has a degree interpretation and conveys a quantity reading in a context where lots of people are eating in large quantities, and the speaker expresses surprise both at the amount of food and the number of people eating them. As opposed to it, the utterance in (18) expresses the speaker’s surprise at a situation where couples who were never meant to be together got married, hence yielding a Type 2 reading.

4. Syntax-semantics profile of multiple k-exclamatives

Parallel to multiple wh-questions, multiple wh-exclamatives also allow superiority-obeying and superiority-violating word orders. Both single-pair and pair-list readings are available for each

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Type 1 *ki* does not occur in non-exclamative contexts (*rastay ki jol jomeche [✓!/✗?]* ‘How waterlogged the road has become!’), and therefore Banerjee (2022) termed it exclamatory modifier, whereas Type 2 *ki* and all the other k-words including the Type 1 *koto* can occur in question clauses. When the Type 2 *ki* occurs in a degree context yielding a degree reading, Banerjee (2022) argues that it modifies a null gradable predicate and has the following underlying structure: [*ki* $+\varnothing_{\text{gr}}$].

word order in the case of Bangla Type 2 multiple k-exclamatives. Follow Bhattacharya and Simpson (2007) for a similar observation in Bangla multiple wh-questions.[13] Reconsider the example in (18) which has superiority-obeying word order. It can also have a superiority-violating word order, as in (19).

Superiority-Obeying

(18) kon chele kon meye-ke biye koreche!
which boy which girl-ACC marriage do.PRF.PRS.3
Lit: 'Which boy married which girl!'
Context 1: Surprise at Rajiv marrying Mira.**[OK]** (single-pair)
Context 2: Surprise at Rajiv marrying Mira, and Rahul marrying Anu.**[OK]** (pair-list)

Superiority-Violating

(19) kon meye-ke kon chele biye koreche!
which girl-ACC which boy marriage do.PRF.PRS.3
Lit: 'Which boy married which girl!'
Context 1: Surprise at Rajiv marrying Mira.**[OK]** (single-pair)
Context 2: Surprise at Rajiv marrying Mira, and Rahul marrying Anu.**[OK]** (pair-list)

Think about a context with three boys such as Rishi, Rahul, Arjun, and three girls such as Mira, Suman, and Riya. In a monogamous heterosexual society with respect to the data in (18) and (19), following Hamblin (1973) denotation of questions we will have the set of possible answers for its single-pair reading as in (20) for both superiority-obeying and superiority-violating cases. As for the pair-list readings, we get the sets in (21a) and (21b) for superiority-obeying and superiority-violating word order, respectively.[14]

(20) **Single-Pair Reading**

$$\left\{\begin{array}{l}\text{Rishi married Mira, Rishi married Suman, Rishi married Riya,}\\ \text{Rahul married Mira, Rahul married Suman, Rahul married Riya,}\\ \text{Arjun married Mira, Arjun married Suman, Arjun married Riya}\end{array}\right\}$$

(21) **Pair-List Reading**

a. $$\left\{\left\{\begin{array}{c}\text{Rishi married Mira}\\ \text{Rishi married Suman}\\ \text{Rishi married Riya}\end{array}\right\},\left\{\begin{array}{c}\text{Rahul married Mira}\\ \text{Rahul married Suman}\\ \text{Rahul married Riya}\end{array}\right\},\left\{\begin{array}{c}\text{Arjun married Mira}\\ \text{Arjun married Suman}\\ \text{Arjun married Riya}\end{array}\right\}\right\}$$

b. $$\left\{\left\{\begin{array}{c}\text{Rishi married Mira}\\ \text{Rahul married Mira}\\ \text{Arjun married Mira}\end{array}\right\},\left\{\begin{array}{c}\text{Rishi married Suman}\\ \text{Rahul married Suman}\\ \text{Arjun married Suman}\end{array}\right\},\left\{\begin{array}{c}\text{Rishi married Riya}\\ \text{Rahul married Riya}\\ \text{Arjun married Riya}\end{array}\right\}\right\}$$

[13] Bangla 'mostly' lacks superiority effects (see Bhattacharya and Simpson 2007).
[14] A single-pair reading is formed as a set of propositions. As a requirement of the context, a single-pair reading allows us to have only one true answer from the set of possible answers. However, a pair-list reading is modelled as a set of sets of propositions, which allows us to have an answer from each set (cf. Kotek 2018, 2016).

Up until this point, we have the interpretation of multiple k-questions which satisfy the conditions of exhaustivity and uniqueness presuppositions (Dayal 2002).[15] These two presuppositions require that there be exactly one true answer for each set of questions in (21a) and (21b). Now in order to get the exclamative reading, we must allow domain widening. Widening the domain would allow including more unexpected couples, and the speaker will express surprise at one (in the case of single-pair reading) or at some (in the case of pair-list reading) of the couples.[16]

Adhering to the above-defined context, let us say that for the single-pair reading, the speaker expresses surprise at Rajiv marrying Mira, and for the pair-list reading the speaker expresses surprise at two couples e.g., Rajiv-Mira and Rahul-Anu, where Anu and Rajiv are added to the extended domains quantified by the wh-items.

The following sub-sections form a compositional profile of these multiple k-exclamative readings.

4.1. Analysing single-pair readings

We now look at the compositional analysis of the single-pair readings available for the superiority-obeying and superiority-violating cases. Though Bangla is a wh-*in-situ* language on the surface, Simpson and Bhattacharya (2003) argued for an overt wh-movement to Spec CP in Bangla. While viewing multiple wh exclamatives, we follow the intuition that Bangla is a multiple wh-fronting language as opposed to English (Bhattacharya and Simpson 2007).[17,18]

Now, we propose the syntax for both word orders considering the examples in (18) and (19). See below:

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[15]The presuppositions of a multiple question (Dayal 2002):
a. Domain exhaustivity: every member of the set quantified over by the overtly moved wh is paired with a member of the set quantified over by the *in-situ* wh.
b. Point-wise uniqueness (functionhood): every member of the set quantified over by the overtly moved wh is paired with no more than one member of the set quantified over by the *in-situ* wh.

[16]In the case of single-pair readings, Dayal's (1996) ANS-D operator ensures that we get one unique maximally true informative answer from the set of propositions. However, in the case of pair-list readings, the same answerhood operator fails to apply as the ANS-D can only apply to a set of propositions and **not** to a set of sets of propositions. Therefore, for analysing multiple k-exclamatives, we follow Kotek's answerhood operator that can recursively act on a set of propositions, a set of sets of propositions, and so on.

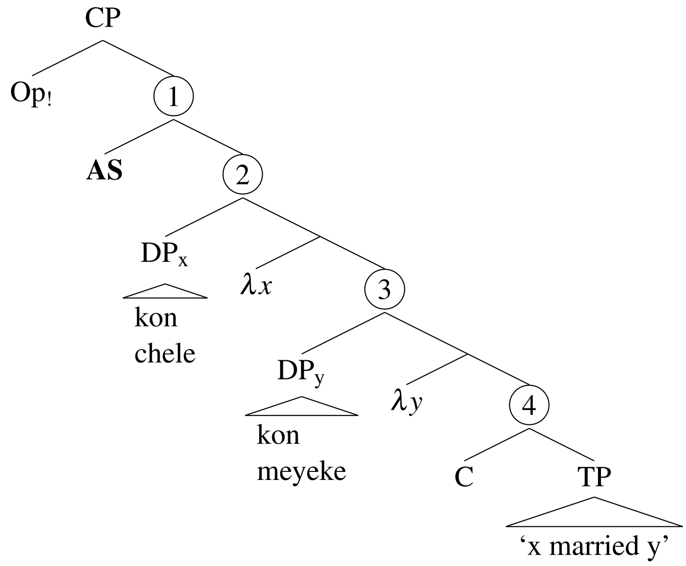
[17]As argued in Bhattacharya and Simpson (2007), in Bangla multiple wh-questions, the wh-phrases are overtly moved to a Spec CP. The evidence follows from the embedded multiple wh-questions in Bangla, where the apparently wh-*in-situ* phrases must move to the matrix CP edge.

a. *tumi **ke**$_i$ bolle [t_i **kothay** thakbe]?
you who say where will-live/stay

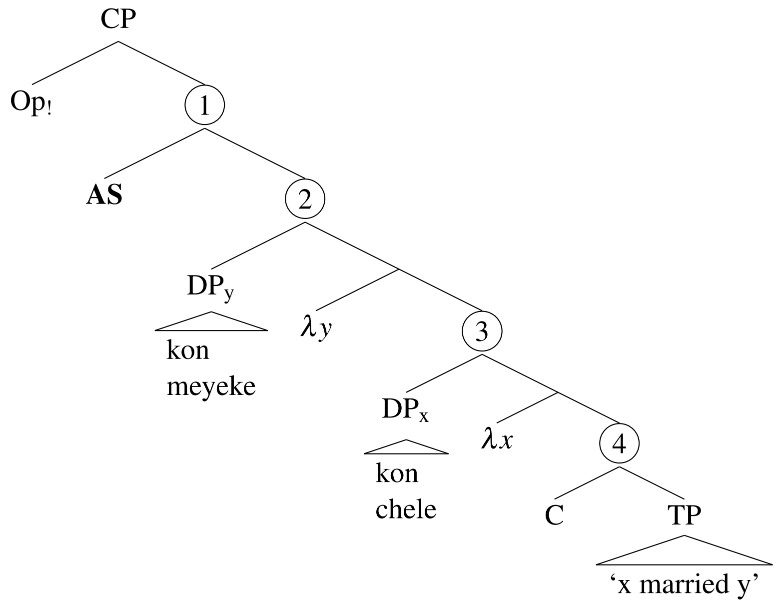
b. tumi **ke**$_i$ **kothay**$_k$ bolle [t_i t_k thakbe]?
you who where said will-live/stay
'Who did you say will stay where?' (Bhattacharya and Simpson 2007: 182)

[18]On a contra view in order to keep Bangla as SOV, one can possibly argue that due to pragmatic prominence, a [*i*Top] feature is present on the wh-word (it may be the subject or the object wh-word) that will be fronted over the other, and a strong [*u*Top*] feature is on the higher Top projection. One may argue that the movement happens due to checking for this uninterpretable Top* feature.

(22) **Superiority-Obeying**



(23) **Superiority-Violating**



In (22), both the wh-phrases overtly move to the CP edge retaining the superiority-obeying word order. However, in the case of superiority-violating word order, we argue along the line of Bhattacharya and Simpson (2007) that the overtly raised object wh-phrase over the subject wh-phrase can be seen as a case of pragmatic prominence i.e., the object wh-phrase being the centre of interest can lead us to have a superiority-violating word order.

Now, let us look at the crucial steps of composition for (22) in (24):

(24) a. $[\![4]\!]^o = \lambda w.x$ married y in w ; $[\![4]\!]^f = \{[\![4]\!]^o\} = \{\lambda w.x$ married y in $w\}$

b. $[\![3]\!]^f = \{\lambda w.x$ married y in $w : y \in$ girl$\}$

c. $[\![2]\!]^f = \{\lambda w.x \text{ married } y \text{ in } w : y \in \text{ girl}, x \in \text{ boy}\}$
d. $[\![\mathbf{AS}\ 2]\!]^o = [\![2]\!]^f$; $[\![\mathbf{AS}\ 2]\!]^f = \{[\![\ \mathbf{AS}\ 2]\!]^o\}$
e. $[\![1]\!]^o = [\![2]\!]^f = \{\lambda w.x \text{ married } y \text{ in } w : y \in \text{ girl}, x \in \text{ boy}\}$

We follow a Kotek (2016, 2018)-style semantics for composing both single-pair and pair-list readings of the Bangla multiple k-exclamatives. In Kotek's system, **AS** is not the complementiser. Rather, it is the question operator on the clausal spine responsible for the interrogative semantics. Kotek's ALTSHIFT (**AS**) operator needs to be introduced in the syntax. This **AS** converts the focus value of the set into its ordinary value.[19] It is the type-flexible version of the Q operator (see Beck 2006; Beck and Kim 2006). The complementiser C remains semantically vacuous in her system. At the compositional level, node 4 represents the open proposition 'x married y'. In the next few steps, the free variables become bound and pointwise composed with the denotation of the wh-phrases in (24b) and (24c), resulting in the focus value of the set of propositions in node 2. Follow (24c). The **AS** operator converts the focus value of node 2 and returns the ordinary value of it in node 1. 1 corresponds to the flat set outlined in (20) in the single-pair context. At the next step, the exclamative operator $\text{Op}_!$ will take the ordinary value obtained via the application of **AS**, as in node 1, and gives us the semantics of exclamatives. Before looking at the semantics of $\text{Op}_!$, let us look at the main compositional steps in (25) for the superiority-violating word order (23) in a single-pair reading.

(25) a. $[\![4]\!]^o = \lambda w.x \text{ married } y \text{ in } w$; $[\![4]\!]^f = \{[\![4]\!]^o\} = \{\lambda w.x \text{ married } y \text{ in } w\}$
b. $[\![3]\!]^f = \{\lambda w.x \text{ married } y \text{ in } w : x \in \text{ boy}\}$
c. $[\![2]\!]^f = \{\lambda w.x \text{ married } y \text{ in } w : x \in \text{ boy}, y \in \text{ girl}\}$
d. $[\![\mathbf{AS}\ 2]\!]^o = [\![2]\!]^f$; $[\![\mathbf{AS}\ 2]\!]^f = \{[\![\ \mathbf{AS}\ 2]\!]^o\}$
e. $[\![1]\!]^o = [\![2]\!]^f = \{\lambda w.x \text{ married } y \text{ in } w : x \in \text{ boy}, y \in \text{ girl}\}$

The alternatives in both cases are composed pointwise resulting in a flat set of type $\langle st, t\rangle$ (like simplex wh-questions), and a single **AS** operator takes the focus value of the entire set and returns us the ordinary value of the set, yielding a single-pair reading.

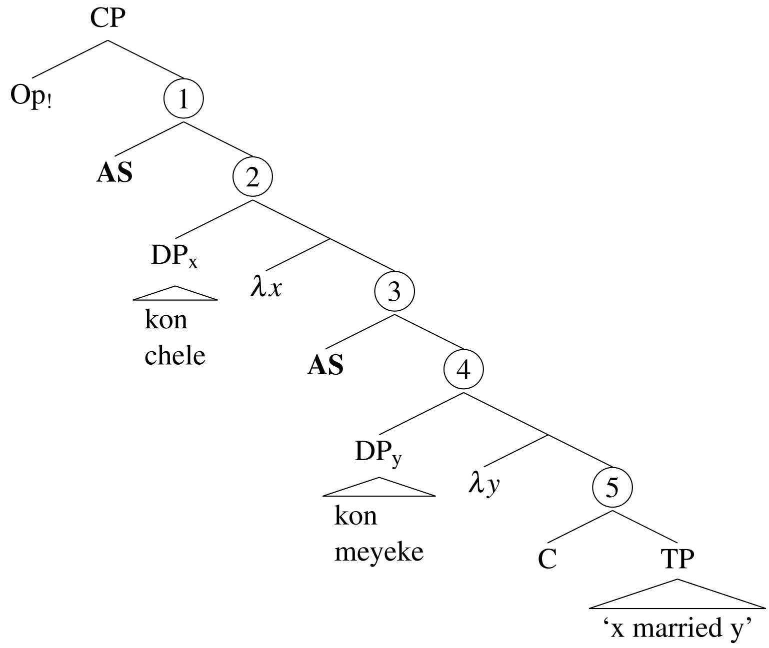
Now, let us look at the compositional steps required to derive the pair-list readings.

4.2. Analysing pair-list readings

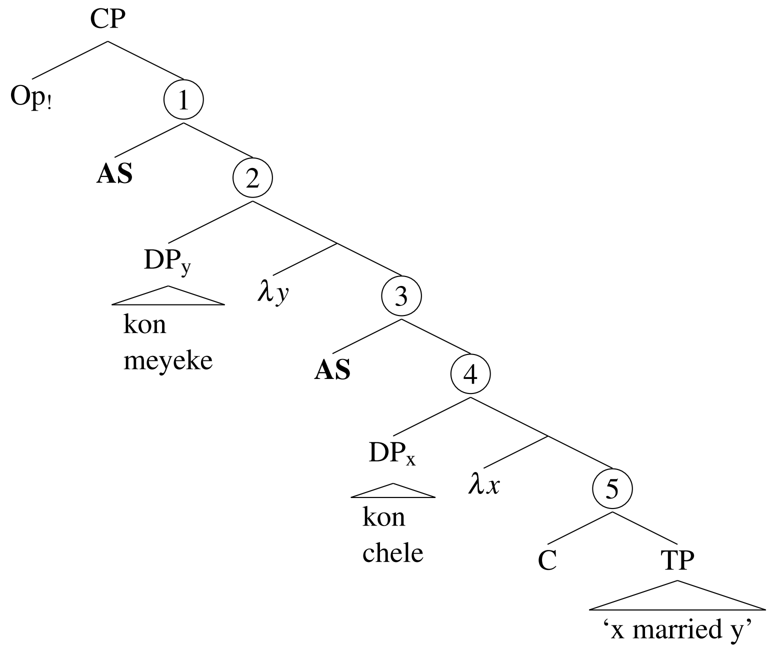
In the instance of pair-list readings, the superiority-obeying and superiority-violating word orders follow the same mechanism used for single-pair readings. The only noticeable difference associated with pair-list readings following Kotek (2018) is that they allow each wh-phrase to be interpreted individually by the **AS** operators. Therefore, in pair-list readings, we have a second **AS** operator. This permits the formation of the set of sets of answers (of type $\langle\langle st, t\rangle, t\rangle$) necessary to produce the pair-list readings. The following are the proposed structures for the pair-list denotations for superiority-obeying and superiority-violating word orders:

[19]The semantics of the ALTSHIFT (**AS**) operator is as follows:
a. $[\![\text{ALTSHIFT } \alpha_\sigma]\!]^o = [\![\alpha]\!]^f$
b. $[\![\text{ALTSHIFT } \alpha_\sigma]\!]^f = \{[\![\text{ALTSHIFT}\alpha_\sigma]\!]^o\}$ $(\sigma \in \{\langle st, t\rangle, \langle\langle st, t\rangle, t\rangle, \ldots\})$ (Kotek 2018: 32)

(26) **Superiority-Obeying**



(27) **Superiority-Violating**



Analysing (26) compositionally, we have the following key steps of derivations in (28):

(28) a. $\llbracket 5 \rrbracket^o = \lambda w.x$ married y in w ; $\llbracket 5 \rrbracket^f = \{\llbracket 5 \rrbracket^o\} = \{\lambda w.x$ married y in $w\}$

b. $\llbracket 4 \rrbracket^f = \{\lambda w.x$ married y in $w : y \in$ girl$\}$

c. $\llbracket \textbf{AS}\ 4 \rrbracket^o = \llbracket 4 \rrbracket^f$; $\llbracket \textbf{AS}\ 4 \rrbracket^f = \{\llbracket\ \textbf{AS}\ 4 \rrbracket^o\}$

d. $\llbracket 3 \rrbracket^o = \llbracket 4 \rrbracket^f = \{\lambda w.x$ married y in $w : y \in$ girl$\}$;
$\llbracket 3 \rrbracket^f = \{\{\lambda w.x$ married y in $w : y \in$ girl$\}\}$

e. $[\![2]\!]^f = \{\{\lambda w.x \text{ married } y \text{ in } w : y \in \text{ girl}\} : x \in \text{ boy}\}$
f. $[\![\textbf{AS } 2]\!]^o = [\![2]\!]^f$; $[\![\textbf{AS } 2]\!]^f = \{[\![\textbf{ AS } 2]\!]^o\}$
g. $[\![1]\!]^o = [\![2]\!]^f = \{\{\lambda w.x \text{ married } y \text{ in } w : y \in \text{ girl}\} : x \in \text{ boy}\}$

The pointwise derivation is similar to the one in (24) and (25), but with a crucial difference that the wh-phrases are individually interpreted by two **AS** operators here. Following Rooth's (1985; 1992) notion of non-focused nodes, we assume that the focus value of 3 is exactly the ordinary value of it in a singleton. This node composes with the other wh-phrase by pointwise predicate abstraction resulting in the set of sets of alternative propositions in node 1. The difference in the pointwise composition of (26) and (27) can be spotted in the denotation of the set of sets of possible answers which is grouped by the wh-phrase that occurs in the higher position in syntax. Therefore, in (27), node 3 has the following focus value in (29a), and moving up further, node 1 will have the following interpretation in (29b).

(29) a. $[\![3]\!]^f = \{\{\lambda w.x \text{ married } y \text{ in } w : x \in \text{ boy}\}\}$
b. $[\![1]\!]^o = [\![2]\!]^f = \{\{\lambda w.x \text{ married } y \text{ in } w : x \in \text{ boy}\} : y \in \text{ girl}\}$

The derivations in (28) and (29) yield a set of sets of answers to form the pair-list denotations for the superiority-obeying and superiority-violating instances. In the case of (28), node 1 corresponds to the pair-list set outlined in (21a), and the same in (29) corresponds to the pair-list set outlined in (21b).

Let us now proceed to explain the semantic tool that is liable for the interpretation of exclamative clauses.

4.3. On the semantics of Op$_!$

As we have the single-pair and the pair-list denotations for both superiority-obeying and superiority-violating instances, we can now move on to obtain the exclamative interpretation. The exclamative operator Op$_!$ introduced on the clausal spine is responsible for giving the semantics of exclamatives. Before we read out the semantic denotation of Op$_!$, we must form an answerhood operator. This answerhood operator is deemed to act on the ES, in order to pick out the maximal true informative answer. As we are following the semantics proposed in Kotek (2018) in order to analyse multiple wh-exclamatives, it seems feasible to opt for the answerhood operator formalised in Kotek (2018) to analyse multiple wh-questions in English. Unlike ANS-D (Dayal 1996) that only applies to a flat set, this answerhood operator introduced in Kotek (2018) can recursively apply to a set of sets of answers. This captures both the single-pair and pair-list readings available for multiple wh-questions. (30) shows us a recursive definition for generalised ANS. As mentioned in Kotek (2018), this ANS can act on a set of propositions iff the set is answerable, i.e., if it has a maximally true informative answer.[20]

(30) a. $[\![\text{ANS}]\!](P_{\langle st,t\rangle}) = \lambda w.\text{Max}_{\text{inf}}(P)(w)$

[20] A recursively defined filter on question meanings using ANS (Kotek 2018: 39):
a. $[\![\text{ANSWERABLE}]\!](P_{\langle st,t\rangle}) = \exists q : [\![\text{ANS}]\!](P) = q.P$
b. $[\![\text{ANSWERABLE}]\!](K_{\langle \sigma,t\rangle}) = \forall P_\sigma \in K(\exists q : [\![\text{ANS}]\!](P) = q).K \qquad (\sigma \in \{\langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, \ldots\})$

where $\text{Max}_{\text{inf}}(P)(w) = \iota p \in P$, such that $w \in p$ and $\forall q \in P(w \in q \rightarrow p \subseteq q)$

b. $[\![\text{ANS}]\!](K_{\langle\sigma,t\rangle}) = \lambda w. \bigcap P_\sigma \in K([\![\text{ANS}]\!](P)(w))$
[i.e., $\lambda w.\lambda w'.\forall P_\sigma \in K([\![\text{ANS}]\!](P)(w)(w'))$]
$(\sigma \in \{\langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\})$ (Kotek 2018: 38)

Though introducing generalised ANS to our semantics for $\text{Op}_!$ will work in the case of single-pair readings of multiple k-exclamatives because the maximally informative true answer will be the surprising one, it will, however, overgeneralise things in the case of pair-list readings as in (31) (obtained by widening (21a) or the ES) where Rajiv and Anu are new additions, whom the speaker knew to be haters of the marriage system. Now, maybe, the speaker finds the actual couples are Rajiv-Mira, Arjun-Suman, Rahul-Anu, and Rishi-Riya. Here the amazement comes only from the first and third couples, whereas the second and last one was expected by the speaker. Though there are four distinct answers from the four question sets in (31), each of them is not surprising to the speaker. In such a scenario, the speaker will not express surprise at each true answer picked out by the answerhood operator in the pair-list readings. The bold-faced propositions below are those answers that can instigate the speaker's surprise.

(31) $\left\{ \begin{Bmatrix} \text{Rishi married Mira} \\ \text{Rishi married Suman} \\ \text{Rishi married Riya} \\ \textbf{Rishi married Anu} \end{Bmatrix}, \begin{Bmatrix} \text{Rahul married Mira} \\ \text{Rahul married Suman} \\ \text{Rahul married Riya} \\ \textbf{Rahul marrying Anu} \end{Bmatrix}, \begin{Bmatrix} \text{Arjun married Mira} \\ \text{Arjun married Suman} \\ \text{Arjun married Riya} \\ \textbf{Arjun married Anu} \end{Bmatrix}, \begin{Bmatrix} \textbf{Rajiv married Mira} \\ \textbf{Rajiv married Suman} \\ \textbf{Rajiv married Riya} \\ \textbf{Rajiv married Anu} \end{Bmatrix} \right\}$

Therefore we need to restrict the generalised ANS operator with respect to exclamative context. Following Grice's (1975) maxim of quantity, which suggests not to contribute more information than is needed in a context, will exactly give us those answers required for the exclamative context. Hence forcing an informativity restriction on the Max_{inf} operator can be done by viewing the discourse topic as Question Under Discussion (QUD), the notion of which dates back to Roberts (2012). QUD is a semantic question corresponding to the current discourse topic (Roberts 2010; Simons et al. 2010). QUDs can be overt questions or they can remain implicit in discourse. A QUD can be addressed by complete or partial answers or by another question that entails the complete or partial answer to it. We propose that while dealing with exclamative clauses, there will always be an implicit QUD relative to the context c, viz. $!\text{QUD}^c$ which is defined as the following:

(32) $!\text{QUD}^c$: What surpasses the norm or the speaker's expectation in context c?

The argument in favour of $!\text{QUD}^c$ is – only that maximally informative true answer will be picked out which is not more informative than is needed for answering the !QUD in c. Hence, pragmatically modifying the Max_{inf} operator with respect to $!\text{QUD}^c$ gives us the following denotation in (33). This $\text{Max}_{\text{inf}\,!\text{QUD}^c}$ operates on the set of propositions and returns the unique maximal true answer which is most informative for the current discourse topic, given there is an answer that is true and surpasses the speaker's expectation or norm. And whenever there is no informative true answer relevant to the current discourse topic, the operator results in giving the set of all possible words W (i.e., trivial; non-informative).

(33) $$\text{Max}_{\text{inf}!\text{QUD}^c}(Q)(w) = \begin{cases} \iota p[p(w) = 1 \wedge p \text{ is not more informative than is needed for answering} \\ !\text{QUD}^c \wedge \forall q \in Q\ [[q(w) = 1\ \wedge\ q \leq_{\text{inf}} p \text{ for answering the } !\text{QUD}^c] \rightarrow \\ p \subseteq q]] \quad \text{if } \exists q : [\![\text{ANS}]\!](Q) = q \wedge q \text{ is informative to answer } !\text{QUD}^c. \\ W \quad \text{otherwise} \end{cases}$$

Now, replacing the Max_{inf} operator with $\text{Max}_{\text{inf}!\text{QUD}^c}$ in the generalised ANS, we get the following revised notion of generalised ANS as in (34) that is sensitive to exclamative readings.

(34) Generalised ANS relative to $!\text{QUD}^c$ ($\text{ANS}^{!\text{QUD}^c}$):
  a. $[\![\text{ANS}^{!\text{QUD}^c}]\!](P_{\langle st,t\rangle}) = \lambda w.\text{Max}_{\text{inf}!\text{QUD}^c}(P)(w)$
  b. $[\![\text{ANS}^{!\text{QUD}^c}]\!](K_{\langle \sigma,t\rangle}) = \lambda w.\bigcap \{p : \forall P_\sigma \in K([\![\text{ANS}^{!\text{QUD}^c}]\!](P)(w)) = p\}$
  $(\sigma \in \{\langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, \ldots\})$

This generalised ANS operator will act on the widened set (D_2) and would pick out only the maximally true surprising answer(s). As we dealt with all the relevant issues, we are now ready to formalise the semantics of the exclamative operator $\text{Op}_!$ as in (35) which is accountable for the interpretation of exclamative readings.

(35) $$[\![\text{Op}_!]\!]^{c,w} = \lambda Q_{\langle\langle st,t\rangle,t\rangle} : \exists p \in (\bigcup [\![Q]\!]_{w,D_2^{wh1},D_2^{wh2},\ldots} - \bigcup [\![Q]\!]_{w,D^{wh1}_{ES_{\text{SPKR/NORM}}},D^{wh2}_{ES_{\text{SPKR/NORM}}},\ldots})[p(w) = 1].\{p : p = \text{ANS}^{!\text{QUD}^c}([\![Q]\!]_{w,D_2^{wh1},D_2^{wh2},\ldots}) \wedge p \notin \bigcup [\![Q]\!]_{w,D^{wh1}_{ES_{\text{SPKR/NORM}}},D^{wh2}_{ES_{\text{SPKR/NORM}}},\ldots}\}$$

Let us now turn to the Type 2 cases where the propositions are always ordered on a likelihood scale. With this definition of the exclamative operator, let us elaborate on (26) that denotes a pair-list reading of a superiority-obeying k-exclamative. The presupposition component of the $\text{Op}_!$ semantics ensures the factivity criterion associated with wh-exclamatives. Let us now work with the set defined in (21a) that is non-widened version of (28g). While $\text{Op}_!$ works on the set (28g), widening it would give us the set mentioned in (31). Now, the $\text{ANS}^{!\text{QUD}^c}$ operator would pick out only that maximally informative true proposition that contains nothing more informative than is needed for answering the $!\text{QUD}^c$. In a context like (18), this type of proposition will be the set of worlds that are compatible only with Rajiv marrying Mira and Rahul marrying Anu, but do not contain information about Arjun marrying Suman and Rishi marrying Mira. The same mechanism would be applied to the pair-list reading available for superiority-violating word order.

The problem arises when we try to accommodate the single-pair readings because the generalised union needs a family of sets to act on. Therefore, in the single-pair case, we must first type-shift it from $\langle st,t\rangle$ to $\langle\langle st,t\rangle,t\rangle$. Here we tap into the `Ident` type-shifter (cf. Partee 1986; Uegaki 2019) to transform the flat set into a singleton. It is defined as what follows:

(36) $\texttt{Ident} = \lambda Q_{\langle st,t\rangle}.\{Q\}$

Now, in a single-pair context, the set defined in (20) is the ES, and widening (20) would include all the new bold propositions in the D_2. The ANS operator in $\text{Op}_!$ will act on D_2 picking out the maximally true surprising answer relevant to the context. Recall context 1 (which was a single-pair context) in (18) where the maximally true answer was 'Rajiv married Mira'.

4.4. Extending the analysis to Type 1 readings

In this section, we move ahead with the Type 1 instance. The Type 1 instance of the multiple k-exclamative in (17) will be analysed following the same mechanism used above. As described earlier, (17) is uttered in a situation where the speaker expresses surprise at the amount/quantity of people and food. The k-words in (17), will therefore be interpreted in the following ways:

(37) a. $[\![\text{koto loke}]\!]^f = \{d : d \text{ is the number of people}\}$; $[\![\text{koto loke}]\!]^o = \text{undefined}$
b. $[\![\text{koto khabar}]\!]^f = \{d' : d' \text{ is the degree denoting the quantity of food}\}$;
$[\![\text{koto khabar}]\!]^o = \text{undefined}$

A pointwise composition would give us the following set for Type 1 k-exclamative sentence uttered in (17). The alternative propositions in the ES of Type 1 instances are ordered relative to a degree scale.

(38)
$$\left\{ \begin{array}{c} d \text{ number of people are having } d' \text{ amount of food} \\ d_1 \text{ number of people are having } d'_1 \text{ amount of food} \\ \ldots \end{array} \right\}$$

Now, widening this set would include higher degrees of both food and people at which the speaker can express surprise. As widening (38) would result in a flat set, application of the exclamative operator $\text{Op}_!$ would require the set to be type-shifted using the `Ident` operator. The ANS would then pick out the maximally true surprising answer relevant to the context from the widened set.

5. Conclusion

Bangla multiple wh-exclamatives show both Type 1 (or degree) and Type 2 (or non-degree) readings. Since Bangla uses a variety of k-words in its exclamative structures, it also shows a combination of k-words in its multiple wh-exclamative structures, yielding single-pair and pair-list readings in both superiority-obeying and superiority-violating word orders.

As the diverse nature of k-exclamatives is introduced in this paper, we see that they cannot be analysed along the lines of Rett's degree approach. We, therefore, base our analysis on the question approach and precisely follow the widening account (Zanuttini and Portner 2003). The course of the analysis, however, uses the modifications in the existing widening approach, mentioned in Balusu (2019) for analysing wh-exclamatives in Telugu and Kannada.

For the syntax of multiple k-exclamatives, we follow the insights of Bhattacharya and Simpson (2007) where the wh-phrases are overtly fronted in Bangla. At the level of compositional analysis, we follow Kotek (2016, 2018) in positioning the **AS** (or ALTSHIFT) operator on the clausal spine. This **AS** operator is accountable for the interrogative semantics. The **AS** operator converts the focus value of the set of alternatives to its ordinary value, upon which the exclamative operator $\text{Op}_!$ acts, giving us the semantics of multiple k-exclamatives. It will work for single k-exclamatives too. The answerhood operator posited in the semantics is mainly drawn from Kotek's generalised ANS used for multiple wh-questions. But, the answerhood operator in $\text{Op}_!$ is pragmatically modified with the concept of QUD (Roberts 2012) so that it can extract only those true answers that are relevant to the exclamative contexts.

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Strict Logophors in Ewe, Yoruba, and Igbo[1]

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Abstract. Logophoric Pronouns (LOGPs) in some West-African Languages occur in attitude environments and are anaphorically linked to an attitude holder in a superordinate clause (*Mary$_i$ says/thinks/hopes [$_{\text{CP}}$ that ...* LOGP$_i$ *...]*). Existing accounts capture this dependency by treating a LOGP as a variable that is obligatorily bound by an operator at the edge of the embedded clause. Culy (1994) and Bimpeh and Sode (2021) however pointed out that from the viewpoint of the strict-sloppy ambiguity of pronouns, LOGPs in Ewe do not behave like bound variables, allowing both sloppy (bound) as well as strict (non-bound) readings. We strengthen this line of criticism by providing novel data indicating that LOGPs in Ewe, Igbo and Yoruba support strict readings in focus contexts. We offer an alternative account to existing approaches which builds on Bimpeh et al. (2023) and can capture both strict and sloppy interpretations of LOGPs.

Keywords: logophor, strict/sloppy readings, presupposition, Ewe, Yoruba, Igbo.

1. Introduction

The logophoric pronoun in Ewe, *yè*, is known to be bound to an attitude holder in propositional-attitude environments (Clements 1975). It is also known to support both sloppy and strict readings in sentences with *only*. This has been observed by Culy (1994) and later by Bimpeh and Sode (2021), see examples (1) and (2).

(1) Kòfí$_1$ kò yé xɔ̀sè bé Ámá$_2$ lɔ̃ **yè**$_1$. **Ewe**
Kofi only FOC believe that Ama love LOGP
'Only Kofi believes that Ama loves him.' (Culy 1994: 1082)

a. $\rightsquigarrow_{sloppy}$ No one$_j$ but Kofi thinks Ama loves **them**$_j$.

b. $\rightsquigarrow_{strict}$ No one but Kofi$_i$ thinks Ama loves **him**$_i$(=Kofi).

(2) Kòfí$_1$ kò yé xɔ̀sè bé **yè**$_1$ kpɔ́ ŋɔ̀lì. **Ewe**
Kofi only FOC believe that LOGP see ghost
'Only Kofi believes that he saw a ghost.' (Bimpeh and Sode 2021: 2)

a. $\rightsquigarrow_{sloppy}$ No one$_j$ but Kofi thinks **they**$_j$ saw a ghost.

b. $\rightsquigarrow_{strict}$ No one but Kofi$_i$ thinks **he**$_i$(=Kofi) saw a ghost.

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A context which supports the strict reading for (2) is as follows (Bimpeh and Sode 2021). Kofi stayed overnight in a cemetery to prove his bravery. His friends, Mansa and Yao, planned to play a trick on him. They know the cemetery guard so they ask him to dress up as a ghost to scare Kofi. In the night Kofi sees a scary creature walking through the vicinity. He thinks that he saw a ghost. The next day, when he told the story to Mansa and Yao, they both burst into laughter. (2) is judged true against this context.

As further pointed by Bimpeh and Sode 2021, the only way to get strict readings in Ewe is by the use of the logophoric pronoun. The ordinary 3RD-person pronoun (henceforth ORDP) in the language, *é*, cannot co-refer with an attitude holder in logophoric environments (Clements 1975; Culy 1994; Bimpeh et al. 2023). As such, *é* does not have a strict interpretation in logophoric contexts (see example 3).

(3) Kòfí$_1$ kò yé xɔ̀sè bé Ámá$_2$ lɔ̃ **é**$_3$. **Ewe**
Kofi only FOC believe that Ama love ORDP
'Only Kofi believes that Ama loves him.' (Culy 1994)

Culy (1994) and Bimpeh and Sode (2021) point out that the existence of the strict reading is problematic for standard accounts of LOGPs. As we elaborate later, those accounts predict LOGPs to behave like a bound variable, and therefore to support only sloppy readings.

In this paper, first, we provide new data based on original fieldwork from Ewe (Kwa, Ghana), Yoruba (Benue-Congo, Nigeria) and Igbo (Benue-Congo, Nigeria) – three West-African languages with logophoric pronouns. We corroborate the findings of the above works on Ewe and show that the generalization extends to Igbo and Yoruba: LOGPs in these three languages allow for strict and sloppy readings in examples with *only* (section 2). Second, we show why strict readings are problematic for existing approaches to the syntax-semantics of LOGPs (section 3). Third, we offer an alternative account to existing approaches which builds on Bimpeh et al. 2023 and captures the basic distributional facts of LOGPs while at the same time allow to capture strict readings (section 4).

2. The data

We elicited data from three Ewe speakers (two Aŋlɔ dialect and one Eʋedome dialect), two Yoruba speakers, and three Igbo speakers. All data was elicited via multiple Zoom sessions with each speaker, transcribed live by the experimenters and checked by the speakers. Speakers' spontaneous comments on the reasoning behind their responses were also noted. Given that the strict/sloppy tests are based on the verbs 'think', the data in (4) present the baselines for each language. The indexation indicates that LOGP obligatorily co-refers with the attitude holder.

(4) a. Kòkú$_1$ súsú bé **yè**$_{1/*2}$ lɔ̃ Àfí. **Ewe**
Koku think that LOGP love Afi
'Koku thinks that he loves Afi.'

b. Adé$_1$ rò wípé **òun**$_{1/*2}$ fẹ́ Ọlá. **Yoruba**
Ade think that LOGP marry Ola
'Ade thinks that he married Ola.'

c. Ézè$_1$ chèrè nà **yá**$_{1/*2}$ lụ́rụ́ Àdá. **Igbo**
Eze think that LOGP marry Ada
'Eze thinks that he married Ada.'

The co-reference patterns reported in (4) align with previous observations regarding LOGPs in each language, see Culy (1994); Pearson (2015); Bimpeh (2019, 2023) for Ewe, Manfredi (1987); Adésolá (2005); Lawal (2006) for Yoruba, and Hyman and Comrie (1981); Manfredi (1987) for Igbo.

In the following, we show that in environments including *only* (association with focus) LOGPs display sloppy and, crucially, also strict readings. We used a binary acceptability judgment task designed with joint presentation for both strict and sloppy interpretations of the target sentence. Speakers were asked to express their acceptability judgment on both paraphrases (one strict and one sloppy), but they were free to accept as felicitous both sentences, one sentence or none.

(5) *Strict/sloppy readings with 'only' in **Ewe***

Élì kò yé súsú bé **yè** ɖùdzí lè àwù-dódó ƒé hòʋíʋlí mè.
Eli only FOC think COMP LOGP win in dress-wear POSS contest inside
'Only Eli thinks that he won the costume contest.'

a. $\leadsto_{sloppy}$ No one$_j$ but Eli thinks **they**$_j$ won the costume contest.

b. $\leadsto_{strict}$ No one but Eli$_i$ thinks **he**$_i$(=Eli) won the costume contest.

All of our Ewe consultants accepted the paraphrase for the strict reading in (5b). One of our Ewe consultants, however, had difficulties accessing the sloppy reading, as it is paraphrased in (5a). So we provided a more explicit paraphrase for the sloppy reading within the session. For the elicitation sessions with Yoruba and Igbo speakers, we then used the more explicit paraphrase to test sloppy readings, see (6a) and (7a). To keep a minimal contrast, we made the paraphrase for the strict reading equally explicit, see (6b) and (7b). All of our Igbo and Yoruba consultants accepted both paraphrases.

(6) *Strict/sloppy readings with 'only' in **Igbo***

Náā̄nị́ Ézè chèrè nà **yá** mérìrì nà ásòmpì i-gó-sì ákwá.
only Eze think that LOGP win PREP contest to-show-SUFF clothes
'Only Ézè thinks that he won the costume contest.'

a. $\rightsquigarrow_{sloppy}$ Eze thinks that he(=Eze) won the costume contest, and Aki doesn't think that he**(=Aki)** won the costume contest, and Ada doesn't think that she**(=Ada)** won the costume contest.

b. $\rightsquigarrow_{strict}$ Eze thinks that he(=Eze) won the costume contest, and Aki doesn't think that he**(=Eze)** won the costume contest, and Ada doesn't think that he**(=Eze)** won the costume contest.

(7) *Strict/sloppy readings with 'only' in* ***Yoruba***

Adé	nìkan	ni	ó	rò	wípé	**òun**	máa	tayọ	nínú	ìdíje	asọ náà.
Adé	only	FOC	RES	think	that	LOGP	FUT	to.win	inside	contest	clothes DEF

'Only Adé thinks that he will win the costume contest.'

a. $\rightsquigarrow_{sloppy}$ Ade thinks that he(=Ade) will win the costume contest, and Niyi doesn't think that he**(=Niyi)** will win the costume contest, and Ọla doesn't think that she**(=Ọla)** will win the costume contest.

b. $\rightsquigarrow_{strict}$ Ade thinks that he(=Ade) will win the costume contest, and Niyi doesn't think that he**(=Ade)** will win the costume contest, and Ọla doesn't think that he**(=Ade)** will win the costume contest.

This section demonstrated that LOGPs can receive strict readings alongside sloppy readings across Ewe, Igbo, and Yoruba. The next section will lay out the implications of this observation for current accounts of logophoricity.

3. A problem for existing approaches

A prominent approach to LOGPs in the formal-semantic literature captures LOGP's basic property—co-reference with the attitude holder—by treating LOGPs as simple variables over individuals (type *e*) that must be bound in attitude environments. This is the view taken for example by Schlenker (2003); von Stechow (2004); Pearson (2015). We will call this the OBLIGATORY BINDING approach. In the implementation in Pearson (2015), following von Stechow (2003), LOGP is a variable that comes with a syntactic feature, LOG, which forces the variable to be bound at the edge of the embedded clause. To illustrate, the LF representation of *Kofi thinks that* LOGP *loves Afi* (4a) on this account is in (8a), where [LOG] enforces index matching between the variable and the λ_x-binder at the edge of the CP. This syntax is coupled with a semantics that assigns the embedded clause a property meaning (type $\langle e, st\rangle$), and an appropriate meaning for attitude predicates such as *think*, *say* etc. which involves quantification over Centered Worlds (Lewis 1979) . The paraphrase of the resulting meaning is given in (8c).

(8) *Obligatory Binding account of* LOGP *(based on Pearson 2015)*

a. **Syntax**:
Kofi thinks that [$\lambda x_1 \lambda w \underbrace{x_{1/*2,[\text{LOG}]}}_{\text{LogP}}$ loves Afi]

b. **Semantics**:
$[\![\text{think}]\!]^w = \lambda P \lambda x.\ \forall \langle w', x' \rangle \in \text{BEL}_{x,w},\ P(x')(w') = 1.$
$\text{BEL}_{x,w} := \{\langle w', x' \rangle : w'$ is compatible with x's beliefs in w and x identifies as x' in $w'\}$

c. (8a) $\approx$ *In all worlds compatible with Kofi's beliefs, the person Kofi identifies as himself in those worlds loves Afi.* (***de se*** **reading**[2])

The fact that [LOG] requires x_1 to be formally bound by λx_1 in (8a) makes sure that LOGP ends up referring to the attitude holder's recognized self—the 'Logophoric Center' of the relevant worlds—and not to any other individual.

However, as noted by Culy (1994) and Bimpeh and Sode (2021) for Ewe, the Obligatory Binding approach to LOGPs makes the wrong prediction regarding the availability of the strict reading with *only*. On standard assumptions about the syntax-semantics interface, bound-variable representations (λ-binding at LF) translate to sloppy readings in quantificational environments like *only* and other focus-sensitive operators.[3] Therefore, it is predicted that LOGP can only have the sloppy (bound-variable) reading. Specifically, when *only Kofi* replaces *Kofi* in (8a), the predicted meaning can only be paraphrased as 'no one$_1$ other than Kofi thinks that they$_1$ love Afi', and not as 'no one other than Kofi$_2$ think that he$_2$ loves Afi'. But the facts above in Ewe, Yoruba and Igbo do not bear out that prediction.

What should be the theory of the syntax-semantics of LOGPs in a way that could support strict (as well as sloppy) readings? In the next section we offer an account, building on Bimpeh et al. (2023) and on ideas in Sauerland (2013).

4. Proposal

4.1. Background: A different route to the *de se* requirement on LOGPs

Bimpeh et al. (2023) recently proposed an analysis of LOGPs that captures LOGPs' basic distributional facts—*de se* coreference with an attitude holder—differently from the Obligatory Binding approach, by relying on a presuppositional semantics for the feature LOG. Their motivation had nothing to do with strict-sloppy configurations, but was rather to capture the distributional properties of LOGPs and ORDPs within a theory of pronominal competition. We will

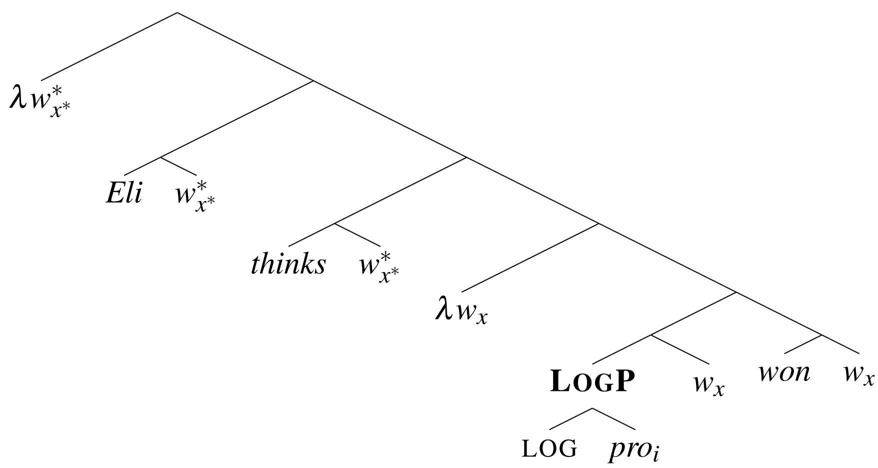
[2]Pearson (2015) claimed that LOGPs are also possible in non-*de se* (*de re*) contexts in which the attitude holder does not recognize themselves as the referent of LOGP. But we follow Bimpeh et al. 2023 who provide contrasting evidence that LOGPs in our languages have a requirement for *de se* readings. The main analytical problem that the current paper is concerned with only becomes more grave if *de re* readings are possible too.
[3]Another relevant environment are ellipsis constructions. See Bassi et al. (2023) for parallel data about ellipsis in Ewe, Yoruba, and Igbo.

dedicate this subsection to review Bimpeh et al.'s (2023) compositional analysis of sentences with LOGPs, as it will be the foreground to our core proposal in section 4.2.

Bimpeh et al. (2023) propose that the logophopric pronoun in Ewe, Yoruba and Igbo underlyingly consists of two syntactic pieces: LOGP $\equiv$ [LOG pro_i]. In a nutshell, pro_i is a variable (over Individual Concepts), which need not be bound, and LOG has a presuppositional semantics that restricts the reference of pro_i to be the Logophoric Center of the embedded clause. The LF of (9), for instance, is in (10), which shows how LOGP is decomposed.

(9) Élì súsú bé **yè** ɖùdzí. **Ewe**
Eli think COMP LOGP win
'Eli$_1$ thinks that he$_1^{de\text{-}se}$ won.'

(10) *LF of (9) in Bimpeh et al. 2023*



The semantics that comes with this LF relies on a framework (standard to capture *de se* readings) where attitude ascriptions involve quantification over centered worlds (Lewis 1979). Centered worlds are world-individual pairs, notated here as 'w_x'.[4] It is also embedded in an approach to intensional semantics which uses syntactically-represented (Centered-)world pronouns that saturate argument slots in the denotation of verbal and nominal predicates (see e.g. von Fintel and Heim 2011; Percus 2000). Denotations that fit this structure are supplied in (11).

(11) a. $[\![Eli]\!] = \lambda w_x$. the person in w named 'Eli'. *type* $\langle s,e \rangle$

b. $[\![win]\!] = \lambda w_x.\lambda z.\ z$ wins in w. *type* $\langle s,et \rangle$

The innovation in Bimpeh et al. 2023 has to do with the structure and interpretation of the logophoric pronoun. pro_i is a variable over individual concepts (type $\langle s,e \rangle$). Just like the typical

[4] 'w_x' throughout is a shorthand for the pair $< w,x >$. Below, 's' is taken to be the semantic type of centered-worlds.

pronoun, it can be bound or free; if free, its value needs to be supplied or accommodated from context (by some salient description, see below). The added feature LOG, however, effectively restricts pro_i to pick out the Center of the embedded clause. It does so by way of a presupposition. Formally, LOG's denotation is in (12) (we employ the notation of Heim and Kratzer 1998 for encoding partial functions, where the part between a colon and a dot defines the domain of the function and is meant to model presuppositional information).

(12) $[\![\text{LOG}]\!]^g = \lambda f_{\langle s,e\rangle}.\ \lambda_{w_x} : \underbrace{f(w_x) = x}_{presupposition}\ .\ x$ (*type* $\langle se, se\rangle$)

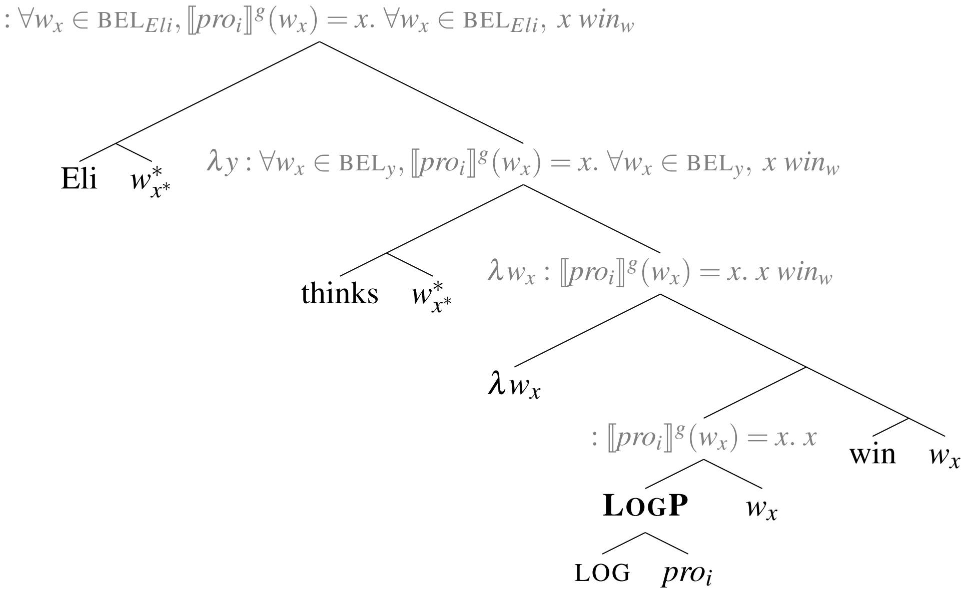
According to (12), LOG(f) is a function from centered-worlds to their Center, defined only for those w_x whose Center equals $f(w_x)$.

(13) $[\![\ \text{LOGP}]\!]^g = [\![\text{LOG}]\!]^g([\![pro_i]\!]^g) =\ [\lambda_{w_x} : [\![pro_i]\!]^g(w_x) = x.\ x]$

Attitude predicates relate a proposition to an individual by quantifying universally over some set of Centered-worlds; *think*, in particular, encodes quantification over BEL—the set of doxastically accessible centered-worlds. Since LOGP introduces partiality in the embedded clause through LOG's presupposition, an entry for such predicates is required that can handle partial propositions in its scope. The entry in (14), after Karttunen 1974 and Heim 1992, says that presuppositions of the embedded clause project universally to BEL.

(14) $[\![\text{think}_{w^*_{x^*}}]\!]^g = \lambda p_{\langle s,t\rangle} \lambda y : \forall w_x \in \text{BEL}_y,\ p(w_x)$ is defined.
$\forall w_x \in \text{BEL}_y,\ p(w_x) = 1.$
$\text{BEL}_y := \{w_x$: w is compatible with y's beliefs and x is the Center of w—-the individual in w who y perceives as y themselves in w.$\}$

A full composition of the structure is shown in gray in (15). In the top line, the assertion part (the part after the dot) captures the desired *de se*-dependency between LOGP and the attitude holder (cf. (8c)). Notably, the attitude holder-LOGP dependency is obtained here less directly than in the Obligatory Binding approach (cf. section 3), through LOG's presupposition.

(15)


The presupposition part of the top line in (15) (the part before the dot) contains a free Individual-Concept pronoun, pro_i, which needs to be recovered by some contextually-salient description. Not just any contextually-salient description will do, of course; only those which can safely satisfy the presupposition. That is, only concepts which Eli associates with himself. One option is the CENTER concept in (16a), which we assume is salient in any context. Another is the concept in (16b), assuming it is common ground that Eli knows himself as 'Eli'. Some possibilities are out in most natural contexts since they would incur a presupposition failure, e.g. (16c); and others are heavily context-dependent, for instance (16d) which would satisfy the presupposition only in contexts where Eli identifies himself as wearing the red hat.

(16) *Options for the value of* pro$_i$ *in (15)*

a. ✓$[\![pro_i]\!]^g = \lambda w_x.\ x.$ (the CENTER-concept)

b. ✓$[\![pro_i]\!]^g = \lambda w_x.$ the person in *w* named 'Eli'

c. ✗$[\![pro_i]\!]^g = \lambda w_x.$ the person in *w* named 'Ann'

d. $[\![pro_i]\!]^g = \lambda w_x.$ the person in *w* who is wearing the red hat in *w*.

4.2. Strict readings by ignoring LOG in alternatives

So far we merely replicated the basic result of previous accounts of LOGPs, only using a different compositional route. Our account of strict readings builds on the above, specifically on the decomposition of LOGP, and makes one more assumption: LOG's meaning can be ignored when computing focus alternatives (in the sense of Rooth 1992) to an expression. This proposal is an extension of an idea put forth by Sauerland (2013), according to whom presuppositions coming from pronominal features do not have to contribute their meaning at the level of focus alternatives. Sauerland (2013) suggested this as a way to explain why locally-bound reflexives in English (*self*-anaphors) can have strict readings, as well as why pronominal ϕ-features on bound variables can be ignored across alternatives (see also McKillen 2016; Sudo and Spathas 2020; Bruening 2021; Bassi 2021 for variants of this idea). If LOG is a pronominal feature, like the *-self* part of reflexives and like ϕ-features on pronouns, then it too, we suggest, can be suspended in alternatives.[5]

Consider again an example that brings strict-sloppy ambiguity to light, i.e., when *only* is added. Example (5) is repeated in an abbreviated form in (17).

(17) Élì kò yé súsú bé **yè** ɖùdzí.
Eli only FOC think COMP LOGP win
'Only Eli thinks that he won.'

a. $\rightsquigarrow_{sloppy}$ No one$_j$ but Eli thinks **they**$_j$ won.

b. $\rightsquigarrow_{strict}$ No one but Eli$_i$ thinks **he**$_i$(=Eli) won.

We analyze these constructions as involving a focus feature [FOC] on the subject, as represented in (18a). [FOC] generates focus alternatives—structures resulting from substituting *Eli* with some (relevant) individual. *only* says that the prejacent (its sister) is true and all the alternatives are false. This much is fairly standard. The core proposal, to repeat, is that LOG's contribution can be ignored in the tier of focus alternatives, like other pronominal features. In (18b), LOG is deleted from the tier of alternatives (though not from the prejacent).

(18) *Analysis of (17) with* LOG *deleted from alternatives*[6]

a. LF: Only $\big[$Eli$_{[\textbf{FOC}]}$ thinks λw_x [[$_{\text{LOGP}}$ **[LOG *pro$_i$*]**$_{w_x}$] won$_{w_x}$] $\big]$[7]

[5] Sauerland argued that only what he called 'purely-presuppositional' elements can be ignored at the level of focus alternatives. The underlying intuition is that an element is purely-presuppositional if it adds nothing but a presupposition to the semantics (i.e., it doesn't add anything to the assertive dimension of meaning). The denotation of LOG in (12) does fit Sauerland (2013)'s definition of pure-presuppositionality in (i).

(i) A functor F of type $\langle\tau,\tau\rangle$ is *purely presuppositional* iff for every f,a such that $F(f)(a)$ is defined, $f(a)$ is defined too and $F(f)(a) = f(a)$. (adapted from Sauerland 2013:167)

The reader can verify that LOG is purely-presuppositional because $[\![\text{LOG}]\!](f)$ is of the same type as f and outputs the same value as f wherever defined.

[6] To simplify the presentation we encode alternatives as syntactic objects, i.e., LFs (Fox and Katzir 2011), and we use a deletion operation to cash out the core idea about LOG. Nothing crucial depends on this; instead of syntactically deleteing LOG across alternatives, we could use the definition of *pure-presuppositionality* from fn.5 and stipulate (as in Sauerland 2013) that the meaning of a pure-presuppositional element can be reset in the alternatives to the total-identity function $[\lambda f.f]$. Both implementations capture the idea the LOG's contribution is ignored in alternatives.

[7] Here we evidently analyze *only* as taking scope over the whole clause at LF, although the surface structure of (17)

b. Alt's: $\{$ Kofi thinks λw_x [[$_{\text{LogP}}$ **[~~LOG~~ *pro$_i$*]**$_{w_x}$] won$_{w_x}$] ,
Koku thinks λw_x [[$_{\text{LogP}}$ **[~~LOG~~ *pro$_i$*]**$_{w_x}$] won$_{w_x}$] , ...$\}$

pro$_i$ is crucially free in this derivation (not λ-bound), so its value remains constant across the alternatives in (18b). The interpretation of this configuration is given in (19). Since LOG is active only in the prejacent, the relevant presupposition is absent in the alternatives.

(19) *The Interpretation of the prejacent and alternatives in (18)*

a. *Prejacent*:
$$: \underbrace{\forall w_x \in \text{BEL}_{Eli}, [\![pro_i]\!]^g(w_x) = x}_{presupposition}.\ \forall w_x \in \text{BEL}_{Eli},\ x\ win_w$$

b. *Alternatives*:
$$\{\ \forall w_x \in \text{BEL}_{Koku},\ [\![pro_i]\!]^g(w_x)\ win_w\ ,\ \forall w_x \in \text{BEL}_{Kofi},\ [\![pro_i]\!]^g(w_x)\ win_w\ , ...\}$$

This paves the path towards the strict reading—depending on the value chosen for *pro$_i$*. All that is required is a concept that Eli as well as all of his alternatives (Koku, Kofi,...) mentally associate with Eli. If, for example, it is common ground that everyone knows Eli by the name 'Eli', then accommodating the value in (16b) for *pro$_i$* results in strict reading, as desired.[8] The sloppy reading can be obtained by setting the value for *pro$_i$* to the CENTER-concept in (16a).

It is crucial for the derivation that LOG's presupposition could disappear from alternatives. If it didn't, only the sloppy reading could be derived (again by plugging the CENTER-concept as the value for *pro$_i$*). To wit, if LOG were active in the alternatives, then its presupposition in each alternative would restrict LOGP to be the Center of the relevant worlds, forcing LOGP to end up (*de se*-) bound in each alternative by the respective attitude holder. Attempting to resolve the value of *pro$_i$* to be a concept like (16b) and thus to obtain a strict reading, but without ignoring LOG's contribution in the alternatives, would suffer from a presupposition failure.

5. Conclusion

To sum up, this paper provided evidence that logophoric pronouns (LOGPs) in Ewe, Yoruba and Igbo support both strict and sloppy readings in sentences with *only* (following observations in Culy 1994 and Bimpeh and Sode 2021), and offered a formal analysis that could capture this behavior. The account supplants existing accounts of LOGPs with the idea that LOGPs are

and the other sentences from section 2 might suggest that *only* forms a constituent with its associate (the subject). We could instead adopt the LF-structure *[[only DP$_{Foc}$] VP]*, where *only* composes with two arguments (Wagner 2006, a.o.). Our main proposal is not affected by this choice, as long as the subject DP triggers focus alternatives.

[8] What if a context furnishes no suitable description that could be the value of *pro$_i$* in this derivation? Our predictions might change. Imagine a scenario where it is impossible to find any (salient) description which is vivid enough in the minds (i.e., across the doxastically-accessible worlds) of Eli and of all his relevant alternatives. In such a context, we predict that sentence (17) would not support the strict reading—even if intuitively the intended reference of LOGP across the alternative is Eli (we thank Amir Anvari (p.c.) for raising a similar point to us). We think, however, that finding convincing cases of such contexts is not trivial. Since we weren't able to construct relevant contexts, we could not test the prediction.

pronouns that contain a semantic feature LOG in charge of encoding the (*de se*-) reference to the attitude holder (see Bimpeh et al. 2023), but whose contribution can be ignored at the level of focus alternatives.

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Adversative *only* is only *only*[1]

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Abstract. The focus particle *only* can be used as a sentential connective, conveying a contrast between its two propositional arguments. This paper provides the ingredients required to unite this *adversative* use of *only* with its exclusive use. We argue that adversative *only* is just exclusive *only* that associates with a full CP and therefore scopes above CP-level operators. We motivate a CP-level informativity operator that enforces a non-triviality condition on utterances and determines a CP's rhetorical function in discourse, and show that its interaction with CP-adjoining *only* can give rise to the adversative inference described in the literature.

Keywords: *only*, adversativity, focus, informativity, triviality.

1. Introduction

In his seminal work on Modern English Grammar, Jespersen (1949) noticed that the focus particle *only* can be used as a sentential connective indicating "a limitation of what has just been said," as illustrated in (1). In recent work, von Fintel and Iatridou (2019) expand the scope of investigation of this use of *only*, which they term *adversative only*. They observe that this pattern is very widespread crosslinguistically, presenting Greek and German counterparts to Jespersen's English examples (2)-(3).

(1) a. Bill is nice, only he talks too much. (Jespersen 1949)
b. The flowers are lovely, only they have no scent. (Brinton 1998)

(2) ine kalos anθropos, mono (pu) milai poli
is good person, but (C) talks much
'He's a nice person, only he talks too much.'

(3) er ist sehr nett, dass er zuviel redet
he is very nice, C he too-much talks
'He's a nice person, only he talks too much.' (von Fintel and Iatridou 2019)

In their discussion of these cases, von Fintel and Iatridou (2019) note that sentences that make use of this *only*-connective convey, intuitively, that the sentence succeeding *only contrasts* with some salient proposition which the sentence preceding it *supports* (a formal characterization of the notions of *support* and *contrast* is proposed later in the paper; for now, we use these notions intuitively as relations strictly weaker than *entail* and *contradict*, respectively). For instance, in Jespersen's original example in (1a), the sentence succeeding *only* expresses the proposition *that Bill talks too much*. This proposition contrasts with the salient proposition *that Bill is nice*, which is expressed (and thus trivially supported) by the sentence preceding *only*.

At first blush, the adversative use of *only* seems quite distant from its use as a focus particle expressing exclusivity, exemplified in (4). A standard analysis of exclusive *only*, provided in (5), argues that *only* is a focus-sensitive propositional operator that presupposes the truth of its

[1]Thanks to Amir Anvari, Kai von Fintel, Danny Fox, Yossi Grodzinsky, Patrick Grosz, Sabine Iaridou, Jad Wehbe, and participants of CreteLing 2022 and SuB27 for discussions and comments.

propositional argument (i.e., its *prejacent*) and asserts that no other proposition in a restricted, well-defined set of alternatives to its prejacent is true (Horn 1969; Rooth 1992).

(4) Only Bill came to the party.

(5) $[\![only]\!] = \lambda p.\lambda w : p(w) = 1.\ \forall p' \in \mathscr{ALT}(p)\ [p \not\subseteq p' \rightarrow p'(w) = 0]$

In principle, we can entertain two hypotheses that relate the meaning of exclusive *only* (4) to that of adversative *only* (1):

- ❖ **Hypothesis #1**: *only* is ambiguous between its exclusive and its adversative use.
- ❖ **Hypothesis #2**: The lexical contribution of *only* is identical in both its exclusive and its adversative use, and external factors are responsible for the differences in meaning.

Hypothesis #1 has recently been defended by Davis and Winterstein (2022), who argue that the meanings of adversative and exclusive *only*, while distinct, are nevertheless diachronically related. A notable weakness of this argument is that it cannot seem to explain the widespread crosslinguistic occurrence of this use of *only*. Another argument in favor of hypothesis 2, given in von Fintel and Iatridou (2019), is that adversative *only* shares a core meaning component with exclusive *only*: it also introduces an exclusivity inference (6). This inference sets adversative *only* apart from other adversative connectives like *but, yet* and *although*, that do not convey that the proposition expressed by their second conjunct is the *only* one that contrasts with their first conjunct, as exemplified by the contrast in (7).[2]

(6) Bill is nice, only he talks too much.
$\rightsquigarrow$ The only limitation/exception to Bill's niceness is that he talks too much.

(7) a. Bill is nice, only he talks too much... ??Furthermore, he gets impatient quickly.
b. Bill is nice, but he talks too much... Furthermore, he gets impatient quickly.

If we can provide a single lexical entry for *only*'s adversative and exclusive uses, von Fintel and Iatridou's observation would simply fall out as a consequence of this unification. The goal of this paper is thus to cash-out this intuition and develop the ingredients required for a unified account of adversative and exclusive *only*. In a nutshell, we suggest that adversative *only* is simply an occurrence of exclusive *only* (5) taking scope over a full CP, and consequently over CP-level operators that effectively restrict *only*'s alternatives. In particular, we claim that when *only* outscopes a CP, it scopes above an *informativity* operator which adjoins to CPs and determines the relation they bear to the question under discussion. It is the scopal interaction between (standard, run-of-the-mill exclusive) *only* and our informativity operator that gives rise to the adversativity component of the meaning of sentences like (1).

Note that if we are correct, then calling the instances of *only* in (1) *adversative only* is misleading, as it suggests that these are occurrences of a distinct type of *only*, that carries an adversative inference as part of its meaning. On our analysis, the source of the adversative inference is not *only* itself. In fact, a key feature of our analysis is that it correctly predicts the existence of another use of wide-scope *only*, which does not introduce an adversative inference. We therefore adopt the more neutral term *CP-level only* to refer to the use of the focus particle in (1). We

[2]Davis and Winterstein contest von Fintel and Iatridou's empirical claim that adversative uses of *only* introduce an exclusivity inference; see our response to their objection in footnote 5.

also, going forward, refer to garden-variety uses of *only* as in (4) as *regular only*, as the term *exclusive only* for these uses suggests that CP-level *only* is not exclusive, contra the main claim in this paper.

The paper is structured as follows: In section 2 we review further observations from von Fintel and Iatridou (2019) about the adversative inference of CP-level *only* that will be relevant to our analysis. Section 3 motivates the introduction of informativity operators. In section 4 we provide our analysis of sentences with CP-level *only*, illustrating how the adversative inference results from the interaction of *only* and an informativity operator. We discuss a prediction of our account, that we expect to find CP-level uses of *only* without an adversativity inference, in section 5. The analysis crucially makes use of the notions of *support* and *contrast*, which are treated as primitive notions until section 6, where they are afforded a formal definition within a probabilistic QUD model of discourse. Section 7 briefly addresses the status of *only*'s prejacent in sentences with CP-level *only*: in some, it seems to be at-issue, while in others it seems to be presupposed. Section 8 concludes and highlights issues left for future research.

2. The adversative inference of CP-level *only*

We paraphrased the adversativity inference of sentences with CP-level *only* as in (8), following von Fintel and Iatridou (2019). This is familiar from the literature on other adversative connectives (Anscombre and Ducrot 1977; Winter and Rimon 1994; Umbach 2005; Winterstein 2012; Toosarvandani 2014), and suggests that three propositions are involved in the meaning of an adversative sentence: the two propositions expressed in the sentence, $[\![\phi]\!]$ and $[\![\psi]\!]$, and some other salient proposition p.

(8) ‘ϕ, *only* ψ’ conveys that $[\![\psi]\!]$ *contrasts* with a salient proposition p that $[\![\phi]\!]$ *supports*.

The salient proposition p that also configures in the adversative inference is not necessarily distinct from *only*'s prejacent in sentences with CP-level *only*. In fact, in Jespersen's original example (9), $p = [\![\phi]\!]$, as the proposition that is supported by $[\![\phi]\!]$ (9a) and that contrasts with *only*'s prejacent $[\![\psi]\!]$ (9b) is the proposition that Bill is nice (9c). However, p can differ from $[\![\phi]\!]$. Consider (10) from von Fintel and Iatridou, for instance. When uttered in a discussion about whether we should buy some specific house, (10) conveys that the nice location of the house supports us buying it, while its physical state contrasts with us buying it. The salient proposition relative to which the two propositions in the sentence (10a)-(10b) are in opposition to each other, then, is the proposition that the house is worth buying (10c); i.e., $p \neq [\![\phi]\!]$.

(9) Bill is nice, only he talks too much.
  a. $[\![\phi]\!] = \lambda w.$ Bill is nice in w
  b. $[\![\psi]\!] = \lambda w.$ Bill talks too much in w
  c. $p = \lambda w.$ Bill is nice in w

(10) The house is in a good location, only it's very dilapidated.
  a. $[\![\phi]\!] = \lambda w.$ the house is in a good location in w
  b. $[\![\psi]\!] = \lambda w.$ the house is very dilapidated in w
  c. $p = \lambda w.$ the house is worth buying in w

Adding the adversative inference to the exclusive one, we can paraphrase the meaning of sentences with CP-level *only* as in (11). Our goal is to motivate the ingredients required to derive this inference from such sentences while keeping *only* unambiguously exclusive. To do so, we need to venture into a discussion of informativity next.

(11) 'ϕ, *only* ψ' conveys that $[\![\psi]\!]$ *contrasts* with a salient proposition p that $[\![\phi]\!]$ *supports*, and that no other relevant, true proposition contrasts with $[\![\psi]\!]$.

3. Informativity operators

In a QUD model of discourse, every utterance is made with respect to a *question under discussion* that partitions the set of worlds compatible with what discourse participants take for granted (Roberts 2012). A simplified model, i.e., an ordered pair $\langle c, \mathscr{Q} \rangle$, is formally defined in (12). In this framework, the *non-triviality condition* in (13) is imposed on any contribution to the discourse, requiring declarative utterances to express an *informative* proposition relative to $\mathscr{Q}$. An obvious question is what is required for a proposition to be informative relative to a partition $\mathscr{Q}$; a first pass at an answer is provided in (14).

(12) A QUD model of discourse is a pair $\langle c, \mathscr{Q} \rangle$, such that:
a. $c = \{w : w$ is compatible with the *common ground*$\}$ (Stalnaker 1978, 2002)
b. $\mathscr{Q}$ is a *partition* over c, i.e., a set of propositions $q_1, ..., q_n$ such that:
(i) $\mathscr{Q} = \{q_1\} \cup \{q_2\} \cup ... \cup \{q_n\}$
(ii) $c = q_1 \cup q_2 \cup ... \cup q_n$
(iii) $\forall i \leq n\ [q_i \neq \varnothing]$
(iv) $\forall i, j \leq n\ [i \neq j \rightarrow q_i \cap q_j = \varnothing]$

(13) **Non-triviality condition:** Every declarative utterance in discourse must denote an *informative* proposition relative to $\mathscr{Q}, c$.

(14) **Informativity (first pass):** A proposition p is *informative* relative to a context c and a partition $\mathscr{Q}$ only if $\exists q \in \mathscr{Q}$ s.t. $q \cap p = \varnothing$.

According to (14), an informative utterance relative to the QUD is one whose corresponding proposition rules out at least one answer to the QUD. Under this definition of informativity, the condition in (13) on admittance of utterances in discourse is correctly predicted to rule out the discourse in (15), given that the uttered sentence does not bear on the question asked (we assume that at least in this case, the question asked is the QUD).

(15) Q: Who won the race?
A: #It's getting colder this week.

But the definition in (14) has a problem: as pointed out by von Fintel and Heim (2011), it fails to account for the felicity of the discourses in (16)-(17). Our first pass at defining informativity predicts (16) to be infelicitous because the declarative utterance in this discourse does not directly bear on, and thus does not rule out any possible answer to its respective question. The eventuality of Adele grinning on her way to the locker room is logically compatible both with her having won and with her having lost the race; of course, her grin might be indicative of a victory, but perhaps she is just a graceful loser? Similarly in (17), Mira having entered without a rain jacket does not rule out the possibility that it is, in fact, raining.

(16) Q: Who won the race?
A: I saw Adele grinning on her way to the locker room.

(17) Q: What's the weather?
A: Mira came in without a rain jacket. (von Fintel and Heim 2011)

Intuitively, the reason these discourses are felicitous, despite involving utterances that do not express informative propositions given (14), is that the replies in each case *support* or *contrast* an answer to the question under discussion. The utterance in (16) supports the answer *Adele won the race*. The utterance in (17) *contrasts* with the answer *it's raining*. To accommodate the felicity of (16)-(17), we modify our definition of informativity as in (18), using the notions of *support* and *contrasts*. We do propose a formal definition of these notions in section 6, but for now we treat them as primitive relations with the axioms in (19), relying on the reader's intuitive ability to make sense of them.

(18) **Informativity (second pass):** A proposition p is *informative* relative to a context c and a partition $\mathscr{Q}$ iff there is a salient $A \in \mathscr{Q}$ s.t. p supports or contrasts with A.

(19) For any propositions p, q:
a. If $p \subseteq q$, then p supports q
b. If $p \cap q = \varnothing$, then p contrasts with q

For reasons that will imminently become clear, we suggest that the condition in (13) requiring declaratives to express informative propositions be enforced by a dedicated syntactic operator. The operator, which we call INFORM, adjoins to declarative CPs and returns undefinedness if they denote a non-informative proposition relative to $\mathscr{Q}$; i.e., a proposition that does not *support* or *contrast* with a salient answer to $\mathscr{Q}$. The lexical entry for this operator is provided in (20).

(20) $$[\![\textsc{Inform}]\!]^{A,\mathscr{Q},c,g} = \begin{cases} \lambda i \lambda p\text{: } p \textit{ supports } A.\ p & \text{if } i = 1 \\ \lambda i \lambda p\text{: } p \textit{ contrasts } A.\ p & \text{if } i = -1 \end{cases}$$

In addition to the familiar parameters, context c and assignment function g, the operator is interpreted relative to two other parameters to $A, \mathscr{Q}$, where A is a proposition that is a salient answer to $\mathscr{Q}$. It takes as arguments two elements: a free variable i, ranging over the set $\{1, -1\}$, and a proposition p. Given these ingredients, INFORM introduces a presupposition that its propositional argument p *supports* or *contrasts* with A, depending on the value of i.

Given our modified definition of informativity, to determine whether an utterance satisfies the non-triviality condition of the QUD framework (13), we must evaluate it relative to a salient answer to the QUD. The idea that utterances are evaluated relative to another salient proposition is not new; in fact, it is a central tenet of the framework of *argumentation within language* (Anscombre and Ducrot 1983; Winterstein 2012; Davis and Winterstein 2022). In that framework, interpretation of an utterance ϕ is made relative to an *argumentative goal*, such that accepting the content expressed by ϕ raises the credence in that argumentative goal.

We therefore borrow argumentation theoretic terminology here, and will henceforth refer to A, the propositional parameter of INFORM as the *argumentative goal* of p, the propositional argument of INFORM. We will also refer to i, the index argument of INFORM that determines whether p supports or contrasts with A, the *argumentative polarity* index of p, or p's *polarity* *index* in short.[3] With this new operator as part of our syntax, we can now turn to our analysis of sentences with CP-level *only*.

4. Analysis

4.1. The structure of adversative *only* sentences

We argue that sentences of the form 'ϕ, *only* ψ' involve implicit coordination of two CPs, one of which is outscoped by regular *only*. That it is a constituent as large as CP that is outscoped by *only* is evident when the complementizer slot of the sentence under *only* is overtly realized. While English does not generally allow overt realization of that complementizer, Hebrew and Greek do. When realized, the complementizer must linearly follow *only* (21)-(22). The same fact can be demonstrated in English as well, if we embed a declarative sentence with Aux-to-C movement under CP-level *only*. The sentence in (23) involves *negative inversion* – the auxiliary verb is fronted under a sentence-initial negative element, in an operation standardly assumed to be a manifestation of Aux-to-C movement (cf. Adger (2003)), and thus indicates a full CP below CP-level *only*.

(21) a. hu neχmad, ʁak ʃe- hu medabeʁ yoteʁ midai
he nice only COMP- he talk too much
'He's a nice person, only he talks too much.'

b. ha-bayit bemikum tov, ʁak ʃe- hu mamaʃ yaʃan
the-house in.location good, only COMP- he very old
'The house is in a good location, only it's very old.' (Hebrew)

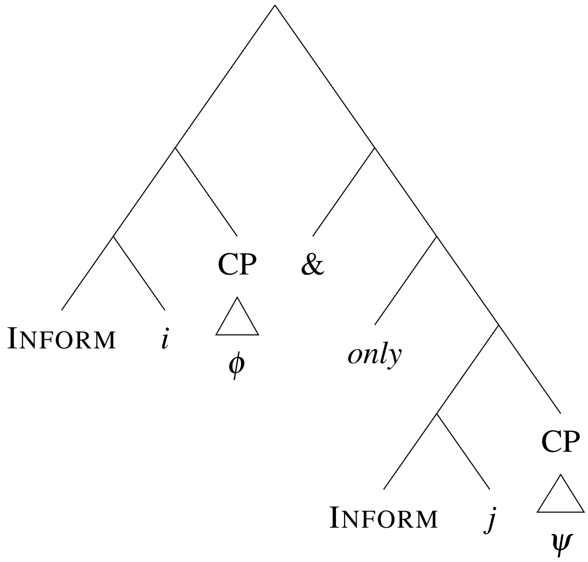
(22) ine kalos anthropos, mono pu milai poli
is good person only COMP talks much
'He's a nice person, only he talks too much.' (Greek)

(23) Bill is nice, only never does he visit his parents for more than a few minutes.

There is an important implication for *only* scoping above a full CP. In a system like ours, which syntacticizes the non-triviality condition in the form of a mandatory INFORM operator at the edge of declarative CPs – this entails that CP-level *only* outscopes INFORM, and sentences with CP-level *only* thus have the schematic coordination structure in (24).

[3]We thank Kai von Fintel for introducing us to the literature on argumentation theory and for suggesting the idea of argumentative polarity.

(24)



4.2. The interaction of *only* and INFORM

Let us take stock of what has been done so far. We postulated that the informativity requirement on declarative utterances is enforced by an operator, INFORM, that resides at the edge of CPs. This operator adds a presupposition that its propositional argument is informative with respect to its contextual parameters. We further hypothesized that being informative means to *support* or *contrast*, in the argumentative sense, with a salient answer to the QUD. Finally, we argued that in the cases of CP-level *only* discussed above, *only* takes scope above INFORM. In this section, we show that those assumptions are enough to account for the adversative inference of sentences with CP-level *only* without stipulating a lexical ambiguity.

To understand the interaction between *only* and the presupposition that INFORM adds to the semantics, we first have to understand the general projection pattern of presuppositions in the scope of *only*. Empirically, the proposition *only(p)* is judged as acceptable whenever p is true, and at least some $q \in \mathscr{A}\mathscr{L}\mathscr{T}(p)$ is defined (i.e. its presupposition is met by the conversational common ground). In that case, *only(p)* is judged as true if every $q \in \mathscr{A}\mathscr{L}\mathscr{T}(p)$ is either false or undefined. In other words, the presupposition of p both projects (since p is presupposed to be true), and restricts the range of alternatives *only* negates (since the alternatives that are asserted to be false are only the ones whose presupposition is satisfied). This is demonstrated in (25)-(26).

(25) a. Only [Adele]$_F$ ate an apple.
b. **Asserts:** $\forall x \in \mathscr{D}_{\mathrm{e}} : x \neq Adele \rightarrow \neg ate\_apple(x)$

(26) a. Only [Adele]$_F$ quit smoking.
b. **Asserts:** $\forall x \in \mathscr{D}_{\mathrm{e}} \cap \{y : y \text{ used to smoke}\} : x \neq Adele \rightarrow \neg quit\_smoking(x)$

In (25), all alternatives are of the form *x ate an apple*, therefore they do not presuppose anything, and the sentence asserts that all of them are false, as we would expect. In (26), on the other hand, the alternatives are of the form *x quit smoking*, and thus they each presuppose that *x used to smoke*. The way this presupposition integrates into the assertion is by restricting the alternatives in the scope of the universal quantifier, which in our case means restricting the set of individuals that can replace x.[4]

We can now calculate the prediction of our system for sentences like (1), or, in general, sentences of the form 'ϕ, *only* ψ'. Recall that we assigned these sentences the implicit coordination structure in (24). Importantly, to interpret this structure we need to assign values to the argumentative polarity indices i and j. We argue that any assignment in which $i = j$ will lead to a contradictory meaning, and is thus not a possible assignment. Let us assume for simplicity that $i = 1$ (the argument in the case of $i = -1$ is identical). We start by calculating the meaning of each conjunct in the structure in (24). As shown in (27), the first conjunct presupposes that $[\![\phi]\!]$ supports A, and asserts that $[\![\phi]\!]$ is true. The second conjunct presupposes both that $[\![\psi]\!]$ is true and that $[\![\psi]\!]$ supports A, and asserts that no other proposition in $\mathscr{ALT}([\![\psi]\!])$ that supports A is true (28). We assume that presuppositions project from both conjuncts, so the entire conjunction presupposes the presuppositions of both its conjuncts, and asserts both assertions as in (29).

(27) $[\![\textsc{Inform}(i)(\phi)]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\text{i}\to 1\\ \text{j}\to 1\end{smallmatrix}\right]}$
  a. **Presupposes:** $[\![\phi]\!]$ supports A
  b. **Asserts:** $[\![\phi]\!] = 1$

(28) $[\![\textit{only}[\textsc{Inform}(j)(\psi)]]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\text{i}\to 1\\ \text{j}\to 1\end{smallmatrix}\right]}$
  a. **Presupposes:** $[\![\psi]\!]$ supports $A \wedge [\![\psi]\!] = 1$
  b. **Asserts:** $\forall p$: $([\![\psi]\!] \not\subseteq p \wedge p \textit{ supports } A) \to p(w) = 0$

(29) $[\![(24)]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\text{i}\to 1\\ \text{j}\to 1\end{smallmatrix}\right]}(w)$
  a. **Presupposes:** $[\![\phi]\!]$ supports $A \wedge [\![\psi]\!]$ supports $A \wedge [\![\psi]\!] = 1$
  b. **Asserts:** $[\![\phi]\!] = 1 \wedge \forall p$: $([\![\psi]\!] \not\subseteq p \wedge p \textit{ supports } A) \to p(w) = 0$

Setting aside for now the division of labor between presupposition and assertion in these utterances, that we return to in section 7, the meaning of the entire construction in the case of $i = j = 1$ is given in (30). It conveys that both conjuncts are true in the evaluation world, that both of them support the argumentative goal A, and that no other salient proposition supports A besides the second conjunct. This of course can never be satisfied – given that the first conjunct supports A (and assuming it is not entailed by the second conjunct), it cannot be the case that only the second conjunct supports A.

(30) $$[\![(24)]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\text{i}\to 1\\ \text{j}\to 1\end{smallmatrix}\right]}(w) = 1 \text{ iff } \begin{cases} [\![\phi]\!](w) = [\![\psi]\!](w) = 1 \\ [\![\phi]\!] \textit{ supports } A \wedge [\![\psi]\!] \textit{ supports } A \\ \forall p\text{: } ([\![\psi]\!] \not\subseteq p \wedge p \textit{ supports } A) \to p(w) = 0 \end{cases}$$

We conclude that to derive a non-contradictory interpretation, the argumentative polarity assignment in sentences with the structure in (24) has to be such that $i \neq j$, namely the polarity

[4]We note that this pattern does not straightforwardly follow from certain theories of presupposition projection. It is strictly weaker than what *strong Kleene* logic (Kleene 1938) predicts, for example. We suggest that this pattern might be the result of local accommodation in the scope of *only*, which collapses the presupposition and the asserted component of the prejacent p. We leave the topic at that, since a serious discussion is beyond the scope of this paper.

index in each conjunct must be assigned a different value. The predicted meaning of such an assignment is given in (31)-(34) (again, assuming for simplicity that $i = 1$). It conveys that both conjuncts are true in the evaluation world, that the first conjunct supports A and the second contrasts with A, and that no other salient proposition contrasts with A beside the second conjunct. This captures both the adversative inference and the exclusivity that the use of *only* in this kind of constructions conveys.

(31) $[\![\textsc{Inform}(i)(\phi)]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\mathrm{i}\to 1\\ \mathrm{j}\to -1\end{smallmatrix}\right]}$
   a. **Presupposes:** $[\![\phi]\!]$ *supports* A
   b. **Asserts:** $[\![\phi]\!] = 1$

(32) $[\![\mathit{only}[\textsc{Inform}(j)(\psi)]]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\mathrm{i}\to 1\\ \mathrm{j}\to -1\end{smallmatrix}\right]}$
   a. **Presupposes:** $[\![\psi]\!]$ *contrasts* with $A \wedge [\![\psi]\!] = 1$
   b. **Asserts:** $\forall p$: $([\![\psi]\!] \not\subseteq p \wedge p$ *contrasts* with $A) \to p(w) = 0$

(33) $[\![(24)]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\mathrm{i}\to 1\\ \mathrm{j}\to -1\end{smallmatrix}\right]}(w)$
   a. **Presupposes:** $[\![\phi]\!]$ *supports* $A \wedge [\![\psi]\!]$ *contrasts* with $A \wedge [\![\psi]\!] = 1$
   b. **Asserts:** $[\![\phi]\!] = 1 \wedge \forall p$: $([\![\psi]\!] \not\subseteq p \wedge p$ *contrasts* with $A) \to p(w) = 0$

(34) $$[\![(24)]\!]^{A,\mathscr{Q},c\left[\begin{smallmatrix}\mathrm{i}\to 1\\ \mathrm{j}\to -1\end{smallmatrix}\right]}(w) = 1 \text{ iff } \begin{cases} [\![\phi]\!](w) = [\![\psi]\!](w) = 1 \\ [\![\phi]\!] \textit{ supports } A \wedge [\![\psi]\!] \textit{ contrasts } A \\ \forall p\text{: } ([\![\psi]\!] \not\subseteq p \wedge p \textit{ contrasts } A) \to p(w) = 0 \end{cases}$$

To demonstrate this, let us turn back to the example in (10), repeated in (35) below. We assume that the argumentative goal A here is *that the house is worth buying.* Our analysis predicts that (35) will be judged true iff it is true (i) that the house is in a good location, and that it is very dilapidated; (ii) that the house is in a good location supports A, and that it is very dilapidated contrasts with A; (iii) that the house is very dilapidated is the only salient proposition that contrasts with A.[5] This seems to be the meaning we intuitively attribute to this sentence. Given

[5]As mentioned in footnote 2, Davis and Winterstein (2022) reject a unified analysis of CP-level *only* and regular *only*, because (among other things) they contest von Fintel and Iatridou's empirical claim that CP-level *only* encodes the exclusivity inference paraphrased above, providing the example in (i) to illustrate their point.

(i) a. Regular *only*: Ali's research output is very narrow; she only writes about Sartre…#not to mention de Beauvoir.
  b. CP-level *only*: Ali is a typical analytic philosopher, only she has a soft spot for Sartre… not to mention de Beauvoir.

Their reasoning is as follows: In (ia), regular *only* takes *Sartre* as its focus associate, presupposes its prejacent (namely, *that Ali writes about Sartre*), and asserts that all propositions derived by replacing *Sartre* with a relevant alternative to are false. Given that *de Beauvoir* is a relevant alternative, the *only*-statement is incompatible with the addition in the *not to mention* phrase, hence its infelicity. Had CP-level *only* introduced a similar exhaustive inference, the *not to mention* addendum in (ib) should have also been infelicitous, contrary to fact.

We agree with the judgement reported in (i), but contest Davis and Winterstein's theoretical conclusion. On our analysis, the sole difference between CP-level and regular *only* is that the former takes scope above a CP, whereas the latter takes a lower scope position, presumably within or at the edge of an IP. The observation in (i) is fully compatible with our analysis, as long as it is assumed that *not to mention* phrases scope below the position of CP-level *only* (i.e., below CP), but above the next highest scope position available for *only* (again, presumably within or right above IP). In that case, the utterances in (i) have the structures in (ii). When *only* is IP-internal (iia), a *not to mention* addendum asserting the truth of one of the alternatives to *only*'s prejacent contradicts the that a different polarity assignment would yield a deviant meaning, we correctly predict that this is the only reading the sentence in (35) can have.

(35) The house is in a good location, only it's very dilapidated.

5. Prediction: *not only*

In our analysis, the adversative meaning of CP-level *only* in constructions like (24) stems from the fact that the two CPs must be assigned different argumentative polarity to avoid contradiction. Crucially, there is nothing inherent in the meaning of *only* that forces this to be the case. We thus predict that whenever *only* can take a CP argument in a coordination structure in which assigning the same argumentative polarity to both conjuncts does not lead to contradiction, we should get a non-adversative readings. As far as we know, the only other construction in which CP-level *only* appears is in sentences of the form '*not only* ϕ*, (also)* ψ', as in (36) below.

(36) a. Not only does he talk too much, he's (also) very hostile.
b. Not only are the flowers lovely, they're (also) good for your health.
c. Not only is the house in a nice location, it's (also) fairly priced.

Let us first show that these examples indeed involve a CP-level *only*. While these examples in English again do not manifest an overt complementizer, they do involve *negative inversion*, i.e., a manifestation of Aux-to-C movement occurring below *only*. That is of course only possible if a full CP is embedded below *only*. Further evidence that *only* in such constructions outscopes a CP comes, again, from languages like Hebrew and Greek (37)-(38), where *only* appears above an overtly realized complementizer.

(37)

lo	ʁak	$\boxed{\text{ʃe-}}$	ha-bait	be-mikum	tov,	(gam)	hameχiʁ	ʃelo	hogen
NEG	only	COMP-	the.house	in.location	good	also	the.price	of.it	fair

'Not only is the house in a good location, it's also fairly priced.'

(38)

den	ine	mono	$\boxed{\text{oti}}$	to	spiti	ine	se	orea	jitonia,	exi	epsis	ke	lojiki	timi
NEG	is	only	COMP	the	house	is	in	beautiful	neighborhood,	has	also	and	logical	price

'Not only is the house in a good neighborhood, it's also reasonably priced.'

negation of alternatives induced by *only*. However, when *only* outscopes a CP (iib), a *not to mention* phrase in its scope simply constitutes a part of its prejacent.

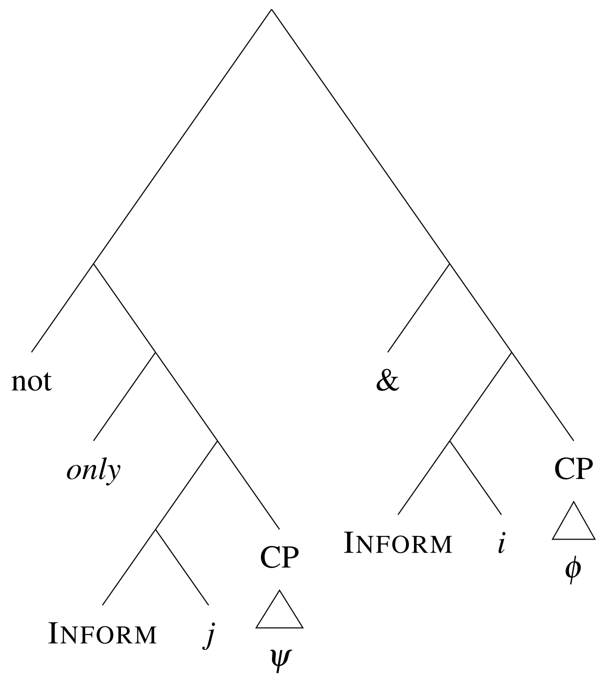
(ii) a. (ia) $\rightsquigarrow$ [[$_{\text{IP}}$ Ali [*only* [$_{v\text{P}}$ writes about [*Sartre*]$_{\text{F}}$]]] [$_{\text{XP}}$ not to mention...]]
b. (ib) $\rightsquigarrow$ [*only* [$_{\text{CP}}$ [$_{\text{IP}}$ Ali has a soft spot for Sartre] [$_{\text{XP}}$ not to mention...]]]

If we reproduce Davis and Winterstein's examples with an addendum that cannot be construed as part of the prejacent of *only*, CP-level *only* seems to behave like an IP-internal regular *only*. This can be achieved by introducing the information in the *not to mention* phrases in (i) with an utterance headed by *furthermore*, which introduces a new sentence. On our analysis of CP-level *only* (iiia) and (iiib) are infelicitous for the same reason, as in both the *furthermore* clause asserts an alternative to *only*'s prejacent right after that alternative was asserted to be false.

(iii) a. Regular *only*: *Ali's research output is very narrow; she only writes about Sartre... #Furthermore, she sometimes writes about de Beauvoir.*
b. CP-level *only*: *Ali is a typical analytic philosopher, only she has a soft spot for Sartre... #Furthermore, she sometimes writes about de Beauvoir.*

We can therefore assign the examples in (36) a structure that is almost identical to that of the original examples (24), the only differences being the order of conjuncts and, importantly, the negation that takes scope above CP-level *only* (39).

(39)



Despite the similar structure, however, their meaning, and specifically the contribution of *only*, are very different in the two constructions – in (36), the adversative inference that *only* introduces in the positive case (1) seems to disappear.

We argue that this difference stems from the fact that a uniform assignment of argumentative polarity to the two conjuncts does not lead to a contradiction in the *not only* cases. To see how this works, consider the result of assigning a uniform polarity, namely the case of $i = j$ in (39). Again, we assume for simplicity that $i = j = 1$. We have already derived the meaning of the constituent $[\![only[\textsc{Inform}(j)(\psi)]]\!]^{A,\mathscr{Q},c,\begin{bmatrix}\text{i}\to 1\\ \text{j}\to 1\end{bmatrix}}$ in (28). To derive the meaning of the first conjunct in (39), we then have to apply negation to that meaning, keeping in mind that presuppositions project from the scope of negation. The result is given in (40). We thus predict (39) to convey the meaning in (41), namely, (i) that both conjuncts are true in the evaluation world; (ii) that both support the argumentative goal A; and (iii) that the first conjunct is *not* the only salient proposition that supports A. This seems to on par with our intuition about these sentences. The example in (36c), for instance, intuitively conveys (assuming again an argumentative goal along the lines of *we should buy the house*), that the good location of the house supports the argumentative goal, and that there is another proposition that supports that goal, i.e., that the house is fairly priced.

(40) $[\![\textsc{Neg}[only[\textsc{Inform}(j)(\psi)]]]\!]^{A,\mathscr{Q},c,\begin{bmatrix}\text{i}\to 1\\ \text{j}\to 1\end{bmatrix}}$

a. **Presupposes:** $[\![\psi]\!]$ *supports* $A \wedge [\![\psi]\!] = 1$

b. **Asserts:** $\neg\forall p$: $([\![\psi]\!] \not\subseteq p \wedge p$ *supports* $A) \rightarrow p(w) = 0$

$(\equiv \exists p : [\![\psi]\!] \not\subseteq p \wedge p$ *supports* $A \wedge p(w) = 1)$

(41) $$[\![(39)]\!]^{A,\mathscr{Q},c,\left[\begin{smallmatrix}\mathrm{i}\to 1\\ \mathrm{j}\to 1\end{smallmatrix}\right]}(w)=1 \text{ iff } \begin{cases}[\![\phi]\!](w)=[\![\psi]\!](w)=1\\ [\![\phi]\!] \textit{ supports } A \wedge [\![\psi]\!] \textit{ supports } A\\ \exists p : [\![\psi]\!] \not\subseteq p \wedge p \textit{ supports } A \wedge p(w)=1\end{cases}$$

We have thus shown that CP-level *only* does not necessarily come in the adversative flavor. Furthermore, there is evidence that the availability of the adversative reading is linked to the logical consistency of a non-uniform argumentative polarity assignment. This is predicted by our analysis of CP-level *only*. Note that in the *not only* cases, the adversative reading is not only avoidable, but it seems to be entirely unavailable. This of itself is not necessarily problematic for our account, given that many factors control the availability of certain variable assignments, and it might be the case that some independent pragmatic consideration blocks the non-uniform polarity assignment in these cases.

However, it is interesting to think what this consideration might be. One possibility is that shifts in argumentative polarity are generally dispreferred. While shifting the polarity between two conjuncts (or generally in consecutive sentences) is possible, it demands either a specialized item that forces this change (*but, however,* etc.), or a last resort move to avoid a pathological meaning, in the spirit of *the default principle of co-orientation*, discussed in (*a.o.*) Blakemore and Carston (2005); Davis and Winterstein (2022). This is demonstrated in (42).[6] Given that the *not only* cases do not fall into either of those categories, that may explain the unavailability of an adversative inference.

(42) Q: Should we buy this house?
A: #It's in a nice location, and it's very dilapidated.

6. Formalizing *support* and *contrast*

We rejected the definition of informativity in (14), repeated in (44), as too restrictive to be the one assumed in a non-triviality condition on declarative utterances (43). Instead, we opted for a weaker definition that makes use of the notions of *support* and *contrast* (45).

(43) **Non-triviality condition:** Every (declarative) utterance in discourse must denote an *informative* proposition relative to $\mathscr{Q}$.

(44) **Informativity (first pass):** A proposition p is *informative* relative to a context c and a partition $\mathscr{Q}$ iff $\exists q \in \mathscr{Q}$ s.t. $q \cap p = \varnothing$.

(45) **Informativity (second pass):** A proposition p is *informative* relative to a context c and a partition $\mathscr{Q}$ iff there is a salient $A \in \mathscr{Q}$ s.t. p supports or contrasts with A.

So far, however, we have been treating these notions as primitives, relying on the reader's intuitive ability to understand them.

To make things more concrete, one may adopt any of the proposals in the literature for formalizing these notions (cf. Winterstein, 2012; Spenader and Maier, 2009; *a.o.*). The debate over the correct formalization is in a large part independent from our discussion so far – we only crucially assume the axioms in (19); i.e., that *support* is weaker than entail, and *contrast* is

[6] The badness of this example may be also explained by *Maximize Presupposition!* and it is difficult to tease the two explanations apart.

weaker than contradict. Solely for concreteness, however, we present in this section a way of formalizing these notions in a *probabilistic* QUD model of discourse, with which our analysis can be made compatible.

Winterstein (2012) suggests that the adversative connective *but* requires there to be some argumentative goal, such that its first conjunct is an argument *for* that goal, while its second is an argument *against* it. The notions of being an argument for or against an argumentative goal are construed by Winterstein probabilistically, following Merin (1999). Simply put, p is an argument *for* a goal A if it raises the probability of A in our epistemic model, and it is an argument *against* A if it lowers its probability in the epistemic model.

Let us adopt a proposal in this spirit for the notions of *support* and *contrast* that we make use of in our definition of informativity (45). To do so, we define a *probabilistic* QUD model of discourse (PQUD). A PQUD model is a tuple $\langle c, \mathscr{Q}, P\rangle$. As in (12), c is a context set and $\mathscr{Q}$ a partition of c. To these we add a probability distribution P, defined in (46), which we think of as assigning to each cell in $\mathscr{Q}$, the likelihood that the actual world is in that cell, given the evidence in the context set c.

(46) In a given PQUD model $\langle c, \mathscr{Q}, P\rangle$, $P : D_{s,t} \to [0,1]$ is a function that assigns probabilities to cells in the partition induced by $\mathscr{Q}$ s.t.

$$P(c) = \sum_{q \in \mathscr{Q}} P(q) = 1$$

i.e., P is a proper distribution over c.

We can now define the notions of *support* and *contrast* in terms of the conditional probability of an argumentative goal given a proposition (cf. van Rooij and Schulz (2019)) and thus revise our definition of informativity and of the INFORM operator as in (47)-(48).

(47) **Informativity (final):** p is *informative* relative to $\langle c, \mathscr{Q}, P\rangle$ iff there is a salient answer $A \in \mathscr{Q}$, s.t. $\underbrace{P(A|p \cap c) > P(A|c)}_{p\ supports\ A}$ or $\underbrace{P(A|p \cap c) < P(A|c)}_{p\ contrasts\ A}$

(48) $[\![\text{INFORM}]\!]^{A,\mathscr{Q},c,g} = \lambda i \lambda p \lambda w : i{\cdot}P(A|p \cap c) > i{\cdot}P(A|c).\ p(w) = 1$

The formalization states that a proposition is informative given a common ground if admitting the proposition into the common ground changes the prior probability of the relevant argumentative goal given just the common ground. The polarity index of INFORM determines the direction in which the probability of the argumentative goal is required to change: $[\![\text{INFORM}]\!]^{A,\mathscr{Q},c,g}(1)(p)$ indicates that p (augments the probability of, and thus) *supports* A, and $[\![\text{INFORM}]\!]^{A,\mathscr{Q},c,g}(-1)(p)$ indicates that p (decreases the probability of, and thus) *contrasts* with A. As mentioned above, nothing in our analysis of CP-level *only* hinges on this conceptualization of argumentative relations, which is proposed here as a more concrete way of thinking about them.

7. On the status of *only*'s prejacent

This paper pursues an analysis of CP-level *only* that does not posit an ambiguity with regular *only*. The primary motivation for such an analysis to begin with is the observation in von

Fintel and Iatridou 2019 according to which the use of CP-level *only* introduces an exclusivity inference that is similar to that introduced by regular *only*.

However, von Fintel and Iatridou (2019) also voice an intuition according to which the prejacent of CP-level *only* seems to express at-issue content, while that of regular *only* is presupposed. If correct, then, at least prima facie, this intuition poses a challenge to our attempt at unifying the semantics of CP-level and regular *only*. In fact, the at-issue status of CP-level *only*'s prejacent is cited by Davis and Winterstein (2022) as a consideration against unification; on their analysis, CP-level *only* denotes an operator that encodes an adversativity presupposition, but crucially lacks the exclusivity inference that the operator denoted by exclusive *only* encodes.

Note that determining whether the prejacent of CP-level *only* is at-issue or not is no trivial matter, since sentences with CP-level *only* cannot be embedded in most environments. Specifically, they seem unacceptable when embedded in environments that are traditionally used to test presupposition projection, like the scope of a downward-entailing predicate or the antecedent of a conditional (49).[7]

(49) a. #I don't think that he's a nice man, only he talks too much.
b. #If the house is in a good location only it's very dilapidated, we shouldn't buy it.

One standard diagnostic for presuppositionality that does not use embedding is von Fintel's (2004) *hey, wait a minute!* test. Applying it to our cases here seems to yield a result which is on par with the intuition expressed by von Fintel and Iatridou (2019): the infelicity of B's response in the example in (50) indicates that the proposition *that he talks too much* is not presupposed.

(50) A: He's a nice man, only he talks too much.
B: # Hey, wait a minute! I didn't know he talked too much!

While this indeed posits a challenge to theories that attempt to unify the different occurrences of *only*, it is part of a more general phenomenon; the status of *only*'s prejacent has long been subject to debate precisely because, as pointed out by a number of authors, that prejacent failes to exhibit the hallmarks of presuppositions in certain environments (see, e.g., discussion in Roberts 2006; Ippolito 2007; Crnič 2022 and references therein). The empirical picture regarding the status of *only*'s prejacent is complex as it is, and thus the pattern exhibited by CP-level *only* does not seem to us to be a devastating argument against a unified analysis, as much as it is an addition to an already complicated empirical landscape.

Note, also, that while the prejacent of CP-level *only* seems at-issue in positive CP-level *only* sentences (1), the intuition with respect to our *not only* cases (36) is an opposite one: for these utterances to be felicitous, the prejacent of CP-level *only* should be taken for granted. This again can be shown by using the *hey, wait a minute!* test: B's response in (51) is felicitous, indicating that *only*'s prejacent is indeed presupposed in this case. This fact renders the presupposition projection patterns of CP-level *only* even more intriguing – the division of labor

[7] This is a curious fact in and of itself, which might be explained on our account by the lack of local informativity constraints on non-matrix CPs. If *only* does not have in its scope any INFORM operator that restricts the set of alternatives it negates, the meaning will inevitably be contradictory, for the same reason that it is contradictory with uniform argumentative polarity. Sentences of the form 'ϕ, *only* ψ' are predicted to assert both that $[\![\psi]\!]$ is true, and that $[\![\psi]\!]$ is the only true proposition.

between presupposition and assertion in the so-called *adversative only* cases seems to differ from both basic occurrences of regular *only* (e.g., (4)) and CP-level *only* that is embedded under negation.

(51) A: Not only does he talk too much, he's also very hostile.
B: Hey, wait a minute! I didn't know he talked too much!

Rejecting the unification hypothesis in favor of an ambiguity analysis on the basis of the status of the prejacent, then, should lead one to conclude that *only* is actually three-way ambiguous. This three-way ambiguity seems unavoidable given the reported intuitions, as one cannot unify regular *only* with the CP-level *only* in our *not only* sentences without assuming some notion of argumentative polarity playing a role in restricting the set of alternatives that *only* operates on. Had *only*'s scope in the *not only* cases been unrestricted by our informativity operator, we would predict that any two true propositions could be conjoined in this construction (#*Not only is he a nice man, he (also) talks too much*); for any two utterances ϕ, ψ, if the truth of ϕ is taken for granted, asserting the truth of ψ makes *not only* ϕ true. On the other hand, if the adversative inference of the 'ϕ*, only* ψ' cases is lexicalized into the meaning of *only*, this also cannot be the *only* used to account for our *not only* cases, where no adversativity inference is observed.

Granted, the at-issue status of *only*'s prejacent in ϕ*, only* ψ, and its seeming non-at-issueness in *not only* ϕ*, (also)* ψ, present us with a curious pattern for which we cannot offer an explanation at this point. But this unexpected division of labor between presupposition and assertion (i) could constitute an argument from Occam's razor against a non-unified account, which requires a proliferation of different *only*s to account for it; and (ii) can be viewed as instantiating a more general problem in the semantics of *only*, rather than an issue restricted to CP-level *only*.

8. Conclusion

This paper is concerned with sentences of the form 'ϕ*, only* ψ', in which *only* surfaces linearly where a sentential connective would usually appear. We show that these are instances in which syntactically, *only* takes scope above a CP constituent, and argue that semantically it is still just the familiar, run-of-the-mill exclusive focus particle. Our approach, which unifies this use of *only* with its regular use as an exclusive, contrasts with a lexical ambiguity approach that posits two *only*s in the lexicon (e.g., Davis and Winterstein 2022).

What seems to set CP-level *only* apart from regular *only* is that it introduces an adversativity inference, indicating that its prejacent contrasts *indirectly* with the utterance preceding it (via some other salient proposition relative to which the argumentative orientation of the contrasting propositions diverges). Rather than encode this inference in a new lexical entry for *only*, we derive it from an interaction between CP-level *only* and an informativity operator, which we argue resides at the edge of CP and determines its argumentative orientation.

Three empirical observations lend support to our unified analysis of *only*. Two were already observed by von Fintel and Iatridou (2019): First, CP-level *only* is not a quirk of a particular language but is quite widespread. Second, this use of *only* seems to carry an exclusivity inference similar to that of the familiar IP-internal *only*. Finally, we further observe here other uses of *only* in conjunctive sentences that can also be shown to reside, syntactically, above CPs, but that lack adversative inferences. These are uses in examples of the form '*not only* ψ*, (also)* ϕ'.

Given that our unification account does not encode adversativity into the semantics of CP-level *only* to begin with, it is well-equipped to account for the absence of it in such examples.

One problem that remains unaddressed by our account relates to the division of labor between presupposition and assertion in the meaning of CP-level *only* sentences. While we predict that the asserted content of the proposition adjacent to *only* should be presupposed by the entire conjunction, the facts are more complicated: in the *not only* cases, it is indeed presupposed, while in the non-negated cases it is part of the at-issue content. We acknowledge this discrepancy as an issue left for future research.

Finally, we note that the range of phenomena investigated by von Fintel and Iatridou (2019) in relation to adversative *only* is broader than the scope of this paper. We point at two of their main observations, which seem like natural paths for extending the analysis presented here in future research. First, von Fintel and Iatridou observe that a similar pattern occurs with the particle *except*, as demonstrated in (52), which conveys, like the non-negated CP-level *only* cases, an adversative relation between the two clauses. Given that *except* is not an exclusive, it is not obvious to us at this point whether and how the ingredients proposed in this paper can be used to account for such cases.

(52) He's a nice man, except (that) he talks too much.

Second, von Fintel and Iatridou (2019) point out that CP-level *only* can precede not only declarative sentences, but speech acts like questions and imperatives (53a)-(53b). Curiously, these cases still convey, intuitively, an adversative relation between the two clauses adjacent to *only*, while maintaining the inquisitive/imperative force of the second one.

(53) a. Fine, I'll go to Oleana with you, only where is it?
b. It's raining, only don't use that as an excuse to skip class!

Accounting for this class of phenomena is using the tools developed here is, too, left for future work.

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About ‘Us’: Clusivity $\sqcup$ exh[1]

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Abstract. This paper argues that two generalizations about person pronouns and agreement point towards a semantic account where both exhaustification and cumulative coordination can apply word-internally. Both generalizations involve reference to pluralities that include both the author and the addressee for which many languages use an inclusive first person morph distinct from exclusive first person and second person. The first generalization (originally due to Zwicky 1977, *CLS Proceedings*) holds that in terms of person categories, in languages that lack an inclusive/exclusive contrast the inclusive neutralizes with the first person and never the second person, despite overlapping meaning with both. The second generalization, which we argue is exemplified by Mandarin and Daur, is that in languages which mark clusivity only in some subsystems, but not others, then not only will the inclusive meaning be expressed as a first (not second) person, but where there are common forms between the (sub)systems, then it will be the exclusive, not the inclusive that expresses the general first person in environments that lack a clusivity contrast. Our account assumes only the two person features AUTHOR and PARTICIPANT, but uses exhaustivization instead of feature negation or Maximize Presupposition and assumes that feature conjunction can be cumulative coordination. By analyzing the first person inclusive as AUTHOR cumulatively conjoined with exhaustivized PARTICIPANT, we derive the two generalizations noted.

Keywords: Person, clusivity, exhaustification, cumulativity, pronouns, agreement, typology

1. Introduction

It is well known that roughly a third of the world’s languages make a distinction in clusivity in person marking (pronouns and/or agreement). The semantic category expressed by English *we* in such languages is divided into two: an *inclusive* first person, which includes the author and the addressee of the speech act (and possibly others), and an *exclusive* first person, which includes the author and others, but does not include the addressee. The plural pronouns of Evenki (ISO 639-3: evn, Tungusic, Nedjalkov 1997: 200-201) presented in (1) illustrate this. Next to Evenki, a language like English may be said to have a ‘general *we*’ category: a group that includes the AUTHOR but is neutral as to whether the ADDRESSEE is or is not included.

[1]The authors are joint first authors–names are listed alphabetically. For feedback, we would like to thank Nina Haslinger, Mora Maldonado, Viola Schmitt, audiences at Sinn und Bedeutung 27 at Charles University Prague and at Humboldt University, our class participants at Harvard University, and anonymous reviewers at various stages of this project. This project has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (grant agreement No. 856421).

(1)

Referents	a. Clusivity Evenki	b. General *we* English	c. *syou *n/a*
AUTH (not ADDR)	bu	we	*swe
AUTH and ADDR	mit	we	*syou
ADDR (not AUTH)	su	you	*syou
neither	nungartyn	they	they

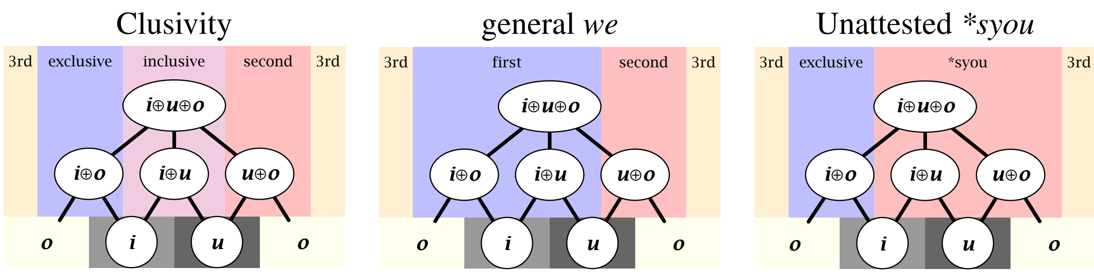
The final column (1c) represents a robust typological generalization from Zwicky (1977):

(2) Languages without an inclusive/exclusive contrast treat inclusive meaning as 1st person not 2nd person.

Even though the inclusive group contains, by definition, both the AUTHOR and ADDRESSEE, when there is no dedicated inclusive category, the inclusive meaning always neutralizes with the AUTHOR-group and not with the ADDRESSEE-group.[2] Put differently, in a language with no clusivity contrast, the first person (non-singular) may or may not include the ADDRESSEE, but the second person never includes the AUTHOR.

The same point can be represented schematically as in (3)—the space of possible person meanings is universal (here represented as a lattice over the atoms i = AUTHOR, u = ADDRESSEE, o = OTHER), but the linguistic categorization of these meanings (represented by colours) varies:

(3)



Alongside this cross-linguistic generalization are patterns in individual languages in which clusivity contrasts occur only in some grammatical subsystems. Mandarin provides a particularly clear example. In Mandarin, there are three plural pronouns which are derived from the corresponding singulars with the suffix *-men*. In some varieties, there is a fourth pronoun, the inclusive *zánmen* (Ross and Ma 2006: 25).

[2] Various qualifications could be made at this point. Zwicky (1977); McGinnis (2005); Harbour (2016) stress that the generalization in (2) holds over the system of contrastive person **categories** in a language as a whole, not over every individual **paradigm**. The Algonquian prefixes are the most well-known example of morphological paradigms with a *syou*-like element, but the suffixes show the general *we* pattern. That is, the languages as a whole draw the four-way distinction with clusivity, but not every paradigm marks all the contrasts. By contrast, some two-thirds of the world's languages have, like English, no morphological clusivity contrast in any paradigm, and have absolute neutralization of the inclusive and exclusive categories. Putative examples of absolute neutralization of inclusive and addressee (as in (1c)) are extremely rare, though not totally unattested; see McGinnis (2005); Harbour (2016) for discussion.

(4) "Optional" clusivity (Mandarin PL pronouns)

	SUBJ only	elsewhere
AUTH (not ADDR)	wǒmen	wǒmen
AUTH and ADDR	(% *zánmen*)	wǒmen
ADDR (not AUTH)	nǐmen	nǐmen
NEITHER	tāmen	tāmen

As Ross and Ma describe it, *zánmen* receives only an inclusive interpretation, and moreover is used only as a subject, never as an object, even though Mandarin has no case marking or other formal distinction between subject and non-subject. When standing in contrast to *zánmen*, *wǒmen* has an exclusive interpretation. But otherwise, *wǒmen* is ambiguous or vague between an inclusive and exclusive sense, exactly like English general *we*. Both typological patterns are thus evidenced in the same language.

Examples similar to Mandarin may also be drawn from languages with clusivity distinctions in one subsystem (e.g., pronouns) but not in another (e.g., agreement). Siewierska and Bakker (2005: 162) provide examples from Daur (ISO 693-3: dta, Mongolic) free pronouns and non-past subject person suffixes to illustrate. We give the plural forms only here. As in Mandarin, there is a morph (*ba:*) which has only an exclusive sense when in paradigmatic contrast with an inclusive morph, but where the inclusive morph is unavailable, *ba:* is a general first person plural.

(5) Mixed clusivity (Daur)

	Pronouns	Agreement
AUTH (not ADDR)	ba:	-bəi-ba:
AUTH and ADDR	bed	-bəi-ba:
ADDR (not AUTH)	ta:	-bəi-ta:
NEITHER	a:n	-bəi-sul

The Mandarin and Daur paradigms seem to neatly illustrate competition effects, of a type with a long tradition in the literature going back at least to de Saussure (1959: Part 2, Ch IV): one could say that the lexical meaning of *wǒmen* is the general first person, consistent across all of its uses, but where a stronger alternative (the inclusive) is available, the meaning of *wǒmen* excludes this stronger alternative.

In this paper, we develop an account of both the typological generalization in (1) and the language-internal mixed patterns like Mandarin and Daur, which gives a central role to this competition. Any account should explain, as ours does, why the general *we* corresponds to the exclusive in mixed patterns, as well as explaining Zwicky's original generalization that inclusive meaning neutralizes with first, rather than second, person. We take it as a further desideratum that the account should derive the relative strength of alternatives intrinsically, from the definition of the features, and without appeal to an external, arguably ad hoc, hierarchy, as Zwicky posited (see below). We provide some brief remarks on the differences between our theory and existing alternatives highlighting the advantages of our theory from this perspective. Although we draw in part on existing accounts, our proposal has two key ingredients which set it apart from these: First, we argue that the right tool for modeling competition effects is via an exhaustivity operator, **exh** (Chierchia et al. 2012), rather than, for example, Maximize Presupposition (Sauerland 2002; Heim 2008). Second, we argue that word internal features must be composed via cumulative, rather than via Boolean conjunction, as Link (1983) proposes for overt conjunctions such as English *and* (see Schmitt 2020 for a recent overview). The success of our proposal thus constitutes an argument that these devices—exhaustification and cumulative conjunction—both established in sentence grammar, apply also to the word-internal composition of features.

2. Towards an account

We sketch briefly the key ingredients of two families of approaches to person features, and then present our account, which is in some ways a hybrid of the two. In focusing on the key ingredients, we will omit much discussion of detail, returning to some of those points below. For the sake of concreteness, we assume that person markers (pronouns or bound markers) are indices and that person features contribute presuppositions on the value assigned to an index (see also Cooper 1979; Sauerland 2003).[3] We assume moreover that the basic meaning of person features is not inherently presuppositional as in prior work, but that an operation ∂ can 'presuppositionalize' properties, i.e. ∂P indicates that property P is presupposed. We adopt an approach to presuppositions as domain restrictions. In the notation of Heim and Kratzer (1998), the presuppositionalizer morpheme ∂ would then be defined as follows – it maps P to a property that is only defined if P is satisfied, but is true whenever defined:

(6) $[[\partial]]^c(P) = \lambda x \,:\, P(x)\,.\,1$

The presuppositional semantics of ϕ-features (Heim 2008; Sauerland 2009) can then be captured by the following structure of a pronoun:

(7)


In this structure, ϕ-FEATURES includes the person features (potentially also number, gender, etc.) interpreted as individual predicates and x is the referential index of the pronoun (or agreement marker). Furthermore, it is assumed that when there are multiple person features of ∂, these are intersected by a Boolean operation, specifically predicate intersection—an assumption we come back to in the following. Finally, we note that a central role will be played in our account, as in all competing accounts, by a competition principle. In our proposal, we will argue that this should be implemented via exhaustification of alternatives in the course of the derivation, but we will for the time being just talk of a generalized 'competition principle', for which the reader may think of Maximize Presupposition or other similar principle.

[3] Most of the morphological and typological literature is not explicit about the formal semantics of the features, in particular regarding whether person features should be characterized as presuppositions. We make an explicit assumption here for the purpose of commensurability among approaches.

2.1. Inclusive-Exclusive

Classic accounts of person categories (Silverstein 1976; Zwicky 1977) and those building on these (McGinnis 2005; Bobaljik 2008; Pertsova 2022) invoke at a minimum the features AUTHOR and ADDRESSEE, defined here, where, for example, a pronoun with the feature AUTHOR refers to a group that includes the author of the speech act:[4]

(8) a. $[[\text{AUTHOR}]]^c = \lambda x \,.\, \text{author}(c) \sqsubseteq x$
b. $[[\text{ADDRESSEE}]]^c = \lambda x \,.\, \text{addressee}(c) \sqsubseteq x$

Using only these two features to characterize the categories of person succeeds in describing both of the attested person systems in (1) and excludes various universally unattested possible systems (see Bobaljik 2008). The inclusive category is readily defined as the conjunction of the two features in (8). This ensures that the inclusive is stronger (narrower) than AUTHOR alone and thus any version of the competition principle will ensure that the general first person will have only an exclusive meaning when it competes with the inclusive, as in Mandarin.

But this account, as it stands, does not answer Zwicky's question regarding (1): when there is no dedicated inclusive category, why is the inclusve meaning (ADDRESSEE and AUTHOR) always expressed by the first person, never by the second? For this, Zwicky and many subsequent authors resort to an independent person hierarchy, as in (9).[5]

(9) The Person Hierarchy
+AUTHOR > +ADDRESSEE > OTHER

While this provides an adequate description of the generalization, it does so at the cost of treating some competition as an intrinsic ranking among features (in the sense that complexity/strength is part of the definition of the features) and some as extrinsic, an irreducible add-on to the feature definitions.

2.2. Participant

The problem for the classic account arises because AUTHOR and ADDRESSEE are both part of the inventory, and neither makes a stronger presupposition than the other, without an additional person hierarchy or equivalent assumption that effectively stipulates that AUTHOR is privileged.

An alternative account (McGinnis 2005; Sauerland 2003, 2008; Singh 2011) resolves this by starting instead from the assumption that the atomic features are AUTHOR and PARTICIPANT,

[4]Different labels are used by different authors. The choice of AUTHOR, ADDRESSEE rather than SPEAKER, HEARER or other labels reflects the assumption that the feature system is not modality-specific, and applies to sign as well as spoken languages. A further distinction, orthogonal to the point made here, is whether the features are binary or privative. Defining features via the predicate "included in (the referent of the pronoun)" is motivated by the observation that first (and arguably second) person plurals universally have an associative plural semantics: the first person plural is a group that contains the author, not a plurality of authors (Lyons 1968: 277, Moravcsik 1978: 354, Bobaljik 2008; Wechsler 2010).

[5]For McGinnis (2005) this is expressed as a stipulation that if only one of the two features in (8) is active, it is universally AUTHOR. Zaslavsky et al. (2021) propose an information-theoretic account of (2) which encodes the hierarchy in (9) as a relative weighting 16:1:0.1 of the features AUTHOR:ADDRESSEE:OTHER.

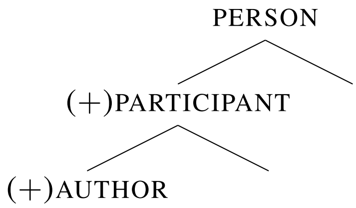
but not ADDRESSEE:

(10) a. $[[\text{AUTHOR}]]^c = \lambda x$. author$(c) \sqsubseteq x$
b. $[[\text{PARTICIPANT}]]^c = \lambda x$. author$(c) \sqsubseteq x \vee$ addressee$(c) \sqsubseteq x$

Note that while participant may be defined as "including author or including addressee", these are terms of the meta-language here. ADDRESSEE is not defined as a feature in this system, and the definition in (10b) is not defined as a disjunction among features.[6]

Since the author is a participant, there is an entailment relationship among the features, and the relationship may be diagrammed as follows: A first cut picks out participants in the speech act, and a second cut then singles out the author among the participants.

(11)



The competition principle ensures that in the absence of a specific inclusive element, the inclusive meaning will always be grouped under the first, not the second, person, as desired:

(12)

	CONTEXT	FORM
a.	[AUTHOR]	we
b.	[PARTICIPANT]	you
c.	[ ]	they

Unlike the classic account, which requires an independent hierarchy to order [1]>[2], on this account the ordering is determined by the relative strengths of the presuppositions: since the presupposition "includes author" is a proper subset of "includes a participant (author or addressee)", the morph with the narrower presupposition (12a) will always win out with first person referents. For the same reason, since the competition (presupposition maximization) principle blocks the use of the PARTICIPANT form with first person referents, that form is effectively limited to second person referents. And the third person is captured by an empty feature content of ∂ which as a null predicate intersection is interpreted as true of all entities. Again competition (presupposition maximization) applies to block the null feature set with first or second person referents.

But although this approach elegantly encodes the person hierarchy in the definition of features, and thereby accounts for Zwicky's puzzle without appeal to an independent hierarchy, this approach cannot straightforwardly derive clusivity. Recall that in the classic account, the clusivity

[6]One could represent it equivalently as follows:

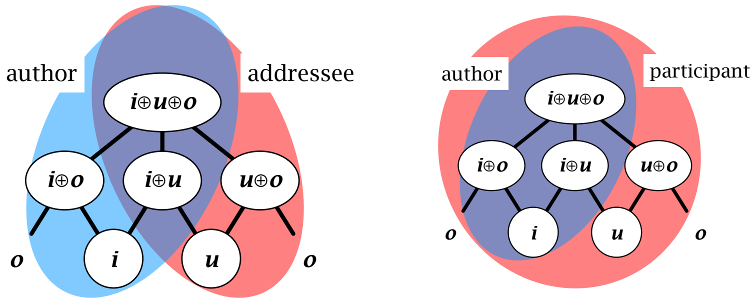
(i) $[[\text{PARTICIPANT}]]^c = \lambda x$. participant-in-speech-act$(c) \sqsubseteq x$

However, this formulation does not reflect the logical entailment relations as perspicuously as (10) does.

parameter is expressible simply as whether a language does or does not admit conjunction of person features: the inclusive is simply the conjunction of the two basic features. But under the author-participant approach, precisely the entailment relation that determines the crucial markedness asymmetry renders conjunction of the two features redundant. Since AUTHOR entails PARTICIPANT, [AUTHOR ∧ PARTICIPANT] is not meaningfully distinct from [AUTHOR] and in particular, does not draw an inclusive/exclusive distinction. Adding the feature ADDRESSEE (as McGinnis 2005 does) allows for the description of the clusivity distinction but returns us to the classic account and Zwicky’s puzzle.

The key properties of the two families of accounts just discussed can be seen in terms of the lattice diagrams we used in the introduction. The AUTHOR-ADDRESSEE system is symmetrical, which allows for the inclusive to be stated as a conjunction of the two features (purple), but requires an independent hierarchy to enforce the fundamental asymmetry in (1). The AUTHOR-PARTICIPANT system is asymmetrical: AUTHOR is a proper subset of PARTICIPANT, so the asymmetry in (1) is intrinsic to the system, but the conjunction of the two features is not distinct from author, so the inclusive-exclusive contrast would need an extra postulate:

(13) a. AUTHOR-ADDRESSEE b. AUTHOR-PARTICIPANT



3. Our proposal: the best of both worlds

We suggest here that using exhaustification (Chierchia et al. 2012) rather than Maximize Presupposition will allow for a refinement of the ‘author-participant’ account which will overcome the issue with conjunction and allow for an integration of the classic assumption that the inclusive is the conjunction of the other two features. A further consequence of this assumption is that we must recognize (drawing on Harbour 2016) that conjunction of morphological features may be non-Boolean, specifically in our case via appeal to a version of the cumulativity operator in Schmitt (2013).[7]

We adopt the structure of the semantic analysis in (7) and also the two features AUTHOR and PARTICIPANT from (8). For exhaustification, we adopt the proposal of Mayr (2015) for the predicate-level exhaustification operator **exh** in (14).[8] Exhaustification applied to a predicate P creates a new predicate with stronger truth conditions than the original predicate P depending on the alternative predicates in the set Alt. Namely the exhaustified predicate $\mathbf{exh}_{\mathrm{Alt}}\ P$ is true

[7] Schmitt extends earlier work by Link (1983); Krifka (1990).

[8] Mayr uses the notations **exh** for proposition-level and **exh2** for predicate-level exhaustification. In our discussion, only property-level exhaustification plays a role. Furthermore, the proposal could be restated using only proposition level exhaustification, for example in the type-inflexible semantics that Hirsch (2017) argues for.

only if P is true and all predicates Q in Alt are false (i.e. Q is excluded) with the exception of predicates Q that are fully entailed by P.[9]

(14) $$[[\mathbf{exh}_{\text{Alt}}]]^w = \lambda P \in D_{et}\ \lambda x \in D_e\ .\ P(x)(w) \wedge \forall Q \in \text{Alt}\ .\ \neg Q(x)(w) \vee (\forall x\ (P(x) \to Q(x)))$$

The **exh** operator in (14) does not make reference to presupposition directly, but this is sufficient for our purposes since **exh** contributes to the assertive meaning in the scope of the presuppositionalizer ∂ from (6). Application of **exh** with a single, strictly stronger alternative has the same effect as earlier pragmatic principles including Maximize Presupposition and Harbour's (2016) Lexical Complementarity. For example, the account of second person is similar to that in (12), namely, the set of participants, excluding those picked out by the stronger alternative AUTHOR:

(15) $$\mathbf{exh}_{\{\text{AUTHOR},\text{PARTICIPANT}\}}(\text{PARTICIPANT})(x) = \begin{cases} 1 & \text{if } x \in \{u, uo\} \\ 0 & \text{otherwise} \end{cases}$$

How is the set of alternatives of **exh** determined? We follow Katzir (2007) and subsequent work that the alternatives are determined from the sister constituent of **exh** by replacement or deletion operations. The alternatives always include the sister P of **exh**—PARTICIPANT in (15)—, which never directly lead to any exclusion because P always entails itself, but their presence can have an effect in cases of recursive application of **exh**. In the following, we only show elements of the set of alternatives that are actually excluded.

Comparing exhaustification with the classical and the PARTICIPANT-based account we introduced in section 2.2, observe that it is fully aligned with the PARTICIPANT-based account: The result of (15) is strictly stronger than the feature ADDRESSEE because ADDRESSEE is true of the inclusive referent *iu* and *iuo* while (15) is false. But the result of exhaustification in (15) is the same as that for PARTICIPANT after blocking by AUTHOR in (12). But as we show in the following, that **exh** captures blocking in the grammar is crucial for our account. With Magri (2009), Meyer (2015), and others, we furthermore assume that application of **exh** is obligatory when it can exclude a strictly stronger alternative as in the above case. We return to further applications of **exh** below, but first turn to the second piece of our proposal, non-Boolean conjunction.

Recall from above that individuals can be formally understood as a lattice, where atoms are singular objects and the join operation $\sqcup$ corresponds to forming a group $a \sqcup b$ out of two distinct objects a and b (Link 1983 and others). Recent work by Haslinger and Schmitt (2018) and Schmitt (2013, 2019) argues that non-Boolean conjunction is generally available as the meaning of the coordinator *and* across different categories. In particular Schmitt (2019: 12) proposes a $\sqcup$-operator that predicts (16) for P and Q of type $\langle e,t \rangle$:[10]

[9]More recent work on exhaustification has argued that it can also include certain alternatives (Bar-Lev and Fox 2020) and presuppose at least exclusion (Bassi et al. 2021). As far as we can see, our proposal can be easily adjusted to these developments, but we do not do so here for presentational reasons.

[10]As we introduced above, Harbour (2016) uses $\sqcup$ for the join operation of type e, while he defines $\oplus$ for sets. It is easy to see though that Harbour's $\oplus$ could be subsumed under (16) by viewing sets as their characteristic functions – i.e. the property of being a member of a set.

(16) $P \sqcup Q = \lambda x\ \exists y, z \in D_e [y \sqcup z = x \wedge P(y) \wedge Q(z)]$

The work cited above concerns conjunction in sentential semantics, not morphological processes. They argue that English conjunction *and* cannot be interpreted as Boolean conjunction, but must be interpreted as $\sqcup$. Consider briefly the account of (17) Schmitt (2019) argues for. She observes that (17) is entailed by the truth of the two sentences *Abe danced* and *Bert smoked*, and proposes to capture this from the application of $\sqcup$ twice: Once to form a plural entity **abe**$\sqcup$**bert** as the subject denotation, and a second time to form a predicate **danced**$\sqcup$**smoked**. Since (16) determines the interpretation of the predicate conjunction, (17) is correctly predicted to be true if *Abe danced* and *Bert smoked*.

(17) Abe and Bert danced and smoked. (Schmitt 2019: p. 32)

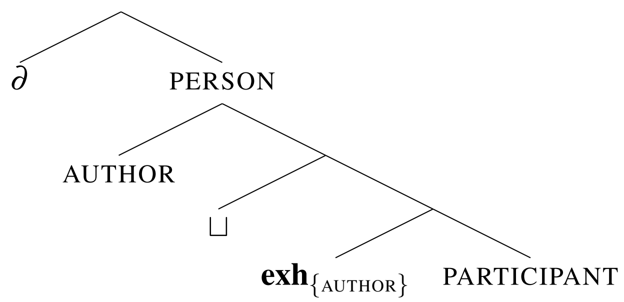
In Schmitt’s account pluralities of meanings are combined compositionally by a general cumulative composition. Generally, composition of two pluralities A and B results in the plurality of meanings derived by combining parts of A with parts of B for any way of dividing up A and B into parts and lining up the parts with one another. The interpretation Schmitt provides for (17) is as in (18), where d and s are the lexical predicates *danced* and *smoked* and a and b the individuals *Abe* and *Bert* respectively:

(18) $[d \sqcup s]\ (a \oplus b) = \{d(a) \oplus s(b), d(b) \oplus s(a), d(a) \oplus d(b) \oplus s(b), \ldots,$
$d(a) \oplus d(b) \oplus s(a) \oplus s(b)\}$

The truth-conditions of (18) are given by the condition there must be at least one element of (18) such that all elementary propositions that are part of that element are true. This accounts for the observation that (17) is judged true, for example, if Abe danced and Bert smoked, but also if Abe smoked and Bert danced.

3.1. Deriving the Typology

The central idea of our proposal is that exhaustification and non-Boolean conjunction predict a different interpretation for the feature combination [AUTHOR,PARTICIPANT] from other frameworks. The predicted interpretation derives from the following structural representation:

(19)


In (19), **exh** applies to PARTICIPANT, which is thus interpreted as second person as we showed in (15).[11] We then assume furthermore that non-Boolean conjunction combines the meanings of AUTHOR and **exh**(PARTICIPANT). Since AUTHOR is true of *i*, *iu* and *iuo* and **exh** PARTICIPANT of *u* and *uo*, the non-Boolean conjunction results in the property true of only *iu* and *iuo*. Note that applying Boolean conjunction in (20) would result in a contradiction.[12]

(20) $$[\text{AUTHOR} \sqcup \textbf{exh}_{\{\text{AUTHOR}\}}(\text{PARTICIPANT})(x) = \begin{cases} 1 & \text{if } x \in \{iu, iuo\} \\ 0 & \text{otherwise} \end{cases}$$

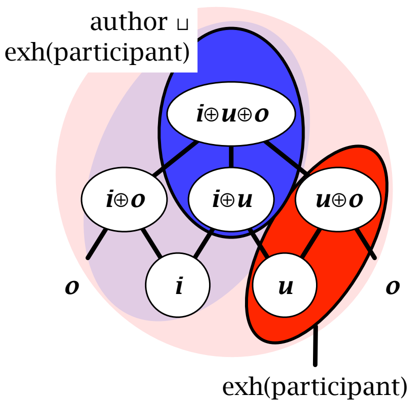
The result as shown in (20) is the meaning of the inclusive as in (3).

The crux of our proposal is this: Without exhaustification, conjunction (whether Boolean or cumulative) of AUTHOR and PARTICIPANT is vacuous. It is exhaustification (and non-Boolean conjunction) that allows us to import into the author-participant account the idea from the classic account that the inclusive is the coordination of the first and second persons.

Thus, just as the classic account could state a clusivity parameter as whether conjunction of features is allowed, our proposal also allows us to assume that languages morphologically vary as to whether the PERSON-position is restricted to a single feature or allows multiple features. Furthermore we assume that at most the two person features AUTHOR and PARTICIPANT are available, and that **exh** and non-Boolean conjunction must apply in the person system.

Graphically:

(21)



The general *we* paradigm results straightforwardly if only a single feature is allowed:

(22) a. first person: **exh**$_{\{\}}$ (AUTHOR)
b. second person: **exh**$_{\{\text{AUTHOR}\}}$ (PARTICIPANT)

[11]If **exh** was to apply to AUTHOR too, the application would be vacuous. Hence we don't represent **exh** for AUTHOR in (19).

[12]Schmitt (2013: 97–102) presents arguments that Boolean conjunction may never be available as the interpretation of conjunction in sentential semantics, i.e. *and* in English or *und* in German. A Boolean interpretation in (20) results in a contradictory predicate, and may therefore not be available. But in the account of the exclusive in (23), we exclude the inclusive. This would not result in the exclusive interpretation if Boolean conjunction could apply in the inclusive. This suggests that a Boolean interpretation is also impossible for morphological conjunction of person features and thereby corroborates Schmitt's conclusion.

c. third person: $\mathbf{exh}_{\{\text{AUTHOR,PARTICIPANT}\}}(\text{NULL})$

The procedure of Katzir (2007) predicts that the alternative set for all three cases of **exh** in (22) is $\{\text{AUTHOR}, \text{PARTICIPANT}, \text{NULL}\}$, but recall that we show only the excluded alternatives. Because all alternatives are entailed by AUTHOR, none are shown for the first person. The interpretation of third person follows analogously to that of second person shown in (15).

The paradigm with clusivity, we propose, results if more than one person feature can occur under PERSON, i.e. in a language where the feature conjunction AUTHOR and PARTICIPANT is possible. This feature conjunction makes the account of the inclusive in (20) available. To derive the exclusive in this system, we assume that the inclusive also becomes available as an alternative for exhaustification whenever it is morphologically possible. Specifically, we assume that, if **exh** applies to the PERSON-node and the language has a clusivity distinction (i.e. allows multiple features under PERSON), [AUTHOR, PARTICIPANT] is an alternative to [AUTHOR].[13] Then the exclusive meaning is captured by exhaustification of AUTHOR:

(23) $$\mathbf{exh}_{\{\text{AUTHOR}\sqcup\mathbf{exh}_{\{\text{AUTHOR}\}}(\text{PARTICIPANT})\}}(\text{AUTHOR})(x) = \begin{cases} 1 & \text{if } x \in \{i, io\} \\ 0 & \text{otherwise} \end{cases}$$

The account of the second and third person in a quadripartition (Harbour’s term for a system with a clusivity contrast, and thus four person categories) can be as in our proposal (22) for a tripartition.[14]

4. Excluding an alternative: against Harbour’s marked exclusive

We see it as a positive aspect of our proposal that it treats the variation across subsystems in Mandarin and Daur in the same way as the cross-linguistic variation. Mandarin *wǒmen*, on our account, is always simply specified as spelling out [AUTHOR]. Where a competitor (inclusive *zánmen*) is available, exhaustification limits *wǒmen* to the exclusive reading (see (23)), but where no alternative is available (as in object position), *wǒmen* is a general *we*. This is a special case of the more general aspect of our proposal that only inclusive and general *we* may be represented directly. There is no combination of features that is inherently exclusive—exclusive readings only arise via exhaustification (competition).

In this, our proposal contrasts with the proposals in Harbour (2016). We do not have the space

[13] Buccola et al. (2021) propose that in specific circumstances also primitive concepts that cannot be pronounced in a language-specific way may be available as alternatives for **exh**. But we assume that the inclusive cannot be available as an alternative to AUTHOR in languages with a tripartition. The conflict between the two proposals is only apparent, however, because Buccola et al. address cases where the alternative is a primitive, while the inclusive is a structurally complex meaning. One implementation directly sensitive to this difference would be to represent the exclusive as **exh** [AUTHOR, **exh** AUTHOR] or **exh** [AUTHOR, **exh** NULL]. Then the inclusive is a structural alternative for the outer **exh** in the sense of Katzir (2007). In sum, Buccola et al.’s (2021) proposal makes interesting, novel predictions when combined with our approach to person marking that we hope future work will explore.

[14] There is a small technical difference. Namely, while only AUTHOR and PARTICIPANT occur in (22) as elements of the alternative set, also the complex [AUTHOR, PARTICIPANT] is an alternative in the quadripartition. But the semantic result is the same because of the entailment relations from [AUTHOR, PARTICIPANT] to [AUTHOR] and further to [PARTICIPANT].

to engage fully with Harbour's innovative approach here, but we make a few brief remarks. Harbour addresses Zwicky's typological observation in (2), and also aims to develop a proposal that derives this observation directly from the inventory of features in UG and constraints on their combination, without appeal to an extrinsic hierarchy. Among the ways in which Harbour's proposals differ from ours, his theory is set up such that in a system with clusivity, it is the exclusive (not the inclusive) which is the more specific category: the inclusive only arises as a general *we* ([AUTHOR]) which is limited to inclusive contexts by competition with the more specified exclusive. When we look at the typological, cross-linguistic comparison of languages as whole systems (Evenki versus English, say) then there is no a priori way to decide which of the two first person categories is more marked. But for languages such as Mandarin and Daur, we contend that the available evidence points to our approach (the more conservative one) over Harbour's.[15] If it is reasonable to see clusivity as applying in some, but not all, subsystems in a language, then these examples suggest the characterization as we have given: one element is a general *we* and the competition (for us, via exhaustification) which limits that to a restricted meaning is competition with a more specific inclusive, the opposite of what an approach built on Harbour's proposal would expect.

An important caveat is in order here: strictly speaking, Harbour does not allow for a single language to have mixed clusivity. He claims that the clusivity parameter applies at the level of the entire language, establishing the categories once for the language as a whole. Any differences among subsystems, as in Mandarin and Daur, must therefore arise as morphological syncretism from an underlying inclusive-exclusive system.[16] This is, as far as we can see, a methodological choice that Harbour makes in assembling data, and does not follow from any postulates in his framework. Observationally, differences in clusivity like that in Daur, between agreement and pronouns for example, are common. Siewierska and Bakker (2005: 161-165) looked at 151 languages that have both bound and free person marking and have a clusivity contrast. Only half of these languages (74/151) have clusivity in both bound and free person marking, in the other half (77/151) there is a difference between the sub-systems. Patterns in which clusivity is contrastive only in free person marking (pronouns) outnumber those, like Daur, in which it is only marked in the bound person markers by about 4:1, though both types are non-negligibly attested in their sample. While acknowledging that there are non-trivial questions about how to define and delineate "subsystems", we take it as nevertheless a reasonable application of theories of clusivity, including Harbour's (even if unsanctioned), to evaluate them against generalizations over subsystems in a language, and not just against each language as a whole. The striking way in which Mandarin and Daur show the same effect across subsystems that Zwicky identified across languages suggests to us that a unified account should be sought. More specifically, we contend that Mandarin and Daur support our implementation of the familiar idea, contra Harbour, that there is no inherent category of first-person exclusive, and that the category arises only via competition with a stronger alternative, the inclusive.

[15]But see Pertsova (2022) for a contrasting opinion based on other types of evidence.

[16]Here mention should also be made of Ackema and Neeleman (2013, 2018) who, in effect, deny the existence of a clusivity parameter at the level of categories. In their account, all languages have four person categories, abstractly distinguishing inclusive from exclusive, but morphological syncretism neutralizes the distinction. They treat (2) and the distributional claim in (3) as a trend (which they leave unexplained), rather than a universal. We disagree, but cannot reasonably do justice to this difference in the limits of this paper.

5. Conclusion and open questions

A long established (but by no means consensus) view in the discussion of clusivity holds that there is no genuine category of first person exclusive. Instead there is a general *we* denoting a group that contains the AUTHOR, and in many, but not all, languages a more specific category of inclusive. The general *we* is restricted to exclusive readings when it competes with a more specific first person inclusive plural. We have offered here an implementation of this approach which characterizes this competition as exhaustification at the property level, internal to the feature bundles in the morphology. We suggest that this provides an account of both the typological generalization we started with and of the language-internal patterns of the Mandarin and Daur sort, allowing for a characterization of the cross-linguistically marked category ‘inclusive’ as conjunction of the independently needed features, and for the characterization of Zwicky’s typological generalization strictly in terms of logical entailments without appeal to an independent and arguably ad hoc hierarchy.[17]

There is clearly more to be said. We have focused specifically on the inventory of person categories in a language or a subsystem. Other authors, including Moskal (2018); Ackema and Neeleman (2018); Pertsova (2022) look instead at patterns of morphological syncretism and marking, for example, whether the inclusive appears to be derived from the exclusive or vice versa (Pertsova 2022 concludes that both patterns are attested). Moskal (2018) investigates stem allomorphy and argues that if only one of the first person plural elements (inclusive or exclusive) shares a stem with the first person singular, then it is the exclusive, consistent with the view that the exclusive is merely the non-singular [AUTHOR], but Pertsova (2022) reports examples of the opposite pattern. Despite these (and other) open issues, we hope here to have shown a way to reconcile two established but conflicting approaches to person, by (i) extending the use of exhaustification to features/properties at the sub-morphemic level, and (ii) extending cumulative rather than Boolean conjunction to morpheme-internal feature composition. In doing so, we aim to have added one further set of considerations to the general theory of person features and thus to discussions about (the formal characterization of) ‘us’.

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Positive gradable adjective ascriptions without positive morphemes[1]

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Abstract. A long-standing tension in semantic theory concerns the reconciliation of positive gradable adjective (GA) ascriptions and comparative GA ascriptions. Vagueness-based approaches derive the comparative from the positive, and face non-trivial challenges with incommensurability and non-GA comparatives. Classic degree-based approaches effectively derive the positive from the comparative, out of sync with the direction of evidence from morphology, and create some difficulties in accounting for GA scale-mates with differing thresholds (e.g., *cold* $\sim$ *warm* $\sim$ *hot*). We propose a new reconciliation that capitalizes on recent proposals analyzing GAs as predicates of states. On our account, GAs lexically involve both a threshold property and a background state structure. Positive occurrences of GAs make use of the threshold property, while comparative occurrences make use of degrees representing elements of the background structure. Our approach preserves the virtues of classic degree-based approaches while offering a natural account of scale-mates, and without appeal to covert morphemes like POS or related devices. As we show, it is possible to inject our solution back into the classic degree-based approach, but we find reasons to prefer our states-based account.

Keywords: comparatives, vague adjectives, thresholds, state structures

1. Introduction

How should we understand gradable adjective (GA) ascriptions as they occur in the positive, (1-a), and comparative forms, (1-b), neither of which entails the other?

(1) a. Miami is hot. [positive]
b. Miami is hotter than Barcelona. [comparative]

Ultimately, how one answers this question depends upon one's assumptions about the lexical semantics of GAs. In 'classic' degree-theoretic approaches, GAs are interpreted directly as measure functions—mappings from individuals to degrees representing their measure along some dimension—as in (2-a) (e.g. Kennedy 1999), or as relations between individuals and degrees that invoke a measure function indirectly, (2-b) (e.g. Heim 2000).

(2) a. $[\![\text{hot}]\!]_K = \lambda x.\mu_{\textbf{heat}}(x)$ $\langle e,d\rangle$
b. $[\![\text{hot}]\!]_H = \lambda d.\lambda x.\mu_{\textbf{heat}}(x) \geq d$ $\langle d,\langle e,t\rangle\rangle$

In what follows, we present and discuss a version of the classic degree semantics picture for GAs that assumes they are interpreted on the model in (2-a). Everything we say applies equally well to the model in (2-b), however, since the issues we highlight flow from the central assumption that the lexical semantics of GAs incorporates degrees *simpliciter*.

Given a degree semantics of this stripe, the relevant positive form is interpreted as in (3-a), and the relevant comparative form as in (3-b). (3-a) indicates that (1-a) is true whenever the

[1]We would like to thank Chris Kennedy for recent discussion, as well as the audience at SuB for their feedback.

heat-measure of Miami (i.e., Miami's degree of heat) meets or exceeds the standard for such measures in context c (i.e., the contextual standard for heat). (3-b) indicates that (1-b) is true whenever Miami's degree of heat strictly exceeds that of Barcelona.

(3) a. $[\![\text{Miami is POS hot}]\!]_K = \mu_{\mathbf{heat}}(m) \geq \mathbf{std}_c(\mu_{\mathbf{heat}})$ [positive]
b. $[\![\text{Miami is hot ER than Barcelona}]\!]_K = \mu_{\mathbf{heat}}(m) > \mu_{\mathbf{heat}}(b)$ [comparative]

These interpretations get the (lack of) entailments right. To see this, consider a context in which we understand the standard for heat to be 100°F, while Miami measures 95°F and Barcelona measures 87°F. In this context, (3-a) is false but (3-b) is true. Next, consider a context in which the standard is again 100°F, but Miami measures 105°F and Barcelona measures 110°F. Here, (3-a) is true but (3-b) is false.

This way of reconciling the positive and comparative forms gets the truth conditions right. But considerations of other kinds can be marshalled against this account. Here are a few.

First, analyses like (3) exhibit a mismatch with the direction of morphology (Klein 1982): they associate positive and comparative occurrences of GAs with underlying forms of equal complexity—i.e., the positive goes with POS, the comparative goes with -ER—in spite of the plausible linguistic universal that comparative forms are strictly more complex than positive forms in terms of their overt morphological realizations (Bobaljik 2012).[2]

Moreover, there is no surface evidence for POS (or anything like it that can discharge a GA's lexical degree semantics), despite the initial promise of some candidate languages (e.g. Grano 2012, Grano and Davis 2018). Finally, these analyses run into difficulties if we assume that some pairs of GAs like *warm* and *hot* exploit the same degree scale. Certain entailment facts involving these GAs in the comparative form can be taken to suggest that they are interpreted as the same measure function. But then it would be mysterious why they have different thresholds in the positive form (cf. Lassiter 2011).

We should like, then, an approach which gets the truth conditions right, and which is also concordant with the wider distribution of form-meaning mappings, and supportive of a plausible analysis of scale-mates. Our approach will do this, by combining the pieces in (i)-(iii):

(i) GAs express properties of states (e.g. Fults 2006; Wellwood 2012; Baglini 2015);

(ii) These states are ordered into a background 'state structure' (Wellwood 2015, 2019; cf. Bale 2006, 2008); and

(iii) GAs contribute two properties—a threshold property and a background property—of which the positive and comparative forms make differential use. Roughly, the threshold property is the property of having enough of the relevant quantity (or quality) to warrant ascription of the positive form. The background property is the property of having some amount of the relevant quantity (or quality). For example, this is the distinction between *being hot* and *having (some) heat*.

[2]Whether because there is a covert morpheme POS as in (3-a) or not, it will be necessary that something intervene between the degree-involving lexical semantics of the GA, and the lack of overt use to which its degree argument is put in the positive form.

In particular, we propose that the lexical semantics of a GA like *hot* looks as in (4),[3] with the threshold property indicated as $\mathbf{hot}_c$, and the background property indicated as the functional restriction to states in an ordering of heat states.[4]

(4) $[\![\text{hot}]\!] = \lambda s : s \in \mathbf{domain}(\langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle) \cdot \mathbf{hot}_c(s)$ $\langle v, t \rangle$

With this lexical semantics in hand, we develop a novel account of the relationship between positive and comparative as follows. Uses of the positive form assert that a threshold property holds of a state that the subject is in; that is, the positive form relates states, and so its uses are true whenever, e.g., Miami's heat-state is ordered higher than some contextually-determined cut-off point in the background ordering on such states. Uses of the comparative form, in contrast, assert that the background property holds of a state *s* that the subject is in, and moreover that the measure of *s* exceeds the measure of some other state; a use of the comparative form is true, then, whenever, e.g., the measure of a heat-state of Miami exceeds that of any heat-state of Barcelona. Our compositional analysis will derive such interpretations as in (5-a) and (5-b).

(5) a. $[\![\text{Miami is hot}]\!]^{c,\sigma}$ [positive]
$= (\exists s : s \in \mathbf{domain}(\langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle))(\mathbf{holder}(s,m) \ \& \ \mathbf{hot}_c(s))$

b. $[\![\text{Miami is hot ER than Barcelona}]\!]^{c,\sigma}$ [comparative]
$= (\exists s : s \in \mathbf{domain}(\mathbf{background}(\mathbf{hot}_c)))(\mathbf{holder}(s,m) \ \& \ \sigma(\mu)(s) > d_b)$

(5-a) says that the positive form is true just in case Miami is in a state of heat that has the contextually-determined property of being hot. (5-b) says that the comparative form is true just in case Miami is in a state of heat *s* whose measure—i.e., the value of an appropriate measure function, supplied by the assignment function σ applied to *s*—is greater than the same for any such state of Barcelona.

In what follows, we discuss the challenges for standard executions of the degree-based analysis in more detail, and show how our proposal addresses those challenges. At least at first, it will appear critical that we have eliminated reference to degrees within the lexical semantics of GAs. However, our solution can be injected back into the classic degree-based framework, as we show. Playing out this possibility, we find that such an approach does well with the basic truth-conditional and scale-mates facts, without appeal to POS or POS-like elements. However, it plausibly lacks the resources to illuminate other important phenomena.

The account that we advocate brings the classic degree analysis of positive GA ascriptions closer to that of its major competing framework, that which interprets the positive form using mechanisms designed for the resolution of vagueness, at least insofar as that approach and ours posit lexical associations with non–degree-based ordering relations. Before diving into our proposal, then, we should like to briefly note why we do not pursue an account that more explicitly aligns itself with the vagueness-based alternative. We hope to show that, as we see it, our approach captures the very best of both worlds, while avoiding the real pitfalls of either.

[3]N.B.: $\mathbf{domain}(\langle D, \succcurlyeq \rangle) = D$.

[4]N.B.: Accessing the background structure from the threshold property: $\mathbf{background}(\mathbf{hot}_c) = \langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle$.

2. Challenges for vagueness-based approaches

Our proposal will understand comparative constructions to express relations between degrees, but not degrees that are lexically introduced by a GA. Why not simply adopt existing non-degree-based theories as offered by vagueness-based approaches? As we briefly review, such accounts face challenges which can generally be avoided on degree-based approaches. The net result is that we should prefer a degree-theoretic approach, if some version of it can meet these challenges.

Vagueness-based approaches (e.g., McConnell-Ginet 1973, Klein 1980) take as their starting point mechanisms for the resolution of GA vagueness, and build a comparative semantics on top of that. (This contrasts, of course, with supposing that the GA starts out lexically 'crisp', e.g., by denoting a measure function.) The central formal idea is that the positive form is evaluated relative to a background ordering contributed by the GA. Specifically, it is evaluated relative to a partitioning on the domain of that ordering into positive, negative, and neutral regions. So, for example, *tall* associates with an ordering of individuals according to their height, and a positive attribution like *Ann is tall* in context *c* is TRUE just in case Ann is in the positive extension of *tall* in *c*, FALSE if she is in the negative extension in *c*, and undefined otherwise. The comparative form, in turn, can be analyzed in terms of quantification over 'delineators' that hard-wire such partitioning effects; a comparative attribution like *Ann is taller than Betty*, then, would come out true just in case there is a delineator which partitions the domain of the ordering associated with *tall* in such a way that Ann is in its positive extension but Betty isn't.[5]

Such proposals are interesting, and, indeed, our proposal maintains the idea that GAs lexically associate with an ordering relation that is not based on degrees. As on vagueness-based approaches, such a formal move supports positing lexical entries for GAs that do not require POS or POS-like elements in the positive form, for a better alignment with the direction of morphological exponence across languages. We are not comfortable simply adopting existing accounts in this vein, however, as we believe there are good use cases for degrees.

One such challenge for vagueness-based approaches that Kennedy (1999) points to are patterns of (in)felicitous composition in 'subcomparatives', i.e., comparatives with distinct adjectives in each of their matrix and *than*-clauses. First, notice that such combinations can be perfectly fine, (6-a), but they can also be odd, (6-b). The question is, why is (6-b), and indefinitely many examples like it that could be constructed, anomalous?

(6) a. The ladder is longer than the doorway is high.
b. ?The hallway is longer than the carpet is green.

According to vagueness-based approaches, (6-b) should simply say that there is a way of dividing up the GAs' domains such that the hallway is in the positive extension of *long* but the carpet is not in the positive extension of *green*; that could be false, of course, but no anomaly is predicted (though see Doetjes 2011). In contrast, in a degree-based framework, one can say that failure to locate a common ordering relation between degrees of different types leads to a sense of semantic anomaly.

[5]This analysis is bolstered by a meaning postulate (e.g., the 'Consistency Postulate' of Klein 1980), which stipulates that if there is such a delineator, then there is no other delineator that could establish the opposite partitioning. This in effect codes the realistic assumption that the background ordering itself is unaffected by delineators.

The broader typology of degree constructions presents a different sort of issue. Vagueness-based approaches place the properties of lexical GAs at the center of their proposals for how comparatives work. As such, they are not straightforwardly extensible to, for example, nominal (7-a) and verbal comparatives (7-b) whose target lexical items do not appear to be vague, at least not in the same ways (though see Burnett 2015 for an approach to nominal comparatives).

(7) a. Mary drank more coffee than John did.
b. John works in Barcelona more than he does in Miami.

In contrast, approaches to cross-categorial verbal comparatives have been successfully carried out in degree semantics, e.g., supplemented by incorporation of a 'universal measurer' contributed by the comparative morphology itself (e.g., Wellwood 2012).

Finally, vagueness-based approaches build the mechanism of comparative semantics off of the threshold-fixing action otherwise used to delineate the positive and negative extensions of a GA in the positive form. Given this, it is not clear why we should see differences in 'crisp' judgments for sentences that, at least superficially, express the same comparisons.[6] For example, Kennedy (2007) describes contexts like that in (8), to which people respond differently with *-er* comparatives and those based on modification of a positive predication: (8-a) is just 'true' in the context, but (8-b) is 'weird' or even 'false'.

(8) **Context**: Al has an almost imperceptible difference in height over Bill.
a. Al is taller than Bill. [comparative]
b. Compared to Bill, Al is tall. [positive]

As it stands, neither vagueness-based approaches nor the classic degree-based framework clearly have the representational power to treat (8-a) and (8-b) differently. But a framework that distinguishes lexical orderings and degree orderings has, in principle, the resource to treat (8-a) and (8-b) differently. (8-a) involves calculations relative to a lexical GA ordering, while (8-b) involves calculations relative to an ordering on degrees.

3. Challenges for degree-based approaches

We pursue an analysis of the positive and comparative forms which not only gets the truth conditions and patterns of entailment right, but also meets additional challenges posed by the relationship between these forms in English and across languages. Here, we discuss three such outstanding challenges.

The first has been long-acknowledged: the apparent mismatch between the compositional pieces posited in a degree-based analysis, and the observed direction of morphological complexity. Bobaljik (2012) concluded his study of morphological patterns across hundreds of languages suggesting that the patterns there observed demand explanation involving the universal derivation of comparative forms from positive forms. Yet, under standard executions of the degree framework, a covert morpheme like POS necessarily co-occurs with the GA in the positive form, (9-a). If so, then the positive and the comparative, (9-b), are equally complex.

[6] See Castillo-Gamboa et al. (2021) for experimental evidence of contrasts like that in (8). They propose that the semantics of (8-b) involves comparison with standards for differences.

(9) a. [GA POS]
b. [GA -ER]

Ideally, the structural analysis of positive and comparative forms would deliver a formulation such that the GA occurs alone in positive ascriptions, and along with a degree relation just when comparative morphology is explicitly indicated.

The second challenge is more subtle. This is the problem of capturing differences in meaning between putative scale-mates like *hot* and *warm*. We assume that a necessary (but probably not sufficient) condition for two gradable adjectives to be considered scale-mates is that their comparative forms are mutually entailing. For instance, plainly it is the case that if (10-a) is true, so is (10-b); and, if (10-b) is true, so is (10-a).[7]

(10) a. Miami is hotter than Barcelona.
b. Miami is warmer than Barcelona.

In the classic degree-based framework, such instances of mutual entailment may be captured by positing that the relevant GAs lexically express the same measure function (cf. Lassiter 2011 on epistemic adjectives). (11) does this, and, if correct, it would obviously guarantee logical equivalence between (10-a) and (10-b).

(11) a. $[\![\text{hot}]\!]^c = \lambda x.\mu_{\mathbf{heat}}(x)$
b. $[\![\text{warm}]\!]^c = \lambda x.\mu_{\mathbf{heat}}(x)$

However, such an analysis runs into serious trouble with the positive form, where differences in lexical form tend to go along with differences in contextual threshold. This leads to a general lack of mutual entailment between just about any putative scale-mates, e.g., while (12-a) being true guarantees the truth of (12-b), the reverse isn't so.

(12) a. Miami is hot.
b. Miami is warm.

Combined with standard assumptions about how POS (or a relevant POS-like mechanism) works, we have no obvious explanation for this difference in threshold sensitivity. Any function like **std** applies to lexical meanings/interpretations, not to the lexical items themselves (cf. Kennedy and McNally 2005); so, if *hot* and *warm* express the same measure function, they are predicted to have the same standards in every context, cf. (13).

(13) a. $[\![\text{POS hot}]\!]^c = \lambda x.\mu_{\mathbf{heat}}(x) \geq \mathbf{std}_c(\mu_{\mathbf{heat}})$
b. $[\![\text{POS warm}]\!]^c = \lambda x.\mu_{\mathbf{heat}}(x) \geq \mathbf{std}_c(\mu_{\mathbf{heat}})$

[7] Some speakers feel that (10-a) and (10-b) are not equivalent, even while agreeing that they're mutually entailing. These speakers get the sense that (10-a) entails or implicates the positive attribution of *hot* at least to Miami. However, our point in the text is not that the two are synonymous, only that they are mutually-entailing.

The issue, then, is that the same assumption that would guarantee patterns of mutual entailment in the comparative form—interpreting scale-mates as encoding the same measure function—blocks any ability to see why they should have different thresholds in the positive form.

An alternative—positing multiple distinct POS-like elements to account for differing thresholds—faces its own challenges, the first being that there simply is no surface evidence for any POS-like elements in the first place. It had seemed at one point that Mandarin *hen* would be a good candidate, however Grano (2012) has argued convincingly that it is not. Certain templatic alternations between the positive and comparative forms in Arabic had seemed a good candidate, but subsequent analysis by Grano and Davis (2018) suggests that they aren't either.[8]

We now turn to see whether a different style of framework can account for the patterns of universal markedness, mutual entailment, and scale mates, without positing POS or any POS-like elements.

4. Our analysis

Our analysis combines elements of both degree-based and vagueness-based approaches with an elaboration of the states-based approach. Like degree-based approaches, we treat comparatives (superlatives, excessives, ...) as involving relations between degrees. Like vagueness-based approaches, we posit that GAs do not lexically involve relations between degrees. In our implementation, though, the ordering associated with a GA is an ordering on states.

Our formal analysis revolves around five main claims. (i) GAs lexically contribute a contextually-determined property of states (i.e., the 'threshold' property). (ii) Those states are part of a 'background' ordering, information about which is encoded in the non-at-issue component of the GA's lexical meaning. (iii) This background ordering includes states that meet the threshold property, but also ones that do not: for example, in the case of *hot*, the background property includes states measuring any degree of temperature (i.e., even states properly called *cold*). (iv) The positive form uses the threshold property, and indicates that this property holds of its subject. (v) The comparative form uses the background ordering, and indicates that some element *s* in the domain of that background ordering holds of its subject, and that a relevant measure function maps *s* to a degree greater than that of any state described in the *than*-clause.

With respect to the idea that GAs lexically contribute a property of something other than individuals, a wealth of evidence has been presented to support the idea that GAs express properties of states. For that reason, we do not see this article as the place to argue this point; instead, the reader is directed to Fults (2006), Moltmann (2009) (where the entities are 'tropes'), Wellwood (2012, 2015, 2016, 2019), Husband (2012), and Baglini (2015). As a sample, we flag some of the more immediately compelling data points that motivate the analysis: GAs may be modified by prepositional phrases that otherwise combine with predicates of eventualities (e.g., *hot/run in the kitchen*); such modifiers must figure into what degrees are compared (e.g., *Ann is more patient in the kitchen than in the den*); GA ascriptions can figure in descriptions of cause and effect (e.g., *Ann burned her hand because the pot was hot*); they contribute something to descriptive and anaphoric reference (e.g., *The pot's heat/it burned her hand*); and so on.

Our second claim is that the states that GAs are true of are ordered. This is a natural assump-

[8]Notice, too, that if those analyses had gone the other way, we would also have found some convincing exceptions to Bobaljik's generalization of the universal markedness of comparatives over positives.

$$\overbrace{\ldots s_1\quad s_2\quad \begin{matrix}s_{3.a}\\ s_{3.b}\end{matrix}\quad s_4\quad s_5\quad s_6\quad \underbrace{\begin{matrix}s_{7.a}\\ s_{7.b}\end{matrix}\quad s_8\quad s_9\quad \begin{matrix}s_{10.a}\\ s_{10.b}\\ s_{10.c}\end{matrix}\quad \begin{matrix}s_{11.a}\\ s_{11.b}\end{matrix}\quad s_{12}\ldots}_{\text{states of being hot}}}^{\text{states of having some heat}}$$

Figure 1: States of being hot, as a sub-ordering of states of having some heat.

tion. Vagueness-based approaches posit as much. And within degree semantics, at least since Cresswell 1976, it has been assumed that a unique background ordering of individuals precedes the mapping from those individuals to degrees representing their measure (see also Bale 2006, 2008). The relation represented in (14) simply has some subset of D_e as its domain. Wellwood (2015), in contrast, posits that GAs associate with orderings between states, with a domain like in (15-a) and an ordering relation that may be read as in (15-b).

(14) $\{\langle x, x' \rangle \mid x \text{ has as much heat as } x' \}$

(15) a. $D_{\mathbf{heat}} = \{s \mid s \text{ is some quantity of heat} \}$
b. $\succcurlyeq_{\mathbf{heat}} = \{\langle s, s' \rangle \mid s \text{ is as much heat as } s' \}$

Following Wellwood, we say that the GA *hot* associates with $\langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle$, understood as in (15). This move is warranted, if nothing else, by the standard assumption in event semantics that thematic relationships—like the one which holds between states and their bearers, or between events and their agents, etc—is one-to-one; $\mathbf{holder}(s,m)$, then, is read 'm is the holder/bearer of s'.[9] Cresswell's individual orderings, then, can be recovered by means of the function **holder** (see e.g., Kratzer 1996, Husband 2012).

Let us turn now to claims (iii) and (iv). As anticipated, the subject of a positive GA ascription combines with the GA via the compositional assumptions standard in event semantics. For example, we interpret θ-marked syntactic arguments as properties of eventualities (Champollion 2015), as in (16), so that the subject is of the same type as the predicate and the two combine by the (appropriately generalized) rule of Predicate Modification (Heim and Kratzer 1998).

(16) $[\![\text{Miami}_{[\text{ho}]}]\!]^{c,\sigma} = \lambda s\ .\ \mathbf{holder}(s,m)$

At this point, we introduce the first novel element of our proposal. We hold that the orderings of states invoked by the lexical semantics of GAs are part of a broader, 'background' ordering of states. For illustration, let us stick to the case of *hot*. We assume that the ordering of states of being hot is part of a broader ordering of states of having some heat—the relevant intuition being that all states of being hot are states of having heat, but not vice versa. The structure consisting of states of being hot may be viewed as a substructure of overall ordering of states of heat—those states that lie above a certain threshold in the background ordering. This is illustrated in Figure 1. We assume that the 'threshold' indicating which states of heat count as states of being hot is fixed by context.

[9] For background, discussion, and references, see 'Role Exhaustion' in Williams (2015).

As the figure shows, we do not generally assume that state structures must be linearly ordered Here it is instructive to consider how we would characterize the case in which two cities—say, Miami and Barcelona—are said to have exactly the same temperature; i.e., that Miami is exactly as hot as Barcelona. The assumption that states are unique to their bearers entails that these are two non-identical states of heat—call them s_m and s_b—neither of which instantiates more heat than the other. Instead, s_m and s_b are equivalent only in the sense that having the same temperature means having the same value under the appropriate measure. In other words, $s_m \neq s_b$ because $\mathbf{holder}(s_m) \neq \mathbf{holder}(s_b)$ but nevertheless $\mu_{\mathbf{heat}}(s_m) = \mu_{\mathbf{heat}}(s_b)$.[10] So, the background ordering has at least two states which are non-identical, and which are not ordered with respect to one another; thus, this background structure is non-linear. We assume this is probably the case for all GAs.

Compositionally, we encode the information that the relevant state is drawn from the domain of a particular ordering in a not-at-issue component of the GA's lexical entry. For concreteness, we think of this component as a presupposition. Consider, for example, the entry in (17). *hot* denotes a function that maps a state s to true only if s meets the relevant threshold in context c; moreover, a presupposition requires that the relevant state be in the domain of the heat ordering.

(17) $[\![\text{hot}]\!]^{c,\sigma} = \lambda s : s \in \mathbf{domain}(\langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle) \ . \ \mathbf{hot}_c(s)$

In addition to the information encoded in lexical entries like (17), we stipulate monotonicity properties as in (18).[11] These help guarantee the validity of certain inference patterns, including that exemplified in (19).

(18) If $\mathbf{hot}_c(s)$ and $s' \succcurlyeq_{\mathbf{heat}} s$, then $\mathbf{hot}_c(s')$

(19)
a. Barcelona is hot.
b. Miami is hotter than Barcelona.
c. Therefore, Miami is hot.

Given these ingredients, the sentential truth conditions for the positive form on our account look as in (20): this says that Miami is hot just in case it bears/is the holder of a state of heat that counts as hot in the context c.

(20) $[\![\text{Miami}_{[\text{ho}]} \text{ is hot}]\!]^{c,\sigma} = (\exists s : s \in \mathbf{domain}(\langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle))(\mathbf{holder}(s,m) \ \& \ \mathbf{hot}_c(s))$

Finally, let us move on to our claim (v), which concerns GAs in the comparative form. Our first goal is to ensure that our interpretation of a sentence like (21) does not entail that in (20); the comparative semantics must not say, e.g., of Miami that it bears a state of being hot.

[10] One can think of the degree structures that are output by measure functions as recording the values of equivalence classes of states in background structures, which remedies precisely this failure of inequality; this appears rather in accord with how Cresswell (1976) was thinking about it, though the mapping from base orderings of individuals to degree orderings was all fixed before one could comprehended the GA at all. Bale (2006) makes transitions between base individual orderings and degree structures yet more explicit and compositionally relevant.

[11] This parallels the 'Consistency Postulate' noted in fn. 5 for vagueness-based approaches.

(21) Miami is hotter than Barcelona.

To accomplish this, we propose that the comparative morphology bypasses the GA's threshold property and accesses directly the background ordering. For (21), the effect of this is that Miami is said to be the bearer/holder of a state of heat (i.e., a state in the background structure of *hot*), the measure of which exceeds any such state described in the *than*-clause.

We build on elements of the semantics of comparative morphology from Wellwood (2015, 2019). On her account, *-er/more* introduces the measure function via the assignment function σ, regardless of whether the target of the comparison is a GA, noun, or verb phrase.[12] The comparative is felicitous with a given XP just in case XP is 'measurable', where a measurable predicate is simply understood to be one that lexically associates with an ordering. This requirement, for us, will be reflected in a not-at-issue component of -ER that its 'contentful' target—whether A, N, or V—specifies an ordering on its domain.

Our novel compositional move is to have the comparative take the GA as an argument and use its background structure. When the comparative combines with *hot*, for example, it uses $\mathbf{hot}_c$ to specify a property of states-of-heat. The matrix subject is merely said to be in one of those states, *s*; the measure function introduced by the comparative morphology maps *s* to a degree.

We propose the entry in (22) for the comparative morpheme, then, assuming: the argument of type *d* is contributed by the *than*-clause;[13] f is the property targeted for measurement; $\mathbf{background}(f)$ is the unique background ordering associated with f; and $\sigma(\mu)$ is the measure function assigned by σ (with restrictions[14]). Given such a degree d, property f, and state s, *more* indicates that the σ-measure of s is greater than d.

(22) $[\![\text{-er/more}_{\mu}]\!]^{c,\sigma} = \lambda d.\lambda f.\lambda s : s \in \mathbf{domain}(\mathbf{background}(f))\ .\ \sigma(\mu)(s) > d$

Putting the pieces together, we deliver the interpretation for the comparative form in (21) as in (23): this says that Miami is in a state in the domain of the background structure associated with the (contextually-determined) property of being hot, the measure of which exceeds any such state for Barcelona.

(23) $[\![\text{Miami}_{[\text{Ho}]} \text{ is hotter (than Barcelona)}]\!]^{c,\sigma}$
$= (\exists s : s \in \mathbf{domain}(\mathbf{background}(\mathbf{hot}_c)))(\mathbf{holder}(s,m)\ \&\ \sigma(\mu)(s) > d_b)$

[12]Strictly speaking, on her account a covert MUCH$_{\mu}$ introduces the measure function. We needn't specify the decomposition here since, for our purposes, it could as well be that -ER bundles together the measure function and the degree relation.

[13]The composition of these clauses is rather complex, involving abstraction over degrees using covert (at least in standard American English) HOW (MUCH); maximization of that derived degree predicate by **max**; etc. See Wellwood (2019: pp. 25-29) for a characterization of the representational and compositional assumptions for *than*-clauses on the classic degree-theoretic approach, and her pp. 78-79 for adaptations related to the comparative morphology introducing measure functions as we assume here.

[14]Some specific restrictions include simple structure preservation/monotonicity (Schwarzschild 2002), and perhaps stronger forms of structure preservation like invariance under automorphism (Wellwood 2018), etc.

5. Solutions

We opened with three challenges for classic degree-theoretic approaches: the mismatch between the patterning of overt morphology across languages with the compositional pieces required for the positive and comparative forms; capturing the compositional semantics of the positive form without appeal to a dubious POS or POS-like element; and, for scale-mates, guaranteeing patterns of mutual entailment of the comparative forms but asymmetric entailment in the positive form. We now show how our account addresses these challenges.

Where the classic degree-theoretic account has GAs introduce a degree variable that needs to be bound in some fashion in the positive form, our GAs express properties of states. Since GAs do not introduce degree arguments, nothing is required to bind them. Instead, the property expressed by the GA is compositionally integrated with the other elements in the clause in the standard neo-davidsonian fashion. The GA's threshold-sensitivity, accordingly, is not viewed as a matter of some external element introducing a **std** function, or the inclusion of a free degree variable, etc; rather, it arises simply due to the context-sensitivity involved in fixing the GA's threshold property itself, much like on vagueness-based approaches.

The meaning of the comparative depends on (and builds off of) the meaning of the lexical GA, albeit through the mechanism of not-at-issue content. The GA lexically provides a context-sensitive property of states—that which we have called the 'threshold property'—and a background ordering on states against which thresholds are computed. The comparative morphology inputs such an interpretation and uses it to access the background ordering; then, it says that an element of the domain of that background ordering holds of the subject, etc. Just as positive occurrences of GAs are interpretable without need of POS or any POS-like element, the comparative meaning is straightforwardly a function of the GA's meaning.

Clearly, then, our compositional analysis aligns with the direction of evidence from overt morphological realization. This result crucially fellows from our account's ability to dispense with any dependence on POS or any POS-like element.

To address the data on putative scale-mates, we must say more about how GA thresholds are fixed. Here, too, our analysis avoids challenges threatening the classic degree-based account. That GAs specify both a background property and a threshold property supports a simple pathway to saying how scale-mates are similar, and how they are different.

Scale-mates are similar, we say, in that they relate to the same background property, e.g., (24) for *hot* and *warm*; these GAs are related in that states of being hot and states of being warm are both ineluctably states of heat; this contrasts with the view on which they merely represent degrees of heat via lexically-determined measure functions.

(24) $\mathbf{background}(\mathbf{hot}_c) = \mathbf{background}(\mathbf{warm}_c) = \langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}} \rangle$

Given this identity of background structures, we can immediately capture facts about mutual entailment between scale-mates in the comparative form. We have already seen the interpretation that our analysis assigns to the comparative with *hotter*; this is given again in (25-a), with the corresponding interpretation for the *warmer* comparative in (25-b).

$$\overbrace{\ldots s_1 \quad s_2 \quad \begin{matrix} s_{3.a} \\ s_{3.b}\end{matrix} \quad s_4 \quad s_5 \quad s_6 \quad \underbrace{\begin{matrix} s_{7.a}\\ s_{7.b}\end{matrix} \quad s_8 \quad s_9 \quad \overbrace{\begin{matrix} s_{10.a}\\ s_{10.b}\\ s_{10.c}\end{matrix} \quad \begin{matrix} s_{11.a}\\ s_{11.b}\end{matrix} \quad s_{12}\ldots}^{\text{positive region for } \textit{hot}}}_{\text{positive region for } \textit{warm}}}^{\text{states of having some heat}}$$

Figure 2: Sample background ordering and thresholds for *warm* and *hot*.

(25) a. $[\![\text{Miami is hotter than Barcelona}]\!]^{c,\sigma}$
$= (\exists s : s \in \textbf{domain}(\textbf{background}(\textbf{hot}_c)))(\textbf{holder}(s,m)\ \&\ \sigma(\mu)(s) > d_b)$

b. $[\![\text{Miami is warmer than Barcelona}]\!]^{c,\sigma}$
$= (\exists s : s \in \textbf{domain}(\textbf{background}(\textbf{warm}_c)))(\textbf{holder}(s,m)\ \&\ \sigma(\mu)(s) > d_b)$

Given (25) and the identity in (24), it is clear that any state which satisfies (25-a) will satisfy (25-b) and vice versa, thus guaranteeing mutual entailment for comparatives with scale-mates.

Scale-mates differ, of course, in labeling different threshold properties. Being warm isn't the same as being hot; indeed, different standards for determining whether a state instantiates one or the other property will be in play both within and across contexts. Yet, certain relationships must be maintained. Consider the sample background structure with thresholds fixed for *hot* and *warm* in Figure 2. Here, the left boundary of the positive region for *hot* is higher in the ordering than the boundary for the positive region for *warm*. This must be so, it seems, for any context *c*. How should we code such standard-setting relationships?

One option would be to stipulate meaning postulates forcing the threshold for one of the scale-mates to be higher than the threshold for states belonging to the other. Another option would be to add indices to the meanings of scale-mates that are used to recover regular, distinct thresholds from the background ordering. Applied to the case of orderings on heat states, for example, we can suppose that the background ordering comes tagged with an upper threshold and a lower threshold. Then, it would be enough for the semantic values of *hot* and *warm* to provide indices that direct semantic evaluation to the relevant upper or lower threshold.[15]

Assuming some sufficient coding along these lines, here is how we can capture the asymmetric entailment from positive forms centered on an 'upper' scale-mate (e.g., *hot*) to those centered on a 'lower' scale-mate (e.g., *warm*). Consider (26-a) and (26-b). Any state satisfying (26-a) will be a state of heat *s*, and one which reaches above the upper threshold defined for the given ordering of heat states. That very same *s* will meet the domain restriction for (26-b) and, by stipulation that upper thresholds exceed lower thresholds on the background ordering, *s* will also satisfy (26-b). The reverse, of course, will not be guaranteed.

(26) a. $[\![\text{Miami is hot}]\!]^{c,\sigma}$
$= (\exists s : s \in \textbf{domain}(\langle D_{\textbf{heat}}, \succcurlyeq_{\textbf{heat}}\rangle))(\textbf{holder}(s,m)\ \&\ \textbf{hot}_c(s))$

[15]In some cases, however, thresholds might be fixed in more complicated ways: in Cariani et al. (shed), we propose a states-based theory of confidence reports in which confidence thresholds are set in part on the basis of 'contrast' states.

b. $[\![\text{Miami is warm}]\!]^{c,\sigma}$
$= (\exists s : s \in \mathbf{domain}(\langle D_{\mathbf{heat}}, \succcurlyeq_{\mathbf{heat}}\rangle))(\mathbf{holder}(s,m)\ \&\ \mathbf{warm}_c(s))$

6. Injecting our solution into the classic account

The core element of the approach we have offered is the idea that the lexical entries of GAs carry two important types of information: one is information about a background ordering, and the other is information about which subset of the domain of that ordering they denote in a given context. The first kind of information is relevant for the interpretation of a GA comparative form, and the second kind is relevant for that of a GA positive form.

We have implemented this proposal within a states-based framework, for the purposes of simplicity and its extensibility to other puzzles. However, the core element as just described can, in fact, be implemented within something closer to the classic degree-based account which posits lexical measure functions to the GA.[16] Here is how it can be done. The lexical entry for the GA introduces its own standard degree, as POS would do on the classic degree-based accounts. The comparative morphology bypasses the information about the standard to access a background scale. So, the GA has the relevant 'background structure' as on our states-based proposal, but this structure is a set of degrees and an ordering relation on it.

Here, just as in §4, our first step is to adapt the lexical entries of GAs. In the Kennedy-style classic degree-based theory discussed at the top, GAs just denote functions from individuals to degrees (type $\langle e,d\rangle$). For ease of reference, an example of such a function is repeated in (28).

(27) $[\![\text{hot}]\!]^c_K = \lambda x.\mu_{\mathbf{heat}}(x)$

The adaptation we explore here departs from this in three critical respects. (i) We render explicit, as a presupposition, the information about the background ordering on degrees. For example, *hot* includes a map from individuals to degrees of heat, and presupposes that those degrees form an ordering. This ordering is distinct from but intimately related to the ordering of states that we used in §4: the background ontology is different—degrees are not states—and orderings of degrees are presumed to be linearly ordered. While these differences are not relevant for current purposes, we will keep track of them by using the notation '$\langle D_{\mathbf{temp}}, \geq_{\mathbf{temp}}\rangle$' for an ordering on degrees representing temperature. (ii) We build the comparison with a contextual degree standard directly in the at-issue component of the GA's meaning, thereby interpreting *hot* so that it is equivalent to ⌜POS *hot*⌝, modulo the above-noted presupposition. And finally (iii), in order to accommodate the scale-mates problem, we hard-code lexical standards as in $\theta_{\mathbf{hot}}$, for reasons that will become clear shortly.

(28) $[\![\text{hot}]\!]^c_A = \lambda x : \mu(x) \in \mathbf{domain}(\langle D_{\mathbf{temp}}, \geq_{\mathbf{temp}}\rangle).\ \mu(x) \geq \theta_{\mathbf{hot}}$

[16] There is a terminological debate at the margin of this discussion that is worth highlighting even though we cannot wade too deeply into it. Whether the semantics in this section would count as a degree semantics depends in part on what we take to be the essential features of degree semantics. One idea would be to think of degree semantics as a theory on which measure functions are involved in the denotations of GAs. In this sense, the semantics would count as a degree semantics. In another sense, a degree semantics is a theory on which GAs have semantic values in the type *d* or in its derivative types. This isn't true here, for reasons that will become clear.

$$\overbrace{\ldots d_1\quad d_2\quad d_3\quad d_4\quad d_5\quad d_6\quad \underbrace{d_7\quad d_8\quad d_9\quad \overbrace{d_{10}\quad d_{11}\quad d_{12}\ldots}^{\text{degrees that count as hot}}}_{\text{degrees that count as warm}}}^{\text{degrees representing temperature (`background' ordering)}}$$

Figure 3: *Hot* and *warm* picking out subsets of the scale of temperature.

This predicts acceptable truth conditions for the positive form, as illustrated with (29): this says, simply, that Miami's degree of temperature is greater than the contextual standard for being hot on the temperature scale. The sentence does not include a positive morpheme or any element like it, since the standard-relativity is incorporated in the lexical meaning of the GA just as on our states-based account (and on vagueness-based approaches generally).

(29) $[\![\text{Miami is hot}]\!]^c_A$ is defined iff $\mu(m) \in \mathbf{domain}(\langle D_{\mathbf{temp}}, \geq_{\mathbf{temp}}\rangle)$
if defined, it is true iff $\mu(m) \geq \theta_{\mathbf{hot}}$

Let us consider how this implementation would apply to the patterns with scale-mates, continuing on with the example of *warm* and *hot*. Here, as in the states-based implementation, one has to stipulate that the lexical entry for the GA includes a context-sensitive threshold. In the present case in which GAs reference only the degree ordering, the idea will be that these thresholds pick out particular, and different, degrees in a shared background scale. This is illustrated in Figure (30).[17] It is not possible here, as on the classic degree-based approach, to make use of a $\mathbf{std}_c$ function to invoke the threshold, because that function would apply to an identical measure function both with *hot* and *warm*; cf. (29) and (30).

(30) $[\![\text{Barcelona is warm}]\!]^c_A$ is defined iff $\mu(b) \in \mathbf{domain}(\langle D_{\mathbf{temp}}, \geq_{\mathbf{temp}}\rangle)$
if defined, it is true iff $\mu(b) \geq \theta_{\mathbf{warm}}$

The interpretation of the comparative must also differ, following again the playbook in §4. The comparative morphology still extracts a background ordering from the GA's interpretation, though in this case that background is a scale (i.e., an ordered set of degrees). Just as before (modulo the types), this account assumes that, for each adjective denotation g, the function **background** maps g to its unique background ordering $\mathbf{background}(g)$. Unlike the states-based approach, the GA introduces the measure function (albeit via a slightly more tortuous path than it did on the classic degree-based account[18]).

(31) $[\![\text{-er/more}]\!]^c_A = \lambda d.\ \lambda g.\ \lambda x : \mu(x) \in \mathbf{domain}(\mathbf{background}(f)).\ \mu(x) > d$

[17]In this diagram, the objects appearing on a line is meant to indicate that the background ordering is a linear ordering. We assume along with the literature that scales, i.e., orderings on sets of degrees, are all linearly ordered.
[18]Consider that, while the g in (31) is of type $\langle e,t\rangle$ rather than of type $\langle v,t\rangle$, the comparative morphology does not introduce a measure on the individual predicate while it did so for the eventuality predicate. On the neodavidsonian approach we advocate, the comparative morphology includes an index, μ, which is provided a value of the measure function type by the assignment function, σ, in accordance with various constraints. On the present alternative, the value of $\mu(x)$ has to be determined on the basis of what is actually found in $\mathbf{domain}(\mathbf{background}(f))$; if this is a set of degrees representing temperature, μ must resolve to $\mu_{\mathbf{temp}}$.

This gets the truth conditions for the comparative form as follows. Again assuming that the *than*-clause straightforwardly contributes a degree (see fn.13), we continue to abbreviate the contribution of, e.g., *than Barcelona is hot*—the maximal degree of temperature measured by Barcelona—as d_b, for simplicity. Given this, the semantics of the comparative works did on much like it the states-based semantics in §4: the property expressed by the GA is used to access a background scale (which also serves to fix the value of μ), so that the sentence, e.g., (32), says that this μ applied to Miami is greater than d_b.

(32) $[\![\text{Miami is hotter than Barcelona}]\!]^c_A$
is defined iff $\mu(m) \in \textbf{domain}(\textbf{background}(\langle D_{\textbf{temp}}, \succeq_{\textbf{temp}}\rangle))$
if defined, it is true iff $\mu(m) > d_b$

This account also meets the challenges that we have discussed. The first challenge was the mismatch between the classic degree-based theory and the direction of morphology: the positive form surfaces as morphologically simpler than the comparative form. Here, by design, the positive form is syntactically simpler than the comparative form. The second challenge was the necessity of postulating (something like) POS, despite little surface evidence to support its existence; there is no such need here. And the third challenge concerned getting the right entailment relations between putative scale-mates; this, too, has been accomplished.

In light of this, we won't claim that the core element of our novel proposal couldn't be captured with the resources of the classic degree-based theory. Further and wider study—some of which we sketch in the next section—is required to adjudicate between these approaches.

7. Coda: advantages of our analysis over the degree-based theory

Our proposal for eliminating POS was initially formulated within a state-based framework. But we have managed to export it to a version of the degree-based framework. Nevertheless, we think there may be additional benefits to a states-based account.

Our analysis shares with Bale's (2008) a differentiation between the ordering lexically associated with the GA, and that in terms of which the comparative relation is stated.[19] However, the difference between positing a base ordering between individuals vs states may provide some purchase on challenges that have been raised for his approach to sentences like (33). Specifically, his account has the *for*-phrase restrict the underlying individual ordering prior to the mapping to degrees. So for example, *tall* restricted by *for a 5-year old* would have a threshold relative to the average tallness of a 5-year old.

(33) Ann is tall for a 5-year-old.

A problem with this style of account was brought to the fore by Schwarz (2010), who pointed out that (34) clearly would not involve restricting the individual ordering of *expensive* with the

[19]Cresswell's (1976) did so as well, differentiating conceptually between an ordering of individuals according to, e.g., height and degrees as names for equivalence classes of individuals under the relevant ordering. Bale's account, uniquely, makes compositionally explicit use of the base orderings and a mapping to degrees, in such a way so as to allow for, e.g., *Ann is taller than Bill* to be true while *Ann is taller for a 20 year old than Bill is for a 5 year old* can be false.

set of 5-year olds—for one thing, such a calculation would exclude the hats, which is what the sentence (on the classic lexical degree analysis) says is being measured for its expensiveness.

(34) Ann bought an expensive hat for a 5-year-old.

In our terms, it seems rather that the *for*-phrase would restrict the threshold property such that the GA's contextual threshold is calculated relative to a property of states instantiated by a 5-year-old, in (33), but by states instantiated by a hat bearing some *R* to a 5-year-old, in (34), where *R* could resolve in relational terms like 'possessed by', 'having bought', or 'being given', etc.[20] A plausible avenue for exploration, then, would consider these different restricting properties relative to attachment height and possible levels of resolution of ellipsis or a predicative anaphor inside the *for*-phrase.

One issue that has not been finally resolved and which may, alone, make the difference for distinguishing between our preferred states-based approach and its lexical degree-based counterpart in section 6, concerns differences in 'crispness'. Recall this was the label Kennedy assigned to the observation that, given only a very minimal difference in ADJ between two individuals, B and C, the comparative form *B is* ADJ*-er than C* is always felicitous, but its putatively positive counterpart like *Compared to B, C is* ADJ need not be. It is potentially significant to emphasize here that, of the options discussed in any detail in this paper, only the states-based account makes different ordering relations available to these two constructions.

But how should we think about the recruitment of these different ordering relations in order to make the relevant predictions? Some thoughts might be usefully suggestive. Combined with a positive GA ascription, a phrase like *compared to B* may introduce an equivalence relation, and contribute that B and the matrix subject are in different classes under that relation. Now, it is true that, strictly speaking, any ADJ-difference with respect to B and C means that some equivalence relation will order them so. However, not all such relations may be equally relevant or salient (cf. Schmidt et al. 2009 on 'indifference'). In contrast, the very point of degree orderings is that they represent any measurable difference.

8. Conclusion

We provided a new account of the relationship between positive and comparative GA ascriptions which preserves insights from both the vagueness- and degree-based approaches to GAs. We first assumed, following recent work, that GAs express properties of (ordered) states, and that comparative morphology introduces a mapping to degrees in a way that respects such lexical orderings. Our novel idea separates out one part of the GA meaning for use in the positive form—i.e., the contextually-determined threshold property—and a different part for use in the comparative form—i.e., the background property against which contextual thresholds are set.

This account avoids problematic aspects of prior approaches. We have the expressive capacity, finally, to capture the semantic patterning of scale-mates like *hot* and *warm*, while remaining faithful to the direction of morphological evidence, and avoiding questions about the realization of POS or any POS-like element. As we saw, it is not at all impossible to reverse engineer our proposal in something like the classic degree-based theory, but we think there may be additional benefits to our states-based account, some of which we have briefly reviewed.

[20]Schwarz (2010) opts for a 'scope of POS'-based analysis that is unavailable to us for the obvious reasons.

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Experimental perspectives on spatial deictic expression acquisition in Thai[1]

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Abstract. This study explored the role of perspectives on the interpretation of Thai spatial deictic terms *lǎŋ* 'behind' and *nâː* 'in front of.' We designed an experiment where the relative location of the experimenter and the participant differed across two sessions. Utilizing 5 objects of 5 different colors arranged in a row, the experimenter asked the participant '*The pen/balloon of which color is behind/in front of the x pen/balloon?*,' where *x* is the color of one of the middle three items. Participants were native speakers of Thai, including 31 adults, 60 typically developing children, and 30 children with Autism Spectrum Disorders (ASD). We found that for Thai-speaking adults, the convention for *behind/in front of* seems to involve object-based allocentric viewpoint, relativizing the deictic notions as if the objects were facing themselves. However, the relative location of the experimenter hugely affected the adults who started off sitting opposite to the experimenter. In contrast, children with TD, egocentric interpretations, projecting their own front and back onto the objects, are preferred for non-fronted, visible objects. Verbal questions and mere presence of Speaker, i.e., without gazes nor gestures, are enough to introduce ambiguities between FoRs for adults and children with TD. Despite their differences from adults in overall perspective resolution, TDs do take into account the experimenter's viewpoint as a contextual resolution option. On the other hand, children with ASD were not affected by experimenter's perspective, and lacked a clear contrast between the opposite deictic terms. They also seem to have general difficulties in grasping the basic relational nature of the two deictic terms.

Keywords: spatial deixis; perspective-taking; relative frame of reference, contextual resolution; autism spectrum disorders.

1. Introduction

Spatial deixis involves resolution of a complex context dependence. While demonstratives like *this* and *that* are mostly anchored to the speaker, this is not always the case for terms such as *behind* and *in front of*. To decide what is *behind* and *in front of* something depends on several factors, including 'frontedness' of entity, additional perspectives or viewpoints of another participants, non-linguistic cues, e.g., gazes, gestures, and developed conventions of different languages. For entities that have obvious fronts, such as dolls or cars, the expressions are usually anchored to the entities. For non-fronted entities, such as balls or pens, the other factors are more likely to come into play. The speaker may choose their own viewpoint or another participant's viewpoint, if there is any, as well as taking into consideration the developed convention of their language. The hearer of such terms may additionally take on non-linguistic cues given by the speaker. We report an experiment investigating factors at play in making these choices in Thai. Given the crucial role of consideration of different perspectives, we look across populations generally assumed to differ in their resources for this, namely children with

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typical development (TD), children with autism spectrum disorders (ASD), and adults. Prior work found the terms *behind*/*in front of* to respectively refer to objects *hidden*/*visible* relative to their body in TDs (Johnston 1984). In ASDs, deictic terms have been found to pose additional challenges with regards to both person deixis (Bartak and Rutter 1974; Charney 1980: a.o.) and spatial deictic terms and gestures (Loveland and Landry 1986; Hobson et al. 2010: a.o.).

The present paper begins with the background literature on spatial deixis, its acquisition, and deixis and autism (Section 2). Section 3 presents the methods of the study. Sections 4 and 5 describe and discuss the results of the experiment.

2. Background

2.1. Spatial deixis and frames of reference

Deixis serves as a linguistic hook into the contextual, perspectival aspects of utterances. It refers to kinds of references that require contextualization based on certain discourse elements, including person deixis (e.g., *I* and *you*), time/temporal deixis (e.g., *now* and *then*), place/spatial deixis (e.g., *here* and *there*), discourse deixis (e.g., *this* and *that*), and social deixis (e.g., honorifics such as *du* vs *sie* in German) (Fillmore 1971, 1975; Lyons 1977; Levinson 1983). Deictic information is important for interpreting utterances. When such information is lacking, a totally unanchored message cannot be fully interpreted, as seen in example (1) of a message that is accidentally come across via a bottle afloat in the sea.

(1) Meet me here at noon tomorrow with a stick about this big. (Fillmore 1971: p. 39)

To anchor a deictic expression, a *deictic center*, also known as 'origo' (Bühler 2011; Diessel 2014), is needed. By default, the deictic center is assumed to be the speaker, but in certain contexts, it can be 'shifted'. For instance, while the spatial deictic term such as *come* usually describes motion towards the deictic center (Talmy 1975; Oshima 2006; Wilkins and Hill 1995), i.e., the speaker in default cases, deictic center may be shifted to the hearer (2a) or another entity altogether (2b).

(2) a. Can I come visit you?
b. John was preparing a meal. Then, the cat came to him. (Oshima 2006: p. 287)

Such deictic projection, where the deictic center/origo is projected from the speaker to the hearer or others, is called 'deictic-center shifting' (DCS; Levinson 1983; Fillmore 1997). It has been found to be important for the analysis of demonstrative reference. In contexts where there is a direct collaboration between interlocutors, proximal or distal linguistic expressions were found to be interpreted based on the partners' 'action space,' as opposed to the speakers' own action space (Rocca et al. 2019). Similarly, for other spatial terms, such as *to the left/right; in front of*, the presence of another person gazing or reaching for tested objects induced more deictic projections where respondents took the other person's perspective, instead of their own (Tversky and Hard 2009; Tosi et al. 2020).

Spatial deictic expressions vary across languages. Different languages make use of different frames of reference (FoR), i.e., the underlying coordinate system for locating a reference object. One important FoR distinction in the developmental and behavioral psychology and neuroscience literature (e.g., Paillard (1991); Burgess et al. (1999); see Levinson (2003: pp. 28-29) for discussion) is the distinction between 'egocentric' vs. 'allocentric' (non-egocentric). With an egocentric FoR, the meanings of expressions are anchored to one's own perspective, e.g., 'behind' for one own's back, whereas they are anchored elsewhere with an allocentric FoR, e.g., others' or object's back. In addition to such distinction, based on the cross-linguistic data from the Max Planck Institute for Psycholinguistics at Nijmegen, Levinson (2003) proposed a tripartite taxonomy of FoR for world's languages, mainly characterizing the relations between three entities, including a 'figure' entity, i.e., the entity to be located, a 'ground' entity, i.e., the entity that is referenced, and a 'coordinate', i.e., the entity that is the deictic center/origo of the coordinate system. Languages vary in their preference or availability of the three types of FoR.

An absolute frame is an environment-based, i.e., geocentric, frame with infinite region of space covered by the frame. For instance, in Figure 1a, the figure (crab) is related to the ground (chicken) via the deictic center (hill). The entire region that is uphill from the chicken is available to be covered by the frame. An intrinsic frame, on the other hand, only involves a figure and a ground, as the latter also serves as the deictic center (origo). In Figure 1b, the frame only relates the figure (crab) to the ground (Sue), which is also the deictic center. The picture is more complicated with a relative frame, where the ground is not the same entity as the deictic center. As seen in Figure 1c, an entity's viewpoint needs to be chosen as the origo of the sentence. If an egocentric FoR is at play, the speaker would be the deictic center. The term 'behind' would then be interpreted as towards the same direction as the speaker's back, making the figure be the orange pen. Conversely, if the speaker makes use of an allocentric FoR, with the hearer being the origo, it is the blue pen which would be 'behind' the purple pen, i.e., locating towards the same direction as the hearer's back with reference to the purple pen.

While intrinsic FoRs are typologically available to all languages, relative FoRs are not. Shusterman and Li (2016) proposed possible explanation for this. First, relative FoRs are harder than intrinsic FoRs conceptually, because of how the deictic center may need to be shifted from the ground. Secondly, relative FoRs allow for ambiguity to arise, further contributing to their difficulty, as seen in Figure 1c. To account for such ambiguity, different languages adopt different developed conventions as the default interpretation of spatial deictic expressions. However, the convention within the same language may also vary by term. For instance, an egocentric viewpoint might be used for the terms *left/right* but an allocentric viewpoint, sometimes of an imaginary listener's, is used for *front/back* (Levinson 2003; Shusterman and Li 2016). Hausa, Tamil (at least the NaTar caste, Ramnad district dialect), and English were used to instantiate these different conventions in (Levinson 2003: pp. 87-88) and (Shusterman and Li 2016: pp. 119-120). When a ground object is non-fronted, Hausa speakers project their egocentric coordinates onto the object for both front/back and left/right. Tamil's convention, on the other hand, is the total opposite, making use of the allocentric viewpoint for all the terms. This is different from the English, where the coordinate system is mixed, i.e., an egocentric projection for left/right but an allocentric frame for front/back. Since Thai is a language with a relative frame of reference, ambiguity arises, and perspectives play an important role in the interpretation of spatial deictic expressions. Which pattern is preferred by Thai-speaking adults, children with TD, and children with ASDs is the interest of our paper.

2.2. The acquisition of spatial deictic terms

Clark (1978) claimed that deictic gesture provides a basis for children's acquisition of verbal

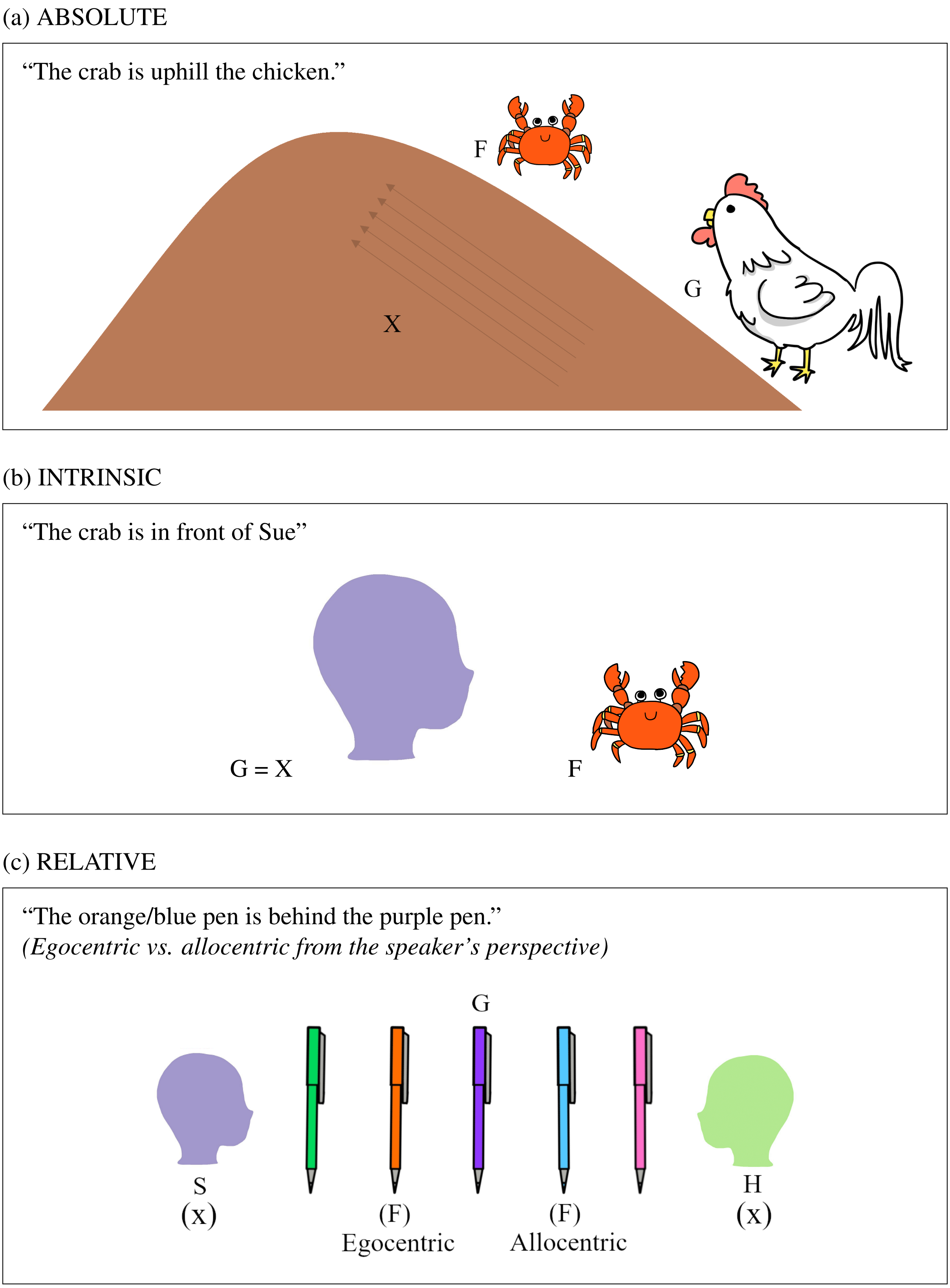

Figure 1: Absolute (a), intrinsic (b), and relative (c) tripartite typology. (F: figure; G: ground; X: coordinate, deitic center/origo)

deixis and that demonstratives are used very frequently in children's early years, being among children's first 50 words. Although there is little empirical research on the acquisition of spatial deixis, recent studies have found that the claim needs to be revisited and verified. Diessel and Coventry (2020) looked at the data in the CHILDES corpora from English (N = 10), Dutch (N = 3), Hebrew (N = 4), and Japanese (N = 3) and found large mean proportions of demonstratives in early child speech ranged from 5.88% to 8.27%. However, the strong claim that demonstratives are within children's first 50 words were not verified. González-Peña et al. (2020) used the language production data of 18- to 24-month-old Spanish- and English-speaking children from the CHILDES corpora (N = 66) and McArthur-Bates Communicative Development Inventories database (N = 950) to explore the long-standing claim and found that demonstratives are not typically among the first 50 words of children.

In learning a relative language, Piaget (1928: pp. 107-108) argued that children initially map FoR terms such as left and right to their own body (Stage I: age 5-8) before considering the interlocutor's point of view (Stage II: age 8-11) and eventually being able to consider FoR from the object's point of view (Stage III: age 11-12). These stages correspond to Piaget's (1928) social stages where ego-centrism begins to decline around the age of 7-8. While children may start to use FoR terms early, the developmental time course before these terms can involve other people's viewpoints is protracted (Shusterman and Li 2016). Additionally, cultural and language-specific influences may come into play, and different spatial terms may also have different acquisition patterns.

While English-speaking children struggle to take an allocentric viewpoint for the terms *left-right*, failing to talk about the *left* and *right* sides of dolls, the non-egocentric interpretation of *back/front* was found to be available to TDs for fronted objects such as dolls (Shusterman and Li 2016). The fact that these two terms, *back/front*, were also found to respectively refer to objects *hidden/visible* in children with TD (Johnston 1984) may ease the children's adoption of a novel viewpoint that may not correspond to their own. At the age of 4, Shusterman and Li (2016) found that English-speaking children with TD equally chose both egocentric and geocentric interpretations for *back/front*.

With regards to children with ASD, social deficits, language and communication deficits, and repetitive behaviors are the three core clinical features of ASD, with pragmatics and discourse deficits being generally accepted to be central to language deficits in autism (for reviews, see (Lord and Paul 1997; Tager-Flusberg 1999; Wilkinson 1998). Among pragmatic deficits, children with autism are known to have difficulties with person deixis (see, for instance, Bartak and Rutter 1974; Charney 1980; Chiat 1982; Fay 1979; Loveland 1984). Spatial deitic terms and gestures were also found to pose challenges to children with autism (Loveland and Landry 1986; Hobson et al. 2010).

With all the factors, including frontedness of entity, additional perspectives or viewpoints of another participants, non-linguistic cues, e.g., gazes, gestures, and developed conventions of different languages, it is of no surprise that the acquisition time course for spatial deictic terms such as *behind* and *in front of* would be protracted for children with TD and children with ASD. However, while, as mentioned earlier, *behind* and *in front of* seem to allow for a non-egocentric interpretation for fronted objects earlier in the acquisition time course than *left* and *right*, it is still unclear whether and how an additional perspective of another participant would affect children's interpretation. On top of that, if other factors are controlled for, i.e., tested with non-fronted objects and without non-linguistic cues, would they only interpret the terms based on the developed convention of their language (or their own generalization) or also allow the other person's perspective as a viable option for their interpretation as well?

3. Methods

Our experiment tests the interpretations of Thai spatial deictic terms *lǎŋ* 'behind' and *nâː* 'in front of', while varying the relative location of experimenter (E) and participant (P) (see Figure 2) across two sessions (administered on two different days or in the morning and in the afternoon). Scenario 1 had E and P sitting on the same side of the table, while they sat on opposite sides in Scenario 2. The shared perspective in Scenario 1, where relativization to E and P yield equivalent interpretations, simplifies contextual resolution choices, whereas Scenario 2 is more challenging. Order of scenarios was counterbalanced across participants, with Group A in Scenario 1 first, and Group B Scenario 2. The setup utilized 5 different color pens and balloons respectively.

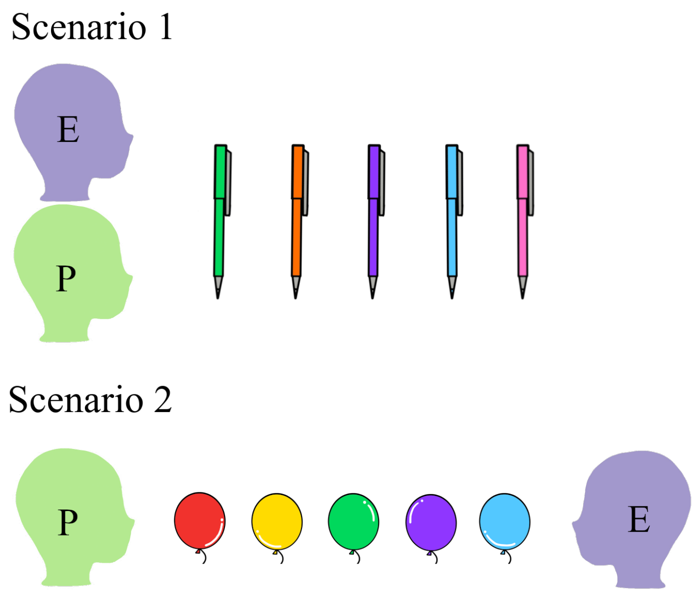

Figure 2: The two scenarios in the experiment (E: Experimenter; P: Participant).

Before the main experiment participants had to name the color of each item to ensure basic understanding. The experimenter then arranged the items in a row and asked the question below (3), with *y* being the color of one of the middle three items. There were 12 trials, with items being rearranged every 3 trials. The experimenter only looked at the data collection form to avoid giving any non-linguistic cues of gazes and movements.

(3) pàːk-kaː/lûːk-pòːŋ sǐː ʔa.raj jùː $\mathrm{k^h}$âːŋ-nâː/$\mathrm{k^h}$âːŋ-lǎŋ pàːk-kaː/lûːk-pòːŋ sǐː **y**
pen/balloon color what COP in front of/behind pen/balloon color **y**
'The pen/balloon of which color is in front of/behind the pen/balloon of **y** color?'

3.1. Participants

Native Thai speaking participants included 31 adults (*M* age = 37.52) and two groups of children. Children with ASD (*N* = 30; *M* age = 9;6) and their typically-developing controls (TDs; *N* = 60; *M* age = 7;11) were recruited from Kasetsart University Laboratory School, Center for Educational Research and Development. All participants from both years had normal hearing and normal or corrected-to-normal vision. The Ravens Standardized Progressive Matrices (Raven et al. 2000) were administered to both groups of children for the assessment of nonverbal IQ (NVIQ; ASD *M* = 94.74; TD *M* = 116.35). The scores were converted using the norms in the 1979 British Standardisation of the Standard Progressive Matrices (Raven 2000, pp. 39-40). Children in both groups had normal hearing and normal or corrected-to-normal vision. This study was approved by the Institutional Review Board at the University of Pennsylvania. Having been informed about the study and their rights, the parents of all the participants provided written consent for their child to participate in the study.

	Adults			ASD			TD		
Group	A	B	Total	A	B	Total	A	B	Total
N (Female *N*)	15(9)	16(11)	31(20)	14(2)	16(1)	30(3)	28(4)	29(6)	57(10)
$M(SD)$ Age	34.67 (6.54)	40.19 (8.55)	37.52 (8.02)	9;6 (1.98)	9;6 (2.13)	9;6 (2.03)	7;10 (1.98)	8;0 (1.86)	7;11 (1.91)
$M(SD)$ NVIQ	NA	NA	NA	105.03 (27.27)	85.74 (17.18)	94.74 (24.12)	118.31 (18.47)	114.47 (18.26)	116.35 (18.30)

Table 1: Participant information

3.2. Data analysis

Responses were coded in terms of distance from the participant, not taking into account where the experimenter was, with Position 0 being the position of the ground (object of **y** color), Position 1 being the position of the pen/balloon adjacent to the ground object that is one position further from the participant, and Position -1 being the position of the pen/balloon adjacent to the ground object that is one position closer to the participant. Figure 3 illustrates (1) how responses were coded for their position indices (Position -2, -1, 0, 1, or 2) and (2) for the term *behind*, which position is considered egocentric vs allocentric interpretation from the participant's perspective in this paper. This is in contrast to the FoR term *in front of* where a egocentric interpretation applies to Position 1, and a allocentric interpretation to Position -1.

Mixed Effects Logistic Regression Models were run using the lme4 package (Bates et al. 2015: version 1.1-28) in the R environment (R Core Team 2016: version 4.1.2) to test whether participants' responses follow the hearer-allocentric pattern of choosing Position 1 for *behind* and Position -1 for *in front of* or not. Main effects included `TrialNumber` and the interactions between `Scenario` (Scenario 1 or 2), `ScenarioOrder` (Scenario 1 first or not), and `ParticipantGroup` (adults, children with TD, children with ASD), and a random effect for participants. `ParticipantGroup` was treatment coded to set different reference levels for each participant group.

To model errors in both groups of children, another mixed effects logistic regression model was run to test whether the children gave strictly incorrect responses (i.e., *z* or objects non-adjacent

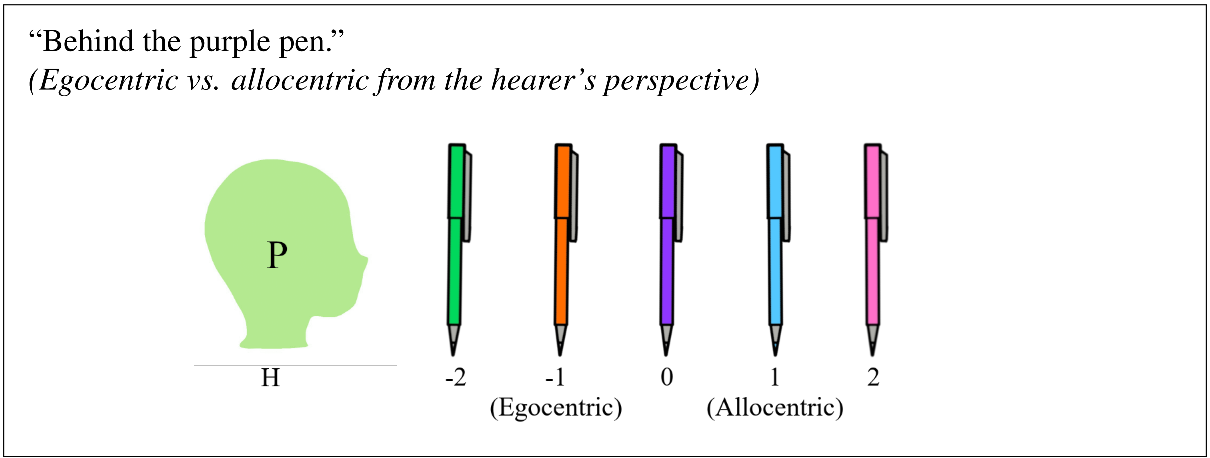

Figure 3: Example coding for responses to the question to locate a pen *behind* the ground (purple pen). (P: Participant; H: Hearer).

to z) or not. Main effects included `Scenario`, `ScenarioOrder`, `Age`, `NVIQ`, `TrialNumber`, the interactions between `Terms` (*in front of* or *behind*) and `ParticipantGroup` (children with TD or children with ASD), and a random effect for participants. `ParticipantGroup` was treatment coded to set different reference levels for each participant group.

4. Results

Overall pattern Figure 4 shows the overall results across participant groups collapsing over scenarios and groups (scenario order). Overall, the adults tended towards choosing Position 1 for *behind* and Position -1 for *in front of*, preferring an allocentric interpretation (e.g., *behind* $z = z$'s back). Children with TD show the opposite pattern, suggesting an egocentric interpretation, relative to their own perspective (e.g., *behind* x = towards the same direction as P's back). Children with ASD generally tended towards objects closer to them (Position -1) regardless of deictic term (*in front of* or *behind*).

Perspectives and Contextual Resolution Both the Scenario ($\beta = 1.54, p < 0.01$) and Scenario order ($\beta = 3.74, p < 0.01$) factors drastically modulated response patterns for adults, as shown in Figure 7. The adults in Group A, who first shared perspective with E, strongly followed the allocative pattern above, although to lesser extent in their second session with divergent perspectives for P and E. In contrast, adults in Group B, who start across from E in Scenario 2, exhibit no overall interpretation preference, suggesting an even mix of contextual resolution choices across speakers. When subsequently sharing perspective with E, their pattern is the exact opposite of Group A, suggesting prominent use of interlocutors' perspective.

For children with TD, the response pattern did not vary across the participants in Group A and B ($\beta = 1.6, p = 0.13$). However, Scenario did affect their response pattern. The TD children were found to perform significantly differently in Scenario 1 versus 2 ($\beta = 0.96, p < 0.01$), with Scenario 1 (sitting together) yielding significantly more allocentric responses. This suggests that children with TD consider E's perspective as a possible viewpoint for the resolution.

While children with TD exhibited similar shifts in performance across sessions, especially

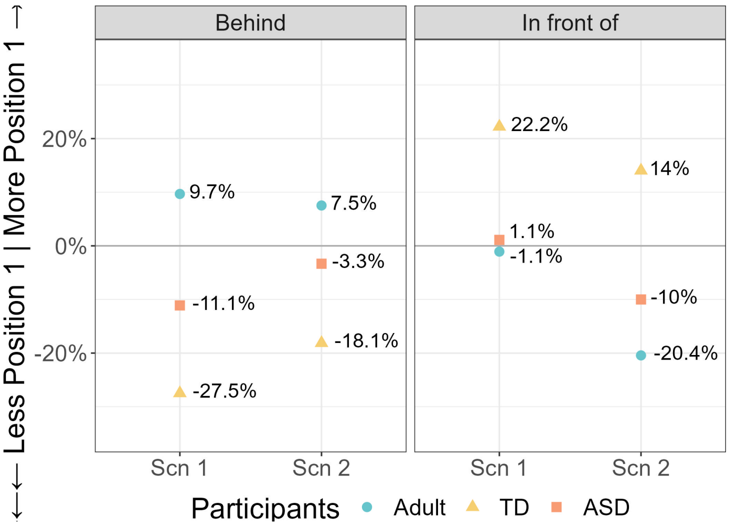

Figure 4: The percentage differences between choosing the object in Position 1 and Position -1. Positive differences indicate the overall preference of the Position 1 choice.

for Group B, no scenario ($\beta = -0.54, p = 0.25$) nor scenario order ($\beta = -0.11, p = 0.87$) effects were found for the ASD group, as seen in Figure 8 and 9. In addition to their minimal performance shifts across sessions, children with ASD gave strictly incorrect responses (e.g., x or objects non-adjacent to x) significantly more often than children with TD (behind: $\beta = 4.62, p = 0.005$; in front of: $\beta = 3.70, p = 0.02$). This can be seen from Figure 5, which presents the overall results across groups, conditions, and sessions and Figure 6, which collapsed the overall rates for choosing the ground object (at Position 0) are presented for each group of participants.

The shifts in performances of Group B between sessions were not significantly different between adults and children with TD ($\beta = 1.03, p = 0.26$) but were significantly different between adults and children with ASD ($\beta = 2.71, p < 0.01$) and marginally significant between children with TD and children with ASD ($\beta = 1.69, p = 0.06$).

5. Discussion

When the initial scenario makes the contrast between speaker's and hearer's perspective moot, adults in Group A employ an object-based allocative viewpoint, with the object construed as facing them. But when distinct perspectives are initially in play (and an allocative viewpoint could be construed as object facing speaker or hearer), responses by adults in Group B suggest an even distribution across contextual resolution options. Once E and P's perspective align in Session 2, interlocutor-based interpretations (E or P, equivalently) dominate the response pattern, in contrast to Group A's allocative viewpoint. Such interpretations relativized to the participant also dominate the response patterns of the children with TD overall, in contrast to Johnston (1984)'s findings ('visible' = *in-front-of* vs. 'hidden'*behind*, which corresponds to allocative resolution). However, in our scenarios, objects were not actually hidden from sight, which plausibly makes an allocative viewpoint less salient, leading the children with TD to prefer an egocentric viewpoint, in line with tendencies based on availability of theory of mind reasoning at their age.

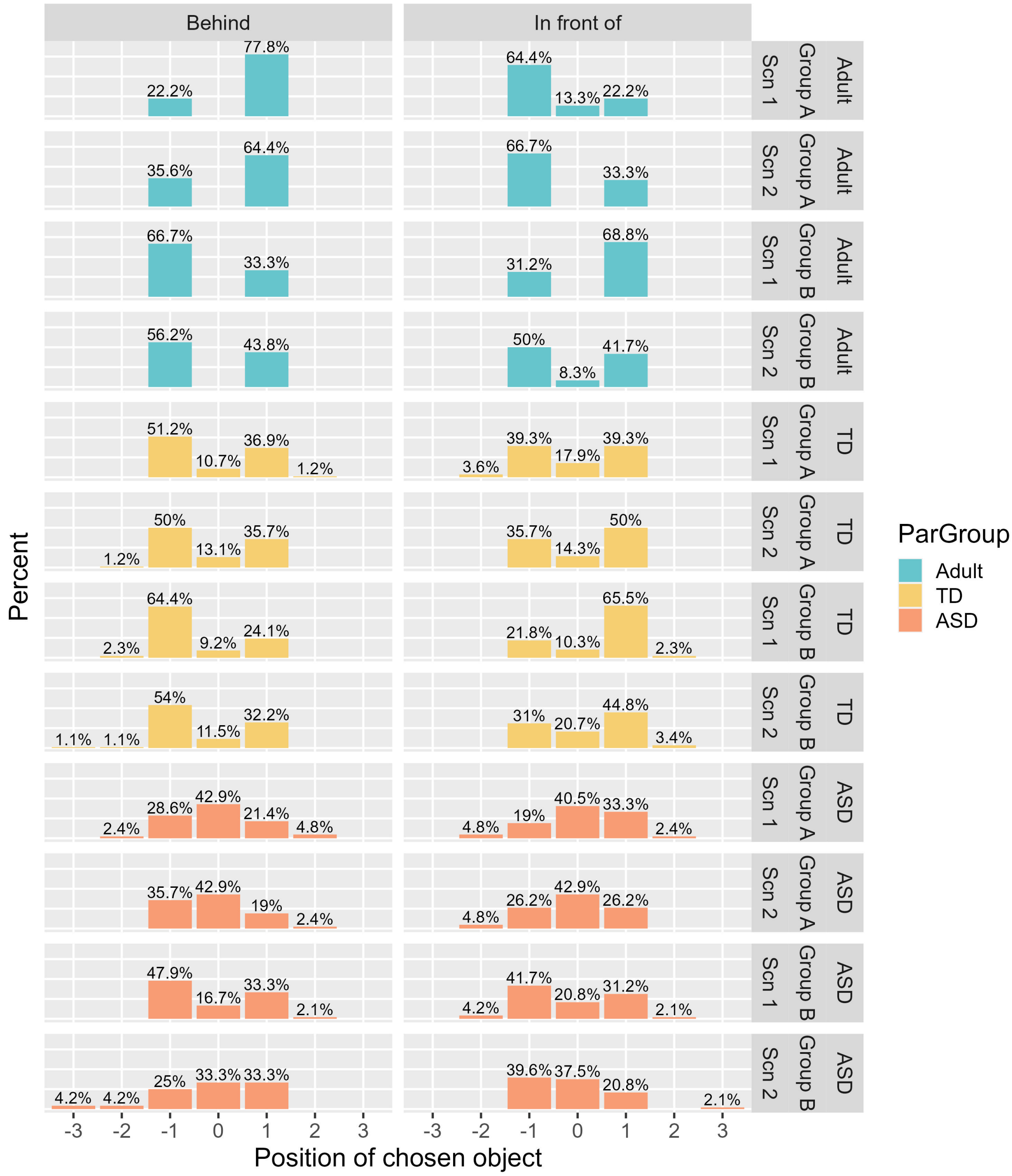

Figure 5: The results in *behind* and *in front of* conditions across participant groups, groups, conditions, and sessions.

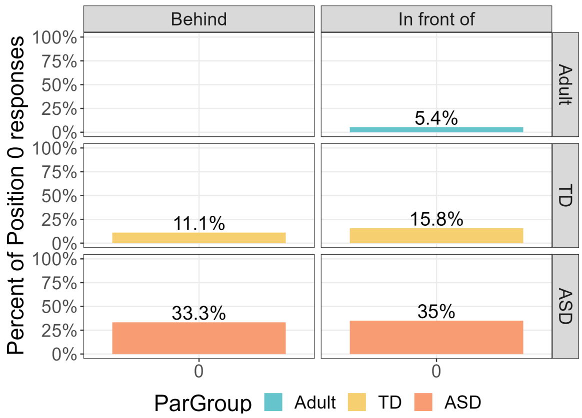

Figure 6: The percentages of choosing the object in Position 0 by term and by participant group.

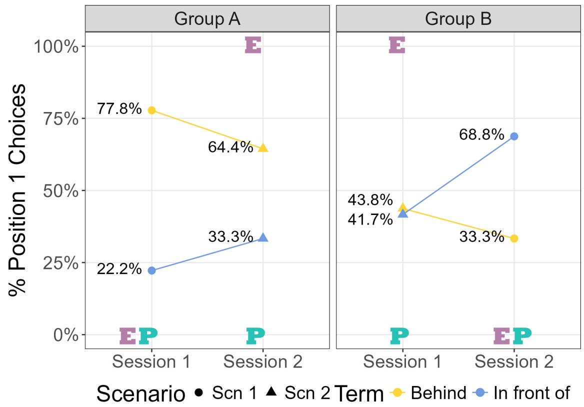

Figure 7: The percentages of responses by the adults in Group A and Group B by preposition, by session, and by location of experimenter.

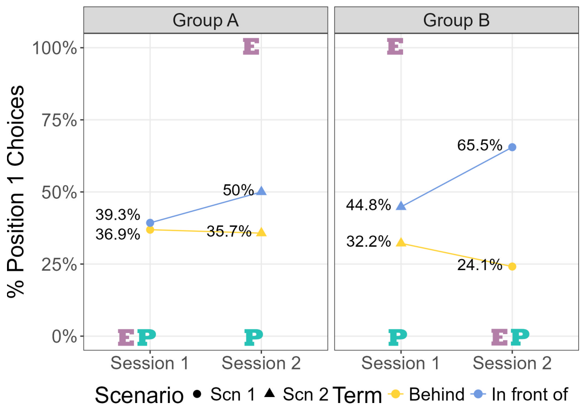

Figure 8: The percentages of responses by the children with TD in Group A and Group B by preposition, by session, and by location of experimenter.

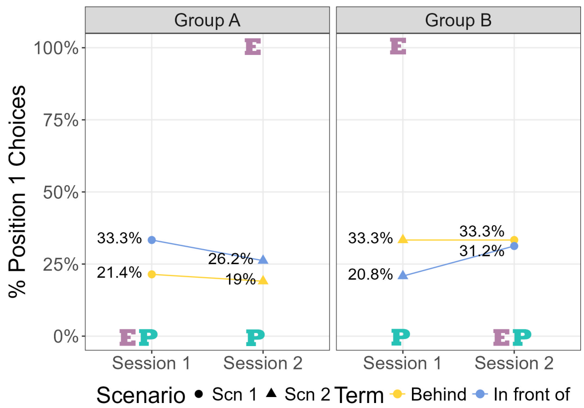

Figure 9: The percentages of responses by the children with ASD in Group A and Group B by preposition, by session, and by location of experimenter.

Both children with TD and adults were similarly affected by the change in experimenter's perspective in Group B, suggesting that despite their differences in overall perspective resolution, children with TD do take into account the experimenter's viewpoint as a contextual resolution option. Children with ASD, on the other hand, were not affected by experimenter perspective, and lacked a clear contrast between the opposite deictic terms. They also had significantly higher error rates than children with TD, suggesting general difficulties in grasping the relational nature of the two deictic terms. This is in noteworthy contrast to another experiment (not reported here) on proximal and distal spatial terms (e.g., *this*, *that*) with the same participants, where children with ASD' deictic interpretations reflected very few struggles of such kind and were more aligned with children with TD's. The particular challenge of the complexity of perspectival options for spatial deixis, also witnessed in the strongly varying adult behavior, thus seems to cause difficulties for children with ASD in the present study, making spatial deixis resolution a rich area for future experimental research, both in general and with regards to population-specific challenges.

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Restrictiveness and the scope of adjectives[1]

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Abstract. I examine the compositional properties of nonrestrictive adjectives, those which are used not to identify referents but to provide additional information about them. By considering the interaction of nonrestrictive adjectives with non-intersective adjectives like *other*, I argue that some nonrestrictive adjectives must take scope over the DP they modify, following Potts (2005). I extend the analysis to account for nonrestrictively modified quantifier phrases, using an anaphoric semantics in line with recent approaches to nominal appositives (e.g. Nouwen 2014), whereby nonrestrictive modifiers are anaphoric to the entity they modify. I provide a compositional dynamic fragment based on Charlow (2014, 2015) that account for a variety of sentences with nonrestrictive adjectives.

Keywords: nonrestrictive adjectives, restrictiveness, scope, anaphora

1. Introduction

Canonical uses of adjectives are restrictive, where they help narrow down the set of potential referents by specifying a subset of the nouns they modify, as in (1). In this example, *my sick dogs* refers not to all of the speaker's dogs, but the subset of the speaker's dogs which are sick.

(1) I have five dogs, but two aren't feeling well. I need to take my sick dogs to the vet.

If adjectives were only used for identifying nominal referents, then uttering (2a), where all of the speaker's dogs are sick, would be using more words than necessary, a violation of the Gricean Maxim of Manner, since *my sick dogs* and *my dogs* are co-referential. But unnecessary uses of adjectives like in (2a) are commonly uttered, and they seem to be serving a different purpose. Rather than being used to identify referents, it contributes information about the referent, such as conveying that the speaker's dogs are sick, and that this is relevant to why they need to be taken to the vet. These uses are nonrestrictive, and there is no consensus on how nonrestrictive adjectives (NRAs) should be analyzed, or whether their compositional semantics differs from restrictive adjectives at all.

(2) I have five dogs, but they aren't feeling well.
 a. I need to take my sick dogs to the vet.
 b. I need to take my dogs, who are sick, to the vet.

Nonrestrictive adjectives are often paraphrased and felt to be synonymous with appositive relative clauses (ARCs) like (2b). Based on this similarity, some linguists have analyzed nonrestrictive adjectives as covert DP-level modifiers, in effect giving the adjectives scope over their hosting descriptions (e.g. Potts 2005, Leffel 2014). However, nonrestrictive adjectives can modify all kinds of quantificational DPs, while appositives are much more restricted. This

[1] I would like to thank Dylan Bumford for his guidance and support throughout the project. I would also like to thank Jesse Harris, Sun-Ah Jun, Ethan Poole, Jessica Rett, Yael Sharvit, and audiences at UCLA SynSem and Sinn und Bedeutung 27 for questions and feedback.

led Morzycki (2008) to an alternate analysis leaving NRAs in-situ where they contribute information to a second, supplemental semantic dimension about the maximal set of referents satisfying the modified noun. There are yet other accounts which treat nonrestrictiveness as a pragmatic epiphenomenon, instead giving an ordinary intersective compositional semantics (e.g. Esipova 2019).

After briefly summarizing previous analyses of nonrestrictive adjectives, I argue that at least some nonrestrictive adjectives must take scope over the DP they modify, based on interactions with non-intersective adjectives like *other*. While (3) presupposes that at least some of the dogs washed yesterday were white, (4) does not. In addition, (4) entails all of the dogs that were not washed yesterday are white. On the other hand, in (3), the dogs that were not washed yesterday includes white dogs but could also include dogs of other colors.

(3) I washed some of the dogs yesterday, and today I'll wash the other white dogs.

(4) I washed some of the dogs yesterday, and today I'll wash the other, WHITE dogs.

I will show how interpreting a nonrestrictive adjective out of the scope of its host DP gives both the proper presupposition for *other* and the proper nonrestrictive interpretation of the adjective. While these data cannot be accounted for by most of the previous analyses I review, it is broadly consistent with Potts (2005). His analysis can be extended to account for additional cases, specifically modified quantifier phrases, using an anaphoric semantics more in line with recent approaches to nominal appositives (e.g. Nouwen 2014). After an informal presentation of my proposed analysis, I provide a compositional fragment analyzing nonrestrictive adjectives, based on Charlow's (2014) compositional dynamic semantics. Finally, I conclude by presenting open questions regarding nonrestrictive adjectives not addressed in this paper and areas that need further research.

2. Previous work

Previous research on nonrestrictive adjectives can be grouped into two broad groups: pragmatic accounts and semantic accounts. Pragmatic accounts attempt to derive nonrestrictive inferences via principles of conversational reasoning, whereas semantic accounts propose some conventionalized mechanism to derive such inferences.

2.1. Pragmatic accounts

In English, there is no obvious conventional way (morphological, syntactic, or prosodic) to mark the (non)restrictiveness of adjectives, unlike the prominent intonational break of nonrestrictive relative clauses.[2] In addition, in many cases like (5) below, the nonrestrictive reading entails the restrictive one. This has lead some to claim that nonrestrictive inferences are pragmatically derived, and that the semantic system only derives the restrictive reading.

(5) I just finished writing my long and tedious manuscript.

a. restrictive: I just finished writing the manuscript of mine which is long and tedious.

[2]While I later discuss some intonational patterns which correlate with nonrestrictiveness in some cases, it is important to note that the intonation does not occur with *all* nonrestrictive adjectives.

b. nonrestrictive: I just finished writing my one and only (salient) manuscript; it is long and tedious.

Esipova (2019), following Schlenker (2005) claims there is no compositional semantic distinction between restrictive and nonrestrictive interpretations. Rather, she argues that what I have called the nonrestrictive inference of a sentence – e.g. in (5), that my manuscript is long and tedious – arises as a pragmatic inference whenever a speaker communicates that they have intentionally used an unnecessary modifier; that is, when a speaker uses a modifier knowing full well that it does not change the truth value of the sentence it is in.

An obvious question for accounts of this kind is how speakers manage to communicate such specific metalinguistic information. Presumably, by hypothesis, the process is not conventionalized, since this is intended to be an alternative to conventionalized implicature analyses. But at the same time, adjectives can be construed to be nonrestrictive even when listeners are a priori unaware of the semantic equivalence between the sentence and its modifier-removed alternative, as in (5). It is not clear what general principle of rational communication would lead an addressee to believe the speaker is being needlessly verbose if they do not already have enough information to know that the verbosity is needless. Of course, in these circumstances, ordinary Maxim of Manner reasoning would put an opposing pressure on the rational addressee to assume, absent contravening knowledge, that the speaker is not being intentionally wordy.

Esipova makes use of the fact that there are many reasons why a modifier might turn out to be vacuous in context. Faced with an utterance in which modifier-vacuity has been signaled, the addressee is presumably free to assume the speaker is conveying anything (or at least, the weakest inference) that would entail the truth-conditional equivalence of the modifier-containing and modifier-less versions of the uttered sentence. This is what leads to conditionalized nonrestrictive inferences in examples like (6). However, this freedom also overgenerates in ordinary cases such as (7).

(6) If all philosophers ask questions like this, I don't want any obnoxious philosophers at my talk next week. (Esipova 2019)

a. correct inference: If all philosophers ask questions like this, they are all obnoxious.

(7) Paige didn't bring her cute puppy.

a. correct nonrestrictive inference: Paige's puppy is cute.

b. predicted (incorrect) possible inference: If Paige didn't bring her puppy, it is cute.

Nevertheless, Esipova (2019) provides a detailed and valuable study on the projection properties of nonrestrictive adjectives. She concludes that the behavior of nonrestrictive adjectives in discourse resembles gender presuppositions, and this holds even when we expand the range of nonrestrictive adjectives to be examined (Chang 2022).

2.2. Semantic analyses

In light of the systematic restrictive/nonrestrictive ambiguity in adjectives, several authors have sought semantic derivations of the contrasts, such as Potts (2005), Morzycki (2008), and Leffel (2014). I will describe and compare the first two, providing a rough sketch of each.

Potts (2005) treats nonrestrictive adjectives just like appositives, giving them scope over the DP they modify (see also Leffel 2014). Nonrestrictive modifiers (adjectives and relative clauses) then serve as functions from the modified entities to truth values in a secondary dimension of meaning, as shown in (8). However, he predicts that nonrestrictive adjectives, like appositives, cannot modify quantifier phrases, since nonrestrictive modifiers are only able to take type *e* arguments. This is not true for adjectives, as shown in Morzycki (2008) and later in Section 4.[3] Below is a rough sketch of Potts' analysis, using the bullet to separate at-issue from not-at-issue content, for both semantic content and types.

(8) Chuck's lovely vases
$\textbf{vases-of}(\textbf{chuck}) \bullet \textbf{lovely}(\textbf{vases-of}(\textbf{chuck})) : e \bullet t$

Morzycki (2008) focuses on quantifier phrases with nonrestrictive adjectives, which generate different inferences from nonrestrictively modified referential phrases. Nonrestrictive adjectives in quantifier phrases generate a "sum-level inference" (Leffel 2014), which means the entire set denoted by the noun is in the extension of the adjective, as shown in (9). For him, a nonrestrictive adjective modifies the noun directly (not the DP), in all cases predicated on the maximal set of entities which have the property of the noun, within the contextually relevant domain *C*. This is shown in (10), with an example in (11).

(9) Few lazy senators voted for the bill.
nonrestrictive inference: the senators are lazy

(10) Expressive Predicate Modification (Morzycki 2008)

$$\beta \bullet \alpha(\Sigma\beta) : (e \to t) \bullet t$$

$$\alpha : e \to t \qquad \beta : e \to t$$

where the modifier is α and the modified expression is β; $\Sigma\beta$ picks out the maximal plural individual in the extension of β.

(11) Every [unsuitable (= α) word$_C$ (= β)] was deleted.
$\textbf{every}(\lambda x.\textbf{word}\,x \wedge x \in C)(\textbf{deleted}) \bullet \textbf{unsuit}(\Sigma(\lambda x.\textbf{word}\,x \wedge x \in C)) : t \bullet t$
inference: every word is unsuitable

His analysis is able to handle nonrestrictively modified quantifier phrases with any quantifier. This is because the inference it generates does not depend on the quantificational force of the quantifier, which is in line with the data: all quantifier phrases can lead to sum-level inferences, which are predicated on the maximal restrictor set and ignore the quantificational force of the quantifier.

3. The scope of non-intersective adjectives

Many non-intersective adjectives display interesting scopal interactions with other adjectives in the same DP. If an adjective *Adj* is intersective, then *X is an Adj N* entails *X is Adj* and *X is an N*. On the other hand, non-intersective adjectives have meanings which are dependent on the

[3] In fact, this is not true for appositives either (Arnold 2004, Del Gobbo 2007).

noun they modify, and do not exhibit the entailment pattern shown by intersective adjectives (e.g. Siegel 1967).

In this section, I examine the interactions these non-intersective adjectives have with other adjectives in the same DP by looking at examples with *other*. I show that under certain readings, adjectives that follow *other* must be interpreted as nonrestrictive. While my examples use *other* for clarity, the properties I describe apply to other non-intersective adjectives as well, which I show at the end of this section.

Let us start by examining the properties of *other* to formulate a simple denotation. *Other* is often used to convey to listeners which entity or entities they are referring to from a given set by contrasting what the speaker is referring to with previously mentioned or contextually salient entities, which I call the antecedent of *other*. In the following examples, I give an explicit linguistic antecedent for *other* to create contrast with, but *other* can take its antecedent from the extralinguistic context.

As shown in (12), *other* requires an antecedent which bears the property denoted by its sister. In this example, the antecedent is *my little poodle*, which bears the property of *dog*, but not *cat*, explaining why it is infelicitous to say *my other cat* in this context.

(12) Over there is my little poodle. My other {dog/#cat} is with my parents right now.

I assume, following Kamp (2001), that *other* is anaphorically linked to this antecedent and presupposes that the antecedent has the property of its sister, *P*. *Other* also requires that its subject and antecedent are disjoint, which I represent with ≠.[4]

(13) $[\![\text{other}_i]\!]^g = \lambda P : P(g_i).\, \lambda x. P(x) \wedge g_i \neq x$

It follows from the denotation in (13) that if a restrictive adjective appears in the first argument of *other*, the antecedent will be presupposed to satisfy that adjective, as in (14). In this example, *the other small book* presupposes that the antecedent book is small, and this presupposition is satisfied by the information given in the first half of the sentence. On the other hand, because the antecedent is small, it is infelicitous to use *the other large book* here. This is explained if the first argument of *other* is *small/large book*, not just *book*, and thus the adjective contributes to the presupposition in addition to the noun.

(14) *(Scenario: I give you two small books and two large books, and point to a small book.)*
Leave that small book on the table, and put the other {small/#large} book on the shelf.

However, with the right intonation, cases like (15) or (16) are also felicitous, where an adjective (here, *larger* or *white*) modifying the noun modified by other does not describe the antecedent.

[4]The reason disjointness is asserted and not presupposed is clearer with indefinites, such as *two other dogs*. In (i), the discourse is felicitous even if there are only two dogs, not four. B's denial of A's assertion involves B denying that the dogs John washed were disjoint from the first group, and *two other dogs* does not presuppose the existence of a third or fourth dog.

(i) A: John washed these two dogs yesterday, and he washed two other dogs today.
B: No he didn't, today he washed the same dogs as he did yesterday!

The relevant intonational cues seem to involve a prosodic break before the relevant adjective, and stress on that adjective, which bring out the nonrestrictive interpretation of the adjective. I discuss the importance of this intonational pattern further in Chang (2022), but I leave a systematic study of the intonation of nonrestrictive adjectives for future work.

Because the examples are acceptable despite the antecedent not being the extension of the adjective, the adjective must not be part of the presupposed predicate. Specifically, in (15), *the other, larger book* does not presuppose that the antecedent book is a "larger book", but merely that it is a book.

(15) *(Scenario: I give you a small book and a large book, and point to the small book.)*
Leave that small book on the table, and put the other, LARGER book on the shelf.

(16) I washed the black dogs today, and I'll wash the other, WHITE dogs tomorrow.

I will call adjectives like this "contrasting", i.e. adjectives between *other* and the noun they modify, but which do not describe the antecedent and thus do not contribute to its presupposition. Examples include *larger* in (15) and *white* in (16). Note that nouns cannot be contrasting in this sense; in the infelicitous example (17), *the red umbrella* is not sufficient to satisfy the presupposition of *the other red book*, since (17) presupposes that there is a red book, not just any red object.

(17) # Leave the red umbrella on the table, and put the other(,) red(,) BOOK on the shelf.

Crucially, contrasting adjectives do not merely commute with *other*; they are necessarily interpreted nonrestrictively. In other words, they are taken to apply to the entire class of objects in the extension of the *other* NP. For instance, (18a) cannot be used to refer to those books which are both larger than and different from the antecedent; instead it commits the speaker, infelicitously here, to all of the other books in the office being larger than the one they picked up. Note that an ordinary restrictive reading like (18b) is also grammatical; however, it is also infelicitous because it is contradictory by assuming that the antecedent book is larger than itself.

(18) *(Scenario: You enter my office with books everywhere. I pick up an average-sized book. You notice there are only two books larger than the one I picked up but many smaller ones.)*
  a. # Take this book home, and put the other, LARGER books on the shelf. NR
  b. # Take this book home, and put the other larger books on the shelf. R

Similar patterns can be observed with other non-intersective adjectives whose semantic contributions are affected by the phrases they modify, such as superlatives, ordinals, and exclusives like *only*. Example (19) contains a minimal pair, differentiated only by intonation.[5] In the first example, with no pauses, *utterly useless* is restrictive and the VHS Pat bought was the last utterly useless one, with the possibility of some non-useless VHS tapes remaining at the sale. In the second example (with pauses), *utterly useless* is nonrestrictive and the VHS Pat bought was the last one overall.

[5]One can replace *last* with *only*, *oldest*, etc. to construct additional examples.

(19) a. Pat bought the last utterly useless VHS tape from the garage sale. R
≈ Pat bought the last VHS tape which was useless (perhaps there are more)
b. Pat bought the last, utterly USELESS, VHS tape from the garage sale. NR
≈ Pat bought the last VHS tape; it was useless (there are no more VHS tapes)

I have shown that some adjectives cannot be interpreted within the scope of their DP, and I will discuss how to handle this issue in the following sections. But first, I would like to comment on the relationship between these examples and pragmatic accounts of nonrestrictive adjectives.

Some of the examples I present display notable entailment patterns between the two readings. In (19), the nonrestrictive reading entails the restrictive one. That is, if it is true that Pat bought the last VHS tape at the garage sale (which happened to be useless), it is also true that Pat bought the last item which was both a VHS tape and useless. In these cases, it is possible to say that the adjective is always restrictive, and that the nonrestrictive reading happens to be true if the context is right (Esipova 2019) or that the nonrestrictive reading is the result of strengthening the restrictive reading in certain contexts.

However, there are cases in which such a pragmatic account is impossible due to the lack of entailment patterns. The examples with *other* (or *second*, *next*, etc.) crucially do not display the entailment patterns just described.

(20) a. I washed these dogs today, and I'll wash the other white dogs tomorrow. R
b. I washed these dogs today, and I'll wash the other, WHITE dogs tomorrow. NR

In (20), the restrictive interpretation commits the speaker to washing the intersection of dogs not washed today and white dogs, but says nothing about dogs of other colors. In addition, the dogs washed today are white. On the nonrestrictive interpretation, all the other dogs (all the dogs the speaker is not pointing to) are white and being washed tomorrow. In this example, neither the restrictive reading nor the nonrestrictive reading entail the other, so the nonrestrictive reading cannot be reduced to a special subcase of the restrictive reading. Thus, the nonrestrictive reading must be derived independently in the semantics.

There are two crucial properties of contrasting adjectives that need to be captured in any analysis. As shown in (18a), repeated below in (21), and similar examples, contrasting adjectives need to i) escape the semantic scope of *other*, and ii) be interpreted nonrestrictively. That is, *larger* does not and cannot describe the antecedent book, and *all* non-antecedent books must be larger than this antecedent.

(21) *(Scenario: You enter my office with books everywhere. I pick up an average-sized book. There are only two books larger than the one I picked up but many smaller ones.)*
\# Take this book home, and put the other, LARGER books on the shelf.

An analysis similar to Potts (2005) or Leffel (2014) can account for these two properties. In effect, nonrestrictive adjectives scope over their host DP and take it as an argument, and return a two-dimensional result: one dimension contains the DP argument unchanged, and the secondary component says the DP has the property of the adjective.[6]

[6]I make no specific claims about the discourse status of the secondary dimension. It is simply used to facilitate

While only some examples (e.g. those with *other*, *second*, etc. + a contrasting adjective) require a special analysis for deriving the nonrestrictive interpretation, this analysis in principle can apply to all nonrestrictive readings, even those in which there is an entailment relationship between the restrictive and nonrestrictive readings. Thus, I leave open whether *all* nonrestrictive adjectives should be treated specially as such, but there is no harm in supposing they do.

Interpreting the contrastive adjective *larger* out of the scope of the DP simultaneously accounts for i) how the nonrestrictive predication is generated, and ii) why *larger* does not describe the antecedent of *other*. This is illustrated in (23b), which is the intended meaning of (22b), and contrasts with an ordinary restrictive adjective in (23a), which corresponds to (22a).

(22) *(Scenario: There are two books on the table. I point to one of the books.)* Put this^i book on the shelf, and take home...
  a. the other$_i$ small book. (restrictive)
  b. the other$_i$, LARGER book. (nonrestrictive)

(23) a. $[\![$[the [other$_i$ [small book]]]$]\!]^g$ presupposes $\textbf{small}(g_i) \wedge \textbf{book}(g_i)$
  foregrounds $\iota x.\textbf{small}(x) \wedge \textbf{book}(x) \wedge g_i \neq x$
  b. $[\![$[larger [the [other$_i$ book]]]$]\!]^g$ presupposes $\textbf{book}(g_i)$
  foregrounds $\iota x.\textbf{book}(x) \wedge g(i) \neq x$
  backgrounds $\textbf{larger}(\iota x.\textbf{book}(x) \wedge g_i \neq x)$

Because contrasting adjectives need to be interpreted outside the scope of the DP, many of the analyses discussed in the previous section, such as Morzycki (2008) or Esipova (2019), are insufficient. This is because they interpret (all) nonrestrictive adjectives within the DP they modify, and thus generate incorrect presuppositions for *other*. That is not to say that their analyses do not capture the data they intended to explain well, but that their analyses cannot be extended to the data I introduce in this paper. In the next two sections, I will develop an analysis based on Potts (2005) to account for additional cases of nonrestrictive adjectives.

4. Modified quantifier phrases

In the previous section, I presented an argument for why nonrestrictive adjectives must be interpreted out of the scope of the DP they modify. It is easy to, following Potts, give a nonrestrictive adjective scope over a definite DP, because the adjective, being type $e \to t$, can be predicated on the referent of the definite DP. However, this analysis will not work for nonrestrictively modified quantifier phrases.

Quantifier phrases have type $(e \to t) \to t$, which is not compatible with the preliminary analysis presented above. Although nonrestrictive adjectives contribute similar backgrounded content as appositive relative clauses, the distribution of nonrestrictive adjectives in quantifier phrases is much less restricted. Nonrestrictive adjectives can modify essentially any kind of quantifier phrase, and they generate different kinds of inferences when compared to appositives. Thus, a Potts-style analysis is insufficient to explain the behavior of nonrestrictive adjectives in quantifier phrases, and it was this insufficiency that led to Morzycki's (2008) analysis, which can also handle modifier quantifier phrases.

composition, whereby a nonrestrictive adjective turns a DP into a DP with additional content (the nonrestrictive inference), allowing composition to continue as it would without the nonrestrictive adjective.

One major distinction between nonrestrictive adjectives and appositive relative clauses concerns their attachment properties. Appositives cannot attach to many quantifier phrases, as in (25), while nonrestrictive adjectives can do so freely (24). While there are examples of quantifier phrases with appositives (Arnold 2004, Del Gobbo 2007), there seem to be more restrictions on their occurrence.

(24) I deleted every embarrassing message.
  a. nonrestrictive: I deleted every message. They were embarrassing.
  b. restrictive: I deleted every message which is embarrassing (but not necessarily those that are not embarrassing).

(25) appositive relative clause: *I deleted every message, which is/are embarrassing.
intended meaning = (24a)

Not only are nonrestrictive adjectives able to modify a variety of DPs, they generate several kinds of inferences as well, which differ based on what the speaker intends to modify. There are three main kinds of nonrestrictive adjective inferences: individual, kind, and sum (Leffel 2014).

(26) I need to take my sick mother to the hospital.
  a. individual-level inference: my mother is sick

(27) Entitled millennials are ruining the economy.
  a. kind-level inference: millennials are entitled

(28) I deleted every unsuitable word.
  a. sum/subkind-level inference: the words in my paper were unsuitable

Individual-level inferences describe the referent of the DP, when there is one. *Sick* in (26) describes the referent of "my mother". Kind-level inferences describe the entire kind denoted by the noun, such as the kind "millennial" in (27) (Carlson 1977). Finally, sum-level inferences describe a group of entities, within a contextually domain-restricted set. Sum-level inferences comment on the maximal set, or "maxset" (Evans 1977), which is the set corresponding to the restrictor of the quantifier. This occurs regardless of whether the quantifier is universal (like *every*) or not; in other words, sum-level inferences ignore the quantificational force.

How do individual-level inferences work in the case of quantifier phrases, where there is no explicit referent? The closest notion of a referent for quantifier phrases would be the witness set, i.e. the intersection of the restrictor set and the scope set. However, this interpretation is generally not available. For example, (29) cannot be used to convey that the senators who voted for the bill are lazy, which would be the individual-level inference. Typically, (29) means that all of the relevant senators are lazy. Because the maximal set of relevant senators is modified, this is the sum-level inference. A kind-level inference is also available, but not as prevalent as the sum-level, and in practice it can be hard to distinguish between the two.

(29) Few lazy senators voted for the bill.
  a. # individual-level inference: the senators who voted for the bill are lazy

b. sum-level inference: the senators (in the US) are lazy
c. kind-level inference: senators in general are lazy

Thus, the form of the DP affects what kind of inferences nonrestrictive adjectives can lead to. Although the focus will be on deriving individual-level inferences from referential DPs and sum-level inferences from quantificational DPs, I will suggest some ways in which kind-level inferences can be derived at the end of this section.

4.1. An anaphoric analysis

I suggest that nonrestrictive adjectives mirror patterns seen with nominal appositives.[7] It has long been argued that appositives are linked anaphorically to their anchors (e.g. Sells 1985, Arnold 2004, Nouwen 2007) in that the felicity of an appositive closely corresponds to the felicity of downstream discourse anaphora. For instance, singular appositives cannot modify distributive quantifiers, just as singular pronouns cannot be bound outside of their scope (30). On the other hand, plural appositives can comment on the plurality of elements satisfying the distributive quantifier's restrictor, just as a subsequent plural pronoun can (31).

(30) a. * Every climber, an experienced adventurer, made it to the summit.
b. * Every climber made it to the summit; he was an experienced adventurer.

(31) a. Every climber, all experienced adventurers, made it to the summit.
b. Every climber made it to the summit; they were all experienced adventurers.

In this section, I informally show how nonrestrictive adjectives can be analyzed as anaphoric to the entity they modify, i.e. to the DP immediately containing them. This allows us to account the properties of contrasting adjectives described in the previous section, while also unifying the definite, indefinite, and quantificational cases. In the next section, I present a formal compositional dynamic fragment that captures the analysis informally described in this section.

I denote adjectives to be interpreted nonrestrictively as labeled with NR. A nonrestrictive adjective is anaphoric to a discourse referent u, written NR_u. NR_u converts adjectives which are restrictive by default into a nonrestrictive adjective which modifies the discourse referent denoted by u. Contrasting adjectives to the right of *other* still need to escape the semantic scope of *other*, so nonrestrictive adjectives are interpreted outside of the DP they modify. This also prevents an adjective anaphoric to u from being evaluated within the DP that introduces that same discourse referent.

In the informal analysis below, I use ιx or $\iota x.Px$ to pick out the unique x that satisfies P, and similarly Σx or $\Sigma x.Px$ to pick out the maximal set of x that satisfy P. Operators such as these and existential $\exists$ can introduce discourse referents as superscripts. When subscripted, these discourse referents are evaluated with respect to an assignment function g. Definite and indefinite DP cases are straightforward to account for.

[7] I chose to draw explicit comparisons between nonrestrictive adjectives and nominal appositives due to the fact that appositive relative clauses are more restricted in their usage, especially in quantifier phrases. However, it turns out that both nominal appositives (Nouwen 2014) and appositive relative clauses (Del Gobbo 2007, Schlenker 2022) have been analyzed as anaphoric, and my analysis of nonrestrictive adjectives follows the spirit of both.

(32) Definite DP: The^u lazy-NR$_u$ student slept.
$[\![$[[lazy-NR$_u$ [the^u student]] slept]$]\!]^g$ asserts $\textsf{\textbf{sleep}}(\iota^u\,\textsf{\textbf{student}})$
backgrounds $\textsf{\textbf{lazy}}\,g_u$

(33) Definite DP with *other*: The^u other$_i$, blue-NR$_u$ book is missing.
$[\![$[[blue-NR$_u$ [the^u [other$_i$ book]]] is missing]$]\!]^g$ presupposes $\textsf{\textbf{book}}\,g_i$
asserts $\textsf{\textbf{missing}}(\iota^u x.\,\textsf{\textbf{book}}\,x \wedge x \neq g_i)$
backgrounds $\textsf{\textbf{blue}}\,g_u$

(34) Indefinite DP: Some^u annoying-NR$_u$ child attended.
$[\![$[[annoying-NR$_u$ [some^u child]] attended]$]\!]^g$ asserts $\exists^u x \in \textsf{\textbf{child}}.\,\textsf{\textbf{attend}}\,x$
backgrounds $\textsf{\textbf{annoying}}\,g_u$

In (32), the backgrounded content is $\textsf{\textbf{lazy}}\,g_u$. The discourse referent u refers to the individual denoted by *the student*, so the backgrounded content says that the student is lazy, as desired. Similarly, in (33), the backgrounded content $\textsf{\textbf{blue}}\,g_u$ evaluates to "the other book is blue". Since *blue* is not evaluated in the scope of *other*, the correct presupposition is predicted as well: the antecedent is a book, not a blue book. Finally, discourse referents introduced by indefinites pose no problem; the backgrounded content in (34) states that the child that the speaker is describing as an attendee is annoying.

Examples like (35) show that non-intersective adjectives like *talented* can be used as a contrasting adjective in the scope of *other*.

(35) A beginner dancer was struggling in class, so the other, talented dancers helped him.

Adjectives like *talented (dancer)*, *possible (winner)*, or *recent (retiree)* are often analyzed as taking the noun they modify as an argument (e.g. Morzycki 2016). That is, they do not combine with the modified noun via set intersection, but via set subsection. An individual can be talented in one domain, but not talented in the other. If *talented* denoted a set of individuals who are talented, then a talented dancer and untalented singer would be predicted to also be a talented singer and untalented dancer. Because this inference should not hold, adjectives like *talented* are subsective adjectives, not intersective, and should take the noun as an argument.

Non-intersective contrasting adjectives can also be handled by this anaphoric analysis. Since the non-intersective adjective *talented* needs to take the noun *dancers* as an argument to determine the kind of talent to attribute to the dancers, I propose that the noun and adjective both scope out of the DP. The noun leaves a trace p, which is later filled in by the noun.[8]

(36) Non-intersective contrasting adjective: The^u other, talented-NR$_u$ dancers came.
$[\![$[[[talented-NR$_u$ dancers] [λp [the^u other p]]] came]$]\!]^g$ presupposes $\textsf{\textbf{dancers}}\,g_i$
asserts $\textsf{\textbf{came}}(\Sigma^u x.\,\textsf{\textbf{dancers}}\,x \wedge x \neq g_i)$
backgrounds $\textsf{\textbf{talented dancer}}\,g_u$

[8] In section 3, I claimed that (at least some) nonrestrictive adjectives must be interpreted outside of the DP they are in. This is the only kind of example that also requires the noun to be interpreted alongside the adjective, but for simplicity, I present similar derivations for all of the examples in section 5, where I scope both the adjective and noun outside of the DP in all nonrestrictive examples.

Finally, I illustrate how the anaphoric analysis derives sum-level inferences from modified quantifier phrases. In (37), *every*^{u} introduces a discourse referent that corresponds to the maximal set of entities which satisfy the restrictor (Evans 1977). Thus, the backgrounded content $\textbf{unsuitable}\, g_u$ evaluates to $\textbf{unsuitable}(\Sigma\textbf{word})$. Similarly, in (38), g_u evaluates to $\Sigma\textbf{senator}$, the maximal set of all relevant senators, and the backgrounded content states that all relevant senators are lazy.[9]

(37) Quantifier DP: Every^u unsuitable-NR_u word was deleted.
$[\![$[unsuitable-NR_u [[every^u word] was deleted]]$]\!]^g$ asserts $\forall^u x \in \textbf{word}.\, \textbf{deleted}\, x$
backgrounds $\textbf{unsuitable}\, g_u$

(38) Quantifier DP: Few^u lazy-NR_u senators voted.
$[\![$[lazy-NR_u [[few^u senators] voted]]$]\!]^g$ asserts $\text{FEW}^u x \in \textbf{senator}.\, \textbf{voted}\, x$
backgrounds $\textbf{lazy}\, g_u$

5. Formal semantic fragment

In this section, I show how nonrestrictive adjectives can be analyzed as anaphoric update modifiers using post-suppositional techniques that have recently been applied to other scope-taking adjectives like modified numerals (Brasoveanu 2013) and superlatives (Bumford 2017). To analyze anaphora compositionally, I use a compositional dynamic semantics based on Charlow (2014). Additionally, following Charlow (2015), any content that can be made dynamic will be enriched with additional secondary meaning when necessary, allowing for backgrounded or not-at-issue content to be written and passed up the tree without affecting the at-issue composition (Giorgolo & Asudeh 2012).[10]

Like above, DPs introduce discourse referents, as denoted by superscripts, and nonrestrictive adjectives are anaphoric to these discourse referents, as denoted by subscripts. A node with type $\mathtt{M}_\alpha := g \to \{\alpha \times g\}$ denotes a dynamic update; it is a function from (input) assignments to sets of pairs of semantic content with type α and (output) assignments. α itself may be a pair of type $\beta \times t$, where t is a truth value storing not-at-issue/backgrounded content, separated from at-issue content with a bullet $\bullet$. The following two type-shifters will be used as necessary to facilitate composition: $\Uparrow$ to raise an element to an enriched, dynamic type, and $\star$ to combine functions with arguments of an enriched type.

(39) a. $x^{\Uparrow} := \lambda g.\, \{\langle x \bullet \top, g\rangle\}$ $\quad \Uparrow :: \alpha \to \mathtt{M}_{\alpha\times t}$

b. $\star mk := \lambda g.\, \{\langle y \bullet s \wedge t, i\rangle \mid \langle x \bullet s, h\rangle \in mg, \langle y \bullet t, i\rangle \in kxh\}$
$\star :: \mathtt{M}_{\alpha\times t} \to (\alpha \to \mathtt{M}_{\beta\times t}) \to \mathtt{M}_{\beta\times t}$

To make denotations more readable, I definite two helper functions. TRUE takes a dynamic truth value (type $\mathtt{M}_t$) and evaluates it at a given context (type g); it returns true if there is any

[9]As an aside, kind-level inferences can also be derived if we assume that nouns (or at least nouns used as kinds) introduce kind-type discourse referents (Carlson 1977). (i) contains an example of the kind "elephants". The pronoun *they*$_u$ in the following sentence can refer to the kind "elephants". If kind-denoting nouns introduce kind-type discourse referents, a nonrestrictive adjective can pick up this discourse referent and modify the kind.

(i) Elephants^u are mammals. They$_u$ do not lay eggs.

[10]Dynamic composition is facilitated by the StateSet monad, and multidimensionality by the Writer monad.

output context such that the dynamic truth value is true, i.e. for any value of an indefinite. TRUE is thus a way to lower dynamic truth values into ordinary ones. MAX takes a function from entities into dynamic truth values, and returns the maximal group of entities such that the entities value the function true at the given input context (for any value of an indefinite). If there is only one such individual, the maximal set is a singleton set and thus returns a unique entity. Additionally, I define one type shifter in (42) which turns ordinary predicates into dynamic restrictors, i.e. functions from ordinary entities to dynamic truth values.

(40) $\text{TRUE} = \lambda m.\lambda g.\exists h.\langle \top, h\rangle \in mg$ $\qquad\qquad \text{TRUE} :: \mathtt{M}_t \to g \to t$

(41) $\text{MAX} = \lambda P.\lambda g.\Sigma y.\,\text{TRUE}(Py)\,g$ $\qquad\qquad \text{MAX} :: (e \to \mathtt{M}_t) \to g \to e$

(42) $p^{\blacktriangle} := \lambda x.\lambda g.\{\langle px, g\rangle\}$ $\qquad\qquad {\blacktriangle} :: (e \to t) \to e \to \mathtt{M}_t$

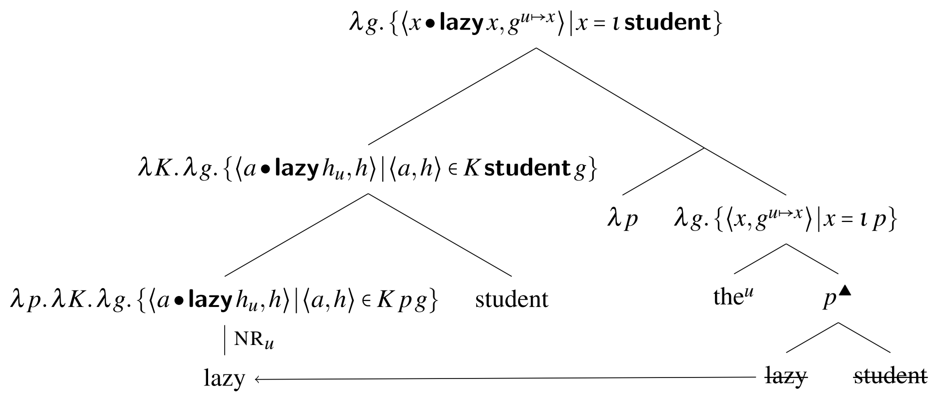
Table 1 shows all the lexical items needed for the examples in this section. NR_u is the nonrestrictive adjective type shifter for intersective adjectives, and NR-NI_u denotes the nonrestrictiveness type shifter for non-intersective adjectives. *et* abbreviates $(e \to t)$.

Item	Type	Denotation
blue	$e \to t$	$\lambda x.\,\mathbf{blue}\,x$
book	$e \to t$	$\lambda x.\,\mathbf{book}\,x$
talented	$(et) \to et$	$\lambda p.\lambda x.\,\mathbf{talented}\,px$
other$_i$	$(e \to \mathtt{M}_t) \to e \to \mathtt{M}_t$	$\lambda P.\lambda x.\lambda g : [\text{TRUE}(Pg_i)\,g].\{\langle p \wedge x \neq g_i, h\rangle \mid \langle p, h\rangle \in Pxg\}$
some^u	$(e \to \mathtt{M}_t) \to \mathtt{M}_e$	$\lambda P.\lambda g.\{\langle x, g^{u \mapsto x}\rangle \mid \text{TRUE}(Px)\,g\}$
the$^u_{\text{PL}}$	$(e \to \mathtt{M}_t) \to \mathtt{M}_e$	$\lambda P.\lambda g.\{\langle x, g^{u \mapsto x}\rangle \mid x = \text{MAX}\,Pg\}$
every^u	$(e \to \mathtt{M}_t) \to (e \to \mathtt{M}_t) \to \mathtt{M}_t$	$\lambda P.\lambda Q.\lambda g.\{\langle \forall x \forall h.\langle \top, h\rangle \in Pxg \Rightarrow \text{TRUE}(Qx)\,h, g^{u \mapsto \text{MAX}\,Pg}\rangle\}$
NR_u	$et \to et \to (et \to \mathtt{M}_\alpha) \to \mathtt{M}_{\alpha \bullet t}$	$\lambda q.\lambda p.\lambda K.\lambda g.\{\langle a \bullet q h_u, h\rangle \mid \langle a, h\rangle \in Kpg\}$
NR-NI_u	$(et \to et) \to et \to (et \to \mathtt{M}_\alpha) \to \mathtt{M}_{\alpha \bullet t}$	$\lambda r.\lambda p.\lambda K.\lambda g.\{\langle a \bullet r p h_u, h\rangle \mid \langle a, h\rangle \in Kpg\}$

Table 1: Example lexical items

First, I present a basic example without *other* or quantifiers, where the adjective *lazy* is interpreted nonrestrictively. While this simple example does not require scoping the adjective or treating it as anaphoric, I show it to demonstrate how it would look under the present analysis.

(43) the lazy$_{\text{NR}}$ student

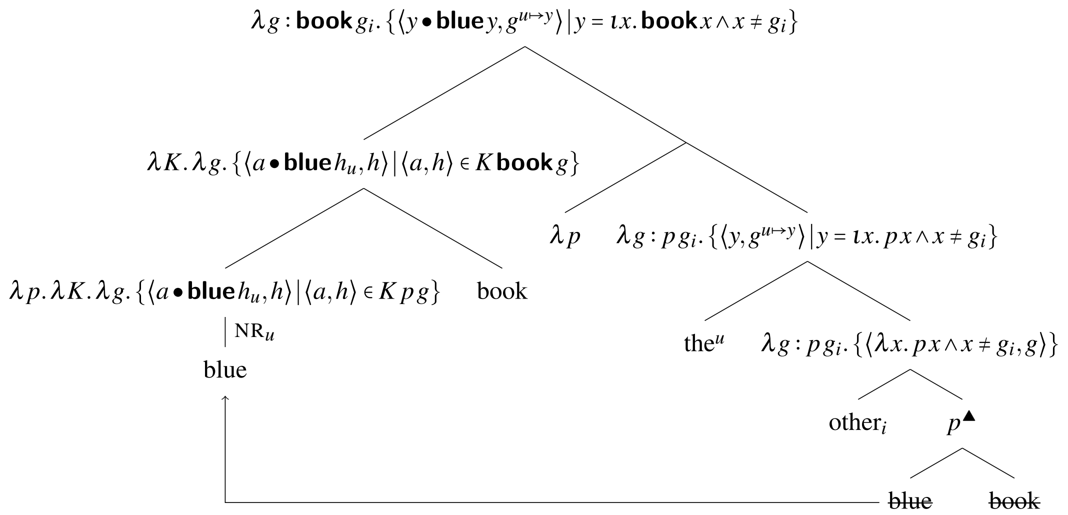


The nonrestrictive adjective *lazy* and the modified noun *student* are evaluated outside of the DP *the lazy student*. The trace left behind is type-shifted with ${}^{\blacktriangle}$, and combines with the determiner. The trace p is then abstracted, and the denotation of *student* later fills in the abstracted position. Meanwhile, the semantic contribution of *lazy* is forced by NR_u into a secondary dimension, written to the right of the bullet. The nonrestrictive adjective is anaphoric to the entity it modifies, the student, which has a discourse referent u. I show how this DP, which contains secondary meaning, can compose with the rest of a sentence in (44). The denotation of the sentence has primary content which says x slept and secondary content that says x is lazy, where x is the student in both cases.

(44) The lazy_{NR} student slept.
$[\![\star[\text{the lazy student}]\ [\lambda x\ [x \text{ slept}]^{\Uparrow}]]\!] = \lambda g.\{\langle \textbf{slept}\, x \bullet \textbf{lazy}\, x, g^{u\mapsto x}\rangle \mid x = \iota\, \textbf{student}\}$

This analysis is able to handle contrasting adjectives in the scope of *other*. Below I contrast a nonrestrictive (contrasting) adjective in (45) with a restrictive one in (46). Since the adjective is anaphoric to the modified entity, the entity does not need to serve as the argument to the adjective. Thus, it is able to be interpreted outside the scope of *other* while contributing the nonrestrictive inference as desired.

(45) the other, blue_{NR} book NONRESTRICTIVE



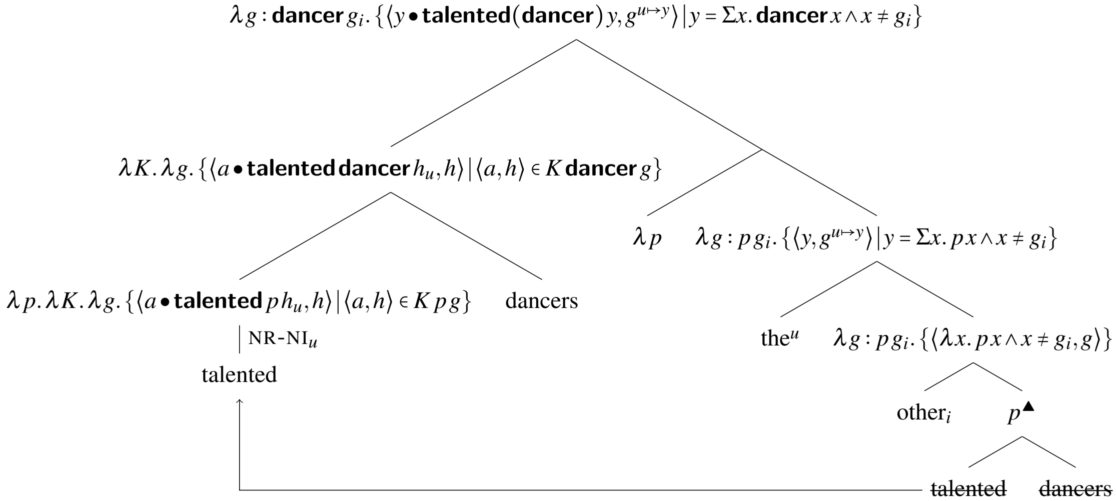
The top-most node presupposes the existence of an antecedent book, g_i; the primary content is the unique book y which differs from the antecedent; and the secondary content states that y is blue. For comparison, below is *the other blue book*, where *blue* is restrictive.

(46) the other blue_{R} book RESTRICTIVE
$[\![[\text{the}^u\ [\text{other}_i\ [\text{blue book}]]]]\!]$
$= \lambda g : \textbf{blue}\, g_i \wedge \textbf{book}\, g_i.\{\langle y, g^{u\mapsto y}\rangle \mid y = \iota x.\, \textbf{blue}\, x \wedge \textbf{book}\, x \wedge x \neq g_i\}$

In contrast with the nonrestrictive interpretation in (45), the restrictive *blue* in (46) contributes to the presupposition of *other*, such that the antecedent book is presupposed to be *blue* as well. Additionally, *blue* in fact has a restrictive role: it is presupposed (by *the*) that there is only one other blue book besides the antecedent, leaving open the possibility of existence of other books of other colors. There is no secondary or backgrounded content, unlike in (45).

Non-intersective contrasting adjectives like *talented* in *the other, talented dancers* can be analyzed in the same manner. Non-intersective contrasting adjectives require a slightly different type-shifter to deal with the abstracted noun, which I call NR-NI. NR-NI differs from NR only in how the adjective combines with the noun; in this case, modification is set subsection, and thus, the adjective needs to take the noun as an argument. In the top-most node, the secondary content states not that *y* are talented, but that *y* are talented dancers.

(47) the other, talented dancers

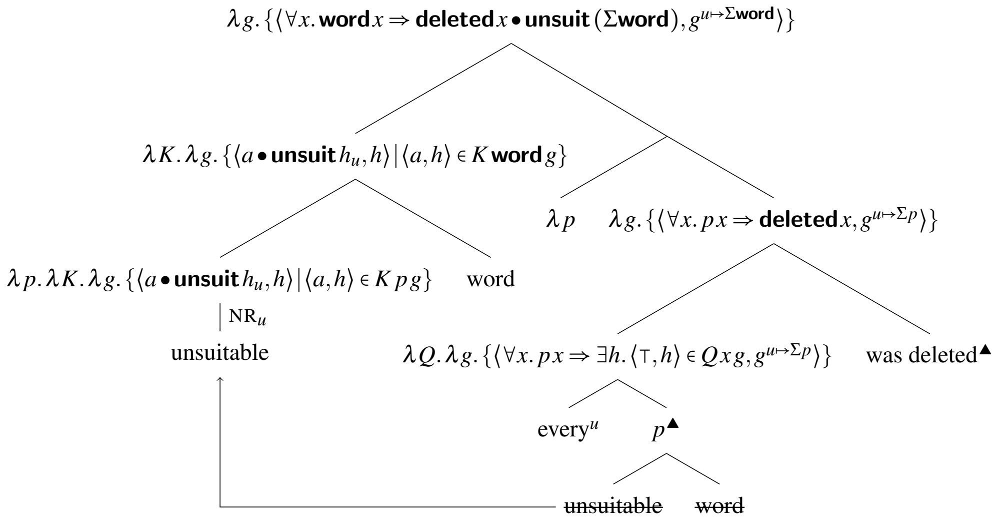


Example (48) contains an indefinite. Following Charlow (2014), indefinites are modeled as nondeterminism via sets of alternatives, so *some child* is a set of tuples whose first component is *x*, and *x* ranges over all the possible individuals who satisfy the property of "child". The indefinite *some* also introduces a discourse referent *u*, so g_u evaluates to whichever child the speaker referred to, and the backgrounded content says that that individual is annoying.

(48) some annoying child
$[\![[[\text{annoying-NR}_u\ \text{child}]\ [\lambda p\ [\text{some}^u\ p^\blacktriangle]]]]\!] = \lambda g. \{\langle x \bullet \textbf{annoy}\, x, g^{u \mapsto x}\rangle \mid \textbf{child}\, x\}$

Finally, the example below in (49) demonstrates how nonrestrictive adjectives in quantifiers work under an anaphoric analysis.

(49) every unsuitable word was deleted



The inference derived is, as desired, that all the words in the relevant context were unsuitable. Note that the quantificational force does not affect the inference generated by the nonrestrictive *unsuitable*; since all quantifiers make their restrictor set available as a discourse referent, the nonrestrictive adjective will be predicated on the same set regardless of the quantifier. Even with other quantifiers like *most* or *no*, we are still able to derive a nonrestrictive inference, since the entities described by the adjective correspond to the "maxset" discourse referent made available by quantifiers.

A careful reader might notice that the adjective is interpreted after the entire clause *every word was deleted*, as opposed to previous examples, where the adjective is interpreted immediately after the DP. This is possible because the adjective, after being type-shifted with NR and combining with the noun, has type $(et \to \mathtt{M}_\alpha) \to \mathtt{M}_\alpha$. After filling in the $e \to t$ gap in the argument with the noun, the adjective modifies an update (type $\mathtt{M}_\alpha$), in that it adds secondary content to it. NR is defined polymorphically so that the adjective can modify any update – anything with type $\mathtt{M}_\alpha$, such as $\mathtt{M}_e$ (like *the other book*) or $\mathtt{M}_t$ (like *every word was deleted*).

It is necessary for the adjective to be interpreted after the clause in (49) since *every p* does not denote an individual of type $\mathtt{M}_e$, but a function of type $(e \to \mathtt{M}_t) \to \mathtt{M}_t$. Since the nonrestrictive adjective cannot modify this type, it must take propositional-level scope in (49). In fact, a nonrestrictive adjective can always take scope at the propositional level, leading to an analysis reminiscent of Schlenker's (2022) proposal for appositives. It is worth noting that this is made possible by the anaphora-based analysis. Under the present anaphoric analysis, the adjective obtains the individual it modifies via anaphora, and this allows the nonrestrictive adjective can be interpreted more freely.

In summary, I have shown how basic examples of nonrestrictive adjectives, contrasting adjectives in *other* DPs, and nonrestrictively modified quantifier phrases can all be analyzed under a uniform approach, by treating nonrestrictive adjectives as anaphoric to the entity they modify.

6. Conclusion

In this paper, I have presented a case for nonrestrictiveness as a semantic phenomenon. Interpretation of contrasting adjectives within the syntactic scope of a non-intersective adjective like *other* often requires for the contrasting adjective to be interpreted in a nonrestrictive way: it is evaluated outside of the scope of *other*, and it is predicated on the entire class of objects it modifies, not just a subset. Additional data from modified quantifier DPs motivate an anaphoric analysis, since nonrestrictive adjectives are able to modify quantifier phrases and derive inferences on the entire restrictor set, which we know is made available for anaphora with any quantifier. Then, I presented a formal semantic fragment which is compositional and dynamic. I derive several examples to show how the fragment handles contrasting adjectives in *other* as well as modified quantifier phrases.

This paper focuses on the compositional properties of nonrestrictive adjectives, and largely ignores what kind of meaning nonrestrictive adjectives contribute and how they update the common ground. Though they are compositionally and intuitively similar to appositives, their meaning projects less strongly, and the contribution of nonrestrictive adjectives need not be new information. On the other hand, nonrestrictive adjective inferences project like presuppositions, and display many similarities to the gender presuppositions of pronouns (Esipova 2019, Chang

2022). I leave further research on the connection between nonrestrictive adjectives and gender presuppositions for further research.

Future work on this topic might also develop a formal update semantics for nonrestrictive adjectives that would capture its discourse and projection properties. Ideally, future research will lead to a theory of nonrestrictiveness that is compositionally united, but allows for nonrestrictive adjectives to update the common ground differently than appositives.

One final open question involves the intonation of nonrestrictive adjectives. Given that appositives require a special intonation, why don't nonrestrictive adjectives also require a special intonation in all cases? One might say that between *other* and a contrasting adjective is a prosodic break, which is true. But this break does not appear when there is only one adjective, for example in (50). A rigorous study into the intonational patterns of nonrestrictive adjectives – both with other (non-intersective) adjectives and alone – should be conducted to gain additional insights on the intonational cues of nonrestrictive adjectives, which are subtle, if any do exist at all.

(50) The lazy senators skipped the meeting.

The issue of intonation has larger implications for nonrestrictiveness in general. If there are no special intonational cues, then perhaps there is no way to distinguish between a nonrestrictive interpretation of (50), and a special case of a restrictive interpretation whereby the modifier does not do any restricting work. That is to say, while I have presented clear cases of nonrestrictive adjectives in the form of contrasting adjectives in the scope of *other* (or similar non-intersective adjectives), these data have no definitive bearing on adjectives which may seem nonrestrictive, but which are compatible with restrictive interpretations. But despite the differences among the kinds of nonrestrictive adjectives, the analysis in this paper provides a unified analysis for all kinds of nonrestrictive adjectives.

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A perfect-like stative: Icelandic *búinn að* and pragmatic competition in the aspectual domain[1]

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Abstract. Modern Icelandic has two "perfects": *hafa* 'have' (a canonical HAVE-perfect) and *búinn*. The latter is younger, gaining an aspectual, perfect-like usage in the 16th century. Prior to this point it is attested as an adjectival participle meaning 'ready, prepared', derived from the verb *búa* 'reside, prepare, adorn', subsequently undergoing a meaning shift from 'ready, prepared' to 'finished' (Thráinsson 2017). In the modern language, *búinn* has a more restricted distribution than *hafa*, especially for some predicate classes (Jónsson 1992). The aims of this paper are twofold. Firstly, I provide an account of *búinn* in modern Icelandic, accounting for these selectional restrictions. Secondly, I show how a difference in truth-conditional meaning coupled with pragmatic reasoning can capture the three-way division of labour between *hafa*, *búinn* and the BE-*resultative*.

Keywords: aspect, perfect, Icelandic, scalarity.

1. Introduction

Many approaches to the semantics of the perfect cross-linguistically endeavour to explain restrictions with regard to reading types, such as *experiential*, *universal* and *resultative* (McCawley 1971). Henceforth I follow Larsson (2008) in the view that the distribution of Icelandic's two perfects, *búinn* and *hafa* 'have', is not adequately captured in terms of the markers having specialized for a subset of reading types. The intuition in (1) is that *hafa* is odd since the time span of the assertion is by default something like "his whole life" (prototypically experiential). *Búinn*, on the other hand, typically has what has been termed *current relevance* (Bybee et al. 1994; Portner 2003); even out-of-the-blue, *búinn* suggests that a state resulting from an eating event has consequences at speech time, which in turn gives rise to an inference of temporal recency.

(1) a. Hann er búinn að borða.
He is BÚINN to eat
'He has eaten.'

b. #Hann hefur borðað.
He HAS eaten
'He has eaten.'

That being said, there typically are no strict recency restrictions on the felicity of *hafa*. Moreover, this reading cannot be classified as *resultative*, since the embedded event description is atelic. This is despite the fact that *búinn* often has a resultative flavour and *hafa* an experiential one (Thráinsson 2017; Larsson 2008; Jónsson 1992). Rather, I will propose that the markers are

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appropriate answers to distinct Questions-Under-Discussion (QUDs) (Roberts 2012). The gist of this view is that, in (1), *eat* is interpreted as an accomplishment rather than an activity under *búinn* (as in *eat his lunch*). While there is indeed significant functional overlap between *búinn* and *hafa*, due to their differing semantics they impose different requirements on the common ground.

As pointed out by Larsson (2008), *búinn* readily gives rise to a "job-is-done" or "that's over" reading, like stative passives elsewhere in Germanic (Kratzer 2000), e.g. *the paper is accepted*. This line of analysis builds on insights from the previous literature, specifically Larsson (2008), which accounts for a number of interpretive contrasts between *hafa* and *búinn* in treating the latter as analogous to a stative passive construction and expressing a resultant state (Parsons 1990). Larsson's (2008) account nonetheless does not provide an explanation for why it is that *búinn* is felicitous with some unaccusative predicates only in the presence of adverbial modification.

In this paper, I build on Larsson (2008) and argue that the distribution of the two perfects can be tied to *búinn* requiring that its internal argument be quantized. The impetus for this move is drawn from Baglini (2012), who shows that the contextual felicity requirements associated with stative passives can be derived from scalar properties of the verb phrase. This view provides an avenue for deriving the interpretive contrasts between *búinn*, *hafa* and other constructions which overlap with them in meaning, namely the BE-*resultative*, which will be introduced in Section 2.

This paper is structured as follows. In Section 2, I begin by outlining the distribution of the two markers through the lens of their selectional restrictions. Here the focus remains on *búinn* as the more marked alternative. In Section 3, I argue that *búinn* has a more specific semantics than *hafa*, involving both a scalar and a causal component. Finally, in Section 4, I show how the semantics proposed in the previous section, coupled with standard assumptions about pragmatic reasoning suffice to explain division of labour that can be observed between the two markers.

2. Beyond reading types

2.1. The primary reading split

Morphologically speaking, *búinn* is the past participle of the verb *búa* which in modern Icelandic primarily means 'live, prepare, make ready' (Wide 2002: 57). Historically, *búinn* underwent a semantic shift from meaning 'prepared' to 'finished' (Thráinsson 2017). The meaning of the *búinn* construction is a result of the interplay of a few elements: the tense of the auxiliary *vera* 'to be', the lexical contribution of *búinn* as well as the Aktionsart of the verb it embeds.

(2) a. María hefur bakað köku.
María HAS baked cake.SG
b. María er búin að baka köku.
María is BUINN to bake cake.SG
'María has baked a cake.' (Jónsson 1992: 134)

The contrast above is quite clear to Icelandic speakers, even in an out-of-the-blue context: *hafa* gets an experiential reading (María has baked a cake at some point in the past) and *búinn* is understood as a resultative (entailing the existence of a cake at speech time).[2] Jónsson (1992) remarks that a natural follow-up would be *við getum því farið að fá okkur bita* 'we can go get ourselves a bite'. The resultative nature of this reading is clear because what is most salient is the state resulting from the event described, the existence of a cake holding at speech time.

(3) a. María hefur verið veik.
María HAS been sick
b. María er búin að vera veik.
María is BÚINN to be sick
'María has been sick.' (Jónsson 1992: 136)

With atelic complements, both *búinn* and *hafa* can have a universal reading. (3a) additionally has a salient experiential reading and (3b) has a recent past reading (María has been sick *lately* but not necessarily right now).[3]

Beyond this reading split, there is a salient interpretive effect associated with *búinn* which has to do with the speaker's expectations—this is why it is often translated with the help of the overt adverbial 'already' when rendered into English.[4] The role of expectations has featured in previous analyses of the construction and will be discussed in considerable detail later on in this paper (Section 3).

The fact that the expectations persist under negation constituted part of Jónsson's (1992) motivation for considering (2b) under negation as resultative, rather than experiential. It is difficult to coerce a result state from a non-existent cake-baking eventuality so one might ask whether this should be considered experiential instead. The intuition is however not parallel to (2a) were it under negation, which does not introduce any expectations about the result state. In fact, (2b), when negated, quite clearly expresses that a cake was expected but not (yet) delivered. Similarly, consider (4), which is felicitous in a context where María being sick would be in line with the speaker's expectations, for instance if María were the sole individual at her workplace not to have become ill in the month of January.

(4) María er ekki búin að vera veik.
María is NEG BÚINN to be sick
'María has not been sick (yet)' (Jónsson 1992: 134)

2.2. What counts as a result state?

Jónsson (1992) and Wide (2002) both use the term *result state* in a relatively broad fashion. To see this, let us consider how one might go about communicating the utterance in (5) in Icelandic. The English sentence is ambiguous without further contextual disambiguation, since the result state of having seen a movie does not differ appreciably from having had the experience of seeing the movie.

[2] *hafa* has an inferential reading as well, which could be rendered in English as 'Mary apparently/must have baked a cake' (Jónsson 1992). This reading will systematically be put aside in this paper, as the focus here is competition.
[3] Both universal and recent past readings are available here.
[4] This was confirmed by a cursory investigation of the *Samhlíða* corpus available at `malheildir.arnastofnun.is`.

(5) I have seen this movie.

A suitable translation of (5) could involve either *búinn* or *hafa*, the choice between them is largely dependent on how salient the effect of the event described is at speech time. For instance, given the context below in (6), *búinn* is the more natural option, while *hafa* is less natural. This example seems to hone in on the present-moment consequences of having seen the movie. Jónsson (1992: 135) mentions that it can for instance be used to emphasize that the speaker knows the whole plot.[5]

(6) **Context**: We are outside a movie theatre discussing what we should watch. I would like to mention that I've already seen one of the movies and hence don't want to see it again:
 a. Ég er búin að sjá þessa mynd. Mig langar ekki að sjá hana aftur.
  I am BÚINN to see this movie I.ACC long NEG to see it again
 b. Ég hef séð þessa mynd. Mig langar ekki að sjá hana aftur.
  I HAVE seen this movie I.ACC long NEG to see it again
  'I have seen this movie. I don't want to see it again.'

Jónsson (1992) notes that this example differs from (2) in that the connection between what he calls "the salient effect" is tied to the lexical semantics of the predicate more tightly in that instance. The resultative/experiential distinction is especially blurry with iterative adverbials, as repeatability is sometimes taken as a criterion for experientials (Mittwoch 2008). Jónsson (1992) argues that (7) in fact involves a result state, something like being sick and tired of losing the keys. In any case, this usage of *resultative* goes beyond the more typical usage which is restricted to target states of telic eventualities. In response to this line of analysis, Larsson (2008) has pointed out that Jónsson's (1992) view of result states is reminiscent of *resultant* rather than *target* states; this matter will be taken up in more detail in Section 3.

(7) Ég er búinn að týna lyklunum *(fimm sinnum) en er sem betur fer með þá núna.
 I am BÚINN to lose keys:DEF *(five times) but am as better goes with them now
 'I have lost the keys *(five times) but as luck would have it I have them now.'
 (Jónsson 1992: 139)

2.3. Restrictions with durative predicates

According to the foundational literature on the topic (Friðjónsson 1989; Jónsson 1992; Larsson 2008), *búinn* is only compatible with homogeneous predicates (states, activities) if there is adverbial modification, giving rise to a universal reading. The example in (8b) is only felicitous if, for instance, we are talking about a baby's scheduled nap. Otherwise it is odd. With the adverbial, however, *í allan dag* 'all day' it is felicitous. The same holds for *liggja í rúminu* 'lie in bed' (Friðjónsson 1989: 105). Jónsson (1992) accounts for this contrast by claiming that without the temporal specification, an experiential reading is the only one available, and *búinn* is thus ruled out. This reasoning seems somewhat circular to me. On the analysis presented

[5]Two of the younger speakers I consulted with perceive *hafa* to be more formal than *búinn* and would hesitate to use it in an informal context.

later on in this paper, unacceptability is not *directly* due to the lack of this, but rather what is missing is a salient contrast between degrees on a scale.

(8) a. #Hún er búin að sofa.
she is BÚINN to sleep
Intended: 'She has slept'
b. Hún hefur sofið.
she HAS slept
Intended: 'She has slept'
c. Hún er búin að sofa í allan dag.
she is BÚINN to sleep all day
'She has slept all day.' (Thráinsson 2017: 126)

2.4. Restrictions with unaccusative predicates

It is often claimed that *búinn* requires supplemental adverbial modication in combination with unaccusative predicates (Jónsson 1992; Kress 1982; Thráinsson 2017). For instance, *búinn* seems to require measure modification (e.g. *a lot*, *enough*) when embedding intransitive accomplishments and iteration or frequency adverbials with intransitive achievements.

(9) Bíllinn er búinn að ryðga *(mikið) í vetur.
car:DEF is BÚINN to rust *(much) this winter
'The car has rusted *(a lot) this winter.' (Thráinsson 2017: 127)

(10) Skipið er búið að blása *(tvisvar).
ship:DEF is BÚINN to whistle *(twice)
'The ship has whistled twice.' (Kress 1982: 154)

Jónsson (1992) and Larsson (2008) both puzzle over the distribution of *búinn*, *hafa* and the BE-*resultative* construction. The latter is the typical way of expressing resultativity with change of location accusatives like *fara* 'go'.

(11) a. Jón er farinn til Boston.
Jón is gone to Boston
'Jón has gone to Boston.
b. Jón er búinn að fara til Boston.
Jón is BUINN to go to Boston
'Jón has finished going to Boston.'
c. Jón hefur farið til Boston.
Jón HAS gone to Boston
'Jón has gone to Boston.' (Jónsson 1992: 143)

The relevant contrast in (12) is such that only (11a) has a strictly resultative reading—it can only be uttered if Jón is on his way or has arrived in Boston already. (11b) is to be classified as resultative, too, but in a more widely encompassing sense of the term, according to Jónsson (1992). Here the intuition is such that Jón finds himself in the result state of having fulfilled some kind of requirement by traveling to Boston. On the other hand, (11c) attributes the experience of having gone to Boston to Jón; this utterance cannot be felicitously said if Jón has set off to Boston or is already there, either. Iterative modification provides another contrast: the

BE-*resultative* construction is infelicitous with iterative modification, as shown in (12a). (12b) is felicitous and suggests that Jón's requirement of traveling to Boston three times has been fulfilled. Finally, (12c) has an experiential reading.

(12) a. #Jón er farinn til Boston þrisvar sinnum.
Jón is gone to Boston three times
'Jón HAS gone to Boston three times.
b. Jón er búinn að fara til Boston þrisvar sinnum.
Jón is BÚINN to go to Boston three times
'Jón has gone to Boston three times.'
c. Jón hefur farið til Boston þrisvar sinnum.
Jón HAS gone to Boston three times
'Jón has gone to Boston three times.' (Larsson 2008: 78)

According to Jónsson (1992), *búinn* cannot receive a resultative reading (in a strict sense, not the wider definition he pursues) in these instances due to blocking effects. Larsson (2008) points out that this is not a satisfactory explanation given the data at hand: it is not the case that resultative readings are blocked across the board under *búinn*, as shown below in (13).[6] Furthermore, their availability cannot be correlated with the availability of BE-*resultative*s. Nor can it be correlated with structural properties of the participles, given the assumption that both anti-causative and resultative participles have an eventive *v*-layer (Embick 2004; Sigurðsson 2017).

(13) a. Hún er hætt að reykja.
she is stopped to smoke
'She has stopped smoking.'
b. #Hún er búin að hætta að reykja núna.
she is BÚINN to stop to smoke now
'She has stopped smoking now.'
c. Hún er oft búin að hætta að reykja.
she is often BÚINN to stop to smoke
'She has often stopped smoking.' (Larsson 2008: 79)

(14) a. Snjórinn er búinn að bráðna nóg
snow:DEF is BÚINN to melt enough
'The snow has melted enough.'
b. Snjórinn er bráðnaður.
snow:DEF is melted
'The snow has melted.' (Larsson 2008: 79)

In Section 3, I provide a principled explanation for the contrasts described above. Prior to proceeding to my analysis, I provide a brief sketch of the account in Larsson (2008), which captures important parallels between *búinn* and stative passives in terms of the role of expectations, but falls short of deriving the contrasts with unaccusatives and durative predicates.

[6] Throughout the paper, I refer to such examples as BE-*resultatives*, though they may also be considered stative passives. Canonical passives have identical participles with past morphological marking on the copula. These are largely, with few exceptions, homophonous with predicative deverbal adjectives (Thráinsson 2007).

2.5. Larsson's (2008) analysis

Larsson (2008) provides an analysis of *búinn* as a resultant state participle (Parsons 1990), which corresponds to the term *result state* as used in Jónsson (1992) and Wide (2002). It thus conveys anteriority but does not have a tense component. The primary motivation behind this analysis is evidence from parallels with stative passives. What is meant here by a resultant state and what are the grounds Larsson (2008) has for proposing such an analysis? She points to the prominence of "existential, clause-anticipating constructions", more commonly called impersonal constructions (Thráinsson 2017: 125). In the 2004-5 Icelandic parliamentary corpus, examples similar to (15) account for over half of all *búinn* tokens (Larsson 2008: 82).

(15) Það er búið að lögfesta lækkun.
it is BÚINN to legalize reduction
'A reduction has been made into law.'

While *target states* are the states resulting from a telic eventuality (Parsons 1990; Kratzer 2000), a *resultant* state, by contrast, denotes any state that is temporally preceded by an eventuality. If a door has been closed, the target state holds while the door remains closed, whereas the resultant state holds even after it is opened again. Thus, target states, unlike resultant states, are compatible with *still*, e.g. *the door is still open*.

Larsson (2008) notes that *búinn* resembles stative passives in other languages (specifically Swedish and German). These are not limited to telic predicates and allow adverbials of iteration and frequency (the general availability of which depends on the predicate, in contrast to canonical perfects). *Búinn* and stative passives resemble one another in yet another respect: the role of expectations (Larsson 2008: 84). Stative passives are odd out-of-the-blue initially and require a "job is done" or "that's over" reading to be felicitous . Larsson (2008: 84) points out that the Swedish example below in (16) is appropriate given a context where the cat is meant to be pet at least once every day.

(16) Katten är redan klappad.
cat:DEF is already petted
'The cat has already been petted.'

As mentioned above, *búinn* and stative passives do not have telicity restrictions. This means that they cannot be prototypical resultatives (cf. Pancheva, 2003) or target states (in the sense of Parsons 1990). Resultant states, on other hand, can be derived from atelic eventualities; on Larsson's (2008) analysis *búinn* merely asserts that some part of the event precedes reference or speech time; nothing is asserted about the endpoint of the event, leaving open the availability of universal readings.

3. Proposal

As shown in the previous section, existing literature on búinn does not supply a satisfactory explanation for the restrictions of *búinn*, *hafa*, and the BE-*resultative* with change-of-state (COS) predicates. Kratzer's (2000) analysis, adopted by Larsson (2008), does not explain why stative passives become more felicitous when they are in the context of fulfilling an expectation. Maienborn (2009) provides an analysis of adjectival passives that accounts for this, arguing that in order for them to be licensed, the context needs to make available a contrasting state, e.g. *Das Manuskript ist eingereicht* 'The manuscript is submitted' contrasts with an alternative state s' which differs from s on a salient scalar dimension. For instance, along a temporal scale: *Das Manuskript ist eingereicht, jetzt können wir uns an den Projektantrag machen* 'The manuscript is submitted, now we can get to the project proposal'. Gehrke (2015: 917) shows that Maienborn's pragmatic proposal is not sufficiently restricted, noting that the verb phrase needs to make available a one-dimensional quantity scale—pragmatic licensing may be possible, but depends on the saliency of such a scale.

(17) $\exists e[s : \mathbf{Q}(manuscript) \wedge result(e,s) \wedge submit(e)]$
Resultant state: $...contrast\,(s,s') \wedge s' : \neg\mathbf{Q}(x) \wedge s' < s$
Target state: $...contrast\,(s,s') \wedge s' : \mathbf{Q}'(x)$ (Maienborn 2009: 42)

Baglini (2012) points out some issues with Kratzer's analysis, in particular her strict division between *target* and *resultant* states. First, it is not clear why one ought to posit two underlying meanings for often homonymous expressions with meanings that are closely conceptually related. Second, as mentioned above, Kratzer's (2000) account does not in a principled way derive observed felicity restrictions for stative passives. Baglini's (2012) analysis does so by capitalizing on a contrast between incremental theme and COS verbs. COS verbs are associated with property scales as part of their lexical meaning (Rappaport-Hovav 2008). This is not the case with incremental theme verbs; these only acquire a scale in composition with their theme argument. Moreover, such a scale is an extent scale, reflecting an extent of change that has already been undergone and is not reversible, contrary to property scales. Thus the contrast described by Kratzer (2000) concerning reversibility and modification with *still* can be derived.

On Baglini's (2012) account, a "job-is-done" reading can be yielded from atelic predicates, too, if they are coerced to denote scalar change; the relevant event description is coerced into a homomorphic mapping with a quantized theme. With unaccusatives, this amounts to a requirement that the scalar change to the part structure of the nominal theme be measured out by means of a covert partitive head that yields a gradable event description.

My proposal is rooted in scalar approaches to aspectual composition, more specifically in the relationship between telicity, quantization and scalar structure (e.g. Hay et al., 1999). I argue that the restrictions on adverbial modification sketched above fall out if one takes it that *búinn* requires that its embedded event description be quantized. The relevant event description is coerced into a homomorphic mapping with the nominal theme, which in turn guarantees quantization: a predicate is quantized with regard to an individual x iff it holds of x but not of its proper subparts (Krifka 1998).

3.1. Proposal pt. 1: The role of boundedness

I focus on instances where *búinn* has more restrictive felicity conditions than *hafa*. One such instance is unaccusative predicates, as outlined in the previous section. Unaccusatives can be further broken down into multiple subtypes, following much of the literature on the scalar structure of eventualities (e.g. Kennedy and Levin 2008). Relevant for the present paper is a distinction between Incremental Theme and COS predicates. In both cases, a theme argument undergoes change along some ordered scale; the event description "measures out" this change. For concreteness, I adopt a modified version of Beavers (2012) itself building on Krifka's (1998) mereological model of aspectual composition, according to which changes-of-state (and states more generally) are triples $\langle \delta, S, R \rangle$ defined as follows:

(18) a. $\delta =$ some property/dimension
b. $S =$ a set of (intervals of) degrees for having property δ
c. $R =$ an ordering of members of S (directionality)
(Beavers and Koontz-Garboden 2020: 26)

According to Beavers (2012), purely stative terms serve to assert that there exists a $d \in S$ along a given dimension δ according to R, the latter imposing scalar structure. For upper-closed scales, for instance, d will resolve to the maximal value. With changes-of-state, $d \in S$ is resolved in much the same way for the state holding at the culmination of the event. It is additionally asserted that there is a degree $d' \in S$ at the beginning of the event that constitutes a change along R in the direction that is lexically encoded (i.e. a predicate like *darken* imposes an ordering R s.t. d' necessarily constitutes a lower degree ordered according to the property DARKNESS). Some COS predicates can be either telic or atelic—the determining factor here is the presence of an identifiable (quantized) degree bound, e.g. a scalar maximum (Hay et al. 1999; Kennedy and Levin 2008; Kennedy 2012).

Altogether, the calculation of telicity is sensitive to the mereological properties of three components (Beavers 2012): the event, the theme, and the scale. These three components are subject to two homomorphic relations, which Beavers (2012) combines into a single definition for a *Figure/Path Relation* as shown below. These correspond to Krifka's (1998) *Strict Incrementality Relation* and *Movement Relation*, defined in terms of degrees rather than mereologically.

(19) Figure/Path Relation: An event e, patient x, and continuous, ordered set of degrees S on some dimension δ stand in a Figure/Path Relation (FPR) iff every unique part $x' \leq x$ corresponds to a unique subevent $e' \leq e$, the sum of all such subevents constitutes e, and each e' stands in a Movement Relation with a continuous subset $S' \subseteq S$, where S' includes x' 's initial degree of δ in e' and where the maximal degree in S' is x'' s final degree of δ in e'. (Beavers and Koontz-Garboden 2020: 39)

A consequence of the one-to-one mapping between events and objects is a correspondence between quantized incremental themes and telic eventualities (Krifka 1989). Non-quantized incremental themes, conversely, correspond to atelic eventualities. This follows from the fact that non-quantized incremental themes hold of subparts just as atelic eventualities hold of subintervals (Bennett and Partee 2004).

In the case of *búinn*, I assume that the COS is contributed by the presence of a BECOME operator, adopting the formalization from Beavers and Koontz-Garboden (2020: 26).

(20) For all $e, s \in D_v$, $\text{BECOME}(s)(e) = 1$ iff s holds at the end of e and at the beginning of e there is a state s' such that there is a degree d' on δ_s

In what follows I will assume that *búinn* needs a salient quantity scale; felicity is dependent on a modalized relation between the extent of change (i.e. a quantity scale) in the theme argument and a (contextually resolved free predicate variable) perfect state Q (Nishiyama and Koenig 2010), which will be introduced in the next section. It is the measure of the extent of this change which has discourse significance; the pre-state and post-state are contrasted (Maienborn 2009). What matters here is the salience of a contrast between pre- and post-states as the extent of change relates to establishing the existence of a perfect state. Crucially, quantized theme arguments provide scales that are fully closed. *Búinn* and BE-*resultatives* pattern together in that the two require a quantized theme, as shown below in (21)

(21) a. #Mjólk er drukkin.
milk is drunk
'Milk is drunk.'
b. ?Mjólkin er drukkin.
milk:DEF is drunk
'The milk is drunk.'
c. Það er búið að drekka mjólkina.
it is BÚINN to drink milk:DEF
'The milk has been drunk.'
d. #Það er búið að drekka mjólk.
it is BÚINN to drink milk
'Milk has been drunk.'
e. Það hefur verið drukkin mjólk.
it HAS been drunk milk
'Milk has been drunk.'

The interpretive contrasts here as follows: (21a) cannot be uttered out of the blue and it is indeed difficult to conceive of a context in which it would be appropriate. (21b) would require a context that makes salient a "job-is-done" type interpretation: say two individuals are at a unique type of restaurant which requires that each item on the table be checked off a list before they proceed. (21c) sounds natural in this checklist context. (21d) is odd, as it contrasts the milk having been drunk with a state in which something aside from milk has been drunk—finding an appropriate context is thus dependent on highlighting the importance of it having been milk that was drunk and not another beverage. Finally, (21e) is acceptable and veers towards an inferential reading, which could be translated as 'It seems that milk has been drunk'.

Búinn is felicitous when it embeds bounded event descriptions. Consequently, accomplishments and achievements are the most typical types of eventualities associated with it. Quantized internal arguments are thus a pre-requisite in these cases as well. This account can moreover be extended to activities and states. Both, being homogeneous eventualities, typically yield universal or recent-past readings under *búinn* by default. However, both activities and states can be coerced into quantized event descriptions. With activities, this can be achieved by providing a quantity bound on a salient scale (e.g. a path), denoting the maximal extent to which a state-holder participates in the eventuality in question. Alternatively, both states and activities can be made bounded along a quantity scale with iterative marking. No proper mereological subpart of (22a), an atomic event of walking 2km, can be construed as being in the denotation of the predicate *walk 2km a day for many months*. The same logic can be extended to states—what is relevant to discourse in (22b) is the state-holder having undergone multiple individuated eventualities of sickness.

(22) a. Ég er búinn að ganga 2 km á dag í marga mánuði.
I am BÚINN to walk 2 km in day in many months

'I have walked 2 km per day for many months.'

b. Ég er búin að vera veik mörgum sinnum á þessu ári.
I am BÚINN to be sick many times in this year
'I have been sick many times this year.'

3.2. Proposal pt. 2: Compositional implementation

In this section I outline the compositional details of my analysis. I build on Baglini (2012) who adopts the analysis in Kennedy and Levin (2008). Accordingly, I assume that COS predicates like *close* are of type $\langle d,\langle e,\langle v,t\rangle\rangle\rangle$ as exemplified below; *init* and fin are functions which take an individual and an event argument, yielding degrees of the property denoted by the predicate at the onset and culmination of the event—the function as a whole returns a measure of change undergone by x in degrees. Gradable predicates of this sort must then have their degree argument saturated. I assume that this can be accomplished by an overt degree argument or a covert head $[\![pos]\!]$, which takes the measure function as input and contributes a comparison standard (Kennedy and Levin 2008: 167). When $[\![pos]\!]$ is applied to a gradable property of events, it requires a fully closed scale in order to output a maximal value.

(23) $[\![close_{\triangle}]\!] = \lambda d\lambda x\lambda e[close_{\mathbf{close}(x)(init(\mathrm{e}))}\uparrow(x)fin(e) = d]$

(24) $[\![pos_{v}]\!]= \lambda G \in D_{\langle d,\langle e,\langle v,t\rangle\rangle\rangle}\lambda e.\exists x[G(x)(e) \succeq \mathbf{std}_{c,w}(G)]$

In the case of incremental themes, the composition is more involved, as the theme argument must be mapped to a gradable property of events. Here I assume that this is accomplished by means of a covert partitive head following Baglini (2012).

(25) $[\![part_{\triangle}]\!]= \lambda y\lambda d\lambda x\lambda e[part_{\mathbf{part}(x)(init(\mathrm{e}))}\uparrow(x)fin(e) = d]$

Further, I assume Kennedy's (2007) *Principle of Interpretive Economy*, which states that conventional lexical meaning is maximally utilised to determine truth-conditional interpretation. Consider (1): d can be set to the maximum value (that is, 1) and the durative event description *eat* can measure out a change in a covert theme. Now, I proceed to show the derivation of (9). I begin with the denotation of *vP*, which is of type $\langle v,t\rangle$.

The gradable property of events derived from the composition of the partitive head and the incremental theme argument combines with a predicate of eventualities by *Event Identification* (Kratzer 1996). The resulting gradable event description has its degree argument saturated by *mikið* 'much/a lot' which has the semantics in (26), mapping a gradable property to a comparison class and asserting that this standard is exceeded by a significant degree (treated analogously to *very* in Kennedy and McNally 2005).[7]

(26) $[\![\text{mikið}]\!]^{c,w} = \lambda G \in D_{\langle d,\langle e,\langle v,t\rangle\rangle\rangle}\lambda e.\exists x\left[\mathbf{std}_{c,w}(G) \prec\!\prec_{G,c} G(x)(e)\right]$

(27) $[\![\text{a lot}]\!]^{c,w}([\![\text{rust}]\!])([\![\text{part}_{\triangle}(\text{the car})]\!]) = \lambda e.\exists x[rust(x)(e) \wedge$
$part_{\mathbf{part}(\sigma x.{*}\mathrm{CAR})(init(\mathrm{e}))}\uparrow(\sigma x.{*}\mathrm{CAR})fin(e) \succ\!\succ_{G,c} \mathbf{std}_{c,w}([\![\text{rust part}_{\triangle}(\text{the car})]\!])]$

With these pieces in place, I now delineate the details of my proposal regarding the syntax and semantics of the *búinn* construction. This involves two components: the meaning of the

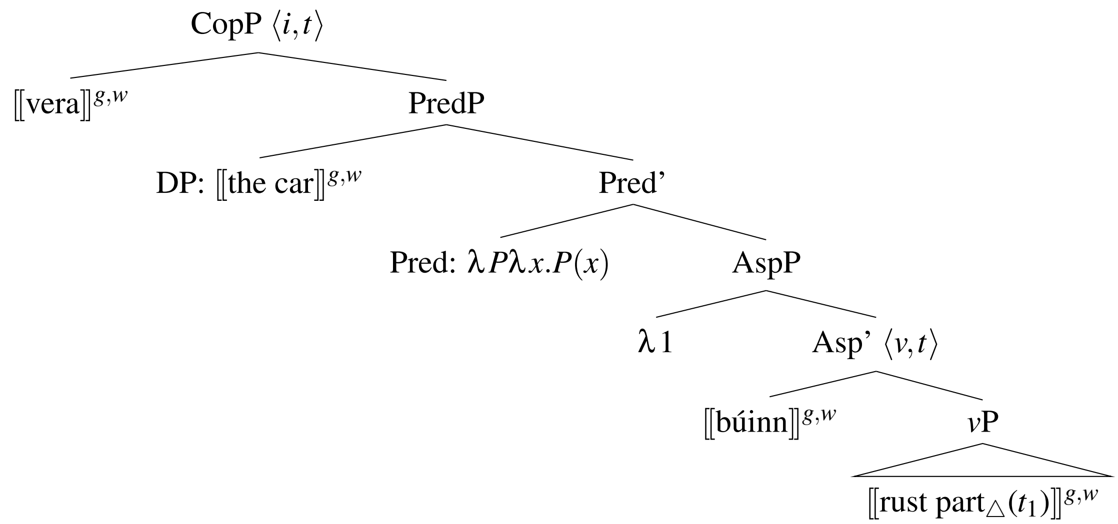
[7]Formalization adopted from Bill and Koev (2022: 133).

participle itself as well as the copula *vera* 'to be'. Syntactically speaking, *búinn* is an adjectival participle (cf. Kratzer, 2000; Gehrke 2015) used as part of a copular construction, whether it has a non-finite verbal complement or is used adjectivally.[8] I assume that it is located in AspP, taking a *v*P or VoiceP as its complement (depending on whether it embeds a transitive or intransitive structure).[9]

The structure of adjectival participles cross-linguistically is a matter of debate (Borik and Gehrke 2019). I adopt the view of participle formation in Icelandic of Sigurðsson (2017), who considers Icelandic data through the lens of Embick (2004). I thus distinguish between participles that are truly stative involving no eventive *v*-head and resultative and eventive participles which have a *v*-layer and event implications in accordance with that. Sigurðsson (2017) additionally argues that transitive and intransitive participles can be further distinguished on the basis of whether or not they project Voice.

Consider first the intransitive case, in which the theme argument must be externalized—the theme DP is merged from outside of the participial projection (Meltzer-Asscher 2012; Bruening 2014). AspP thus denotes a function predicated of an open individual (cf. McIntyre, 2013). I assume AspP composes with a predicative head (Meltzer-Asscher 2012), introducing a DP in its specifier. The predicative head then mediates between this function and the DP argument higher up by applying it to the individual argument in SpecPredP. In the transitive case, by contrast, the DP controls PRO in SpecVoiceP and is interpreted as agent and state-holder (cf. Biggs, 2021). The copula *vera* 'to be' mediates between PredP and TP, localizing the interval provided by tense in the runtime of the state in question.

(28)



I propose the denotation for *búinn* shown below in (29a). Where it takes a non-finite complement, it is a function from predicates of eventualities to predicates of states. When used adjectivally, the lexical entry lacks the first λ-term. Participial morphology (*-inn*) typically suppresses the initiator argument located in Voice (cf. Gehrke 2015), however in the case of unaccusatives it is vacuous (Bruening 2014). The second component of the denotation in (29a) is BECOME, defined above in (20). *Búinn* does not assert anteriority directly, rather only indirectly as an

[8]See Biggs (2021) and Fruehwald and Myler (2015) for analyses of the English *done* construction as copular.

[9]*Búinn* can be embedded by *hafa*, suggesting that it is located structurally lower than canonical perfects (which are relative tenses, cf. Pancheva, 2003).

implicature by means of the state transition provided by BECOME.[10] The copula *vera* 'to be' is of type $\langle\langle v,t\rangle,\langle i,t\rangle\rangle$ and serves to map the runtime of the state in question to the interval provided by tense: i is contained in the temporal trace of s. Finally, *búinn* contains a free predicate variable Q (Nishiyama and Koenig 2010) which holds of the state output by BECOME. The motivation behind this free variable will be treated in considerable detail in the following section. For now, let it suffice to say that Q that the state yielded by asserting *búinn*+*v*P cannot solely be determined from the lexical semantics of the verbal root in combination with BECOME.

(29) a. $[\![\text{búinn}]\!]^{g,w} = \lambda V_{\langle e,\langle v,t\rangle\rangle} \lambda s.\exists x \exists e[init(x)(e) \wedge V(e) \wedge \text{BECOME}(s)(e) \wedge Q(s)]$
b. $[\![\text{vera}]\!]^{g,w} = \lambda V_{\langle v,t\rangle} \lambda i.\exists s[i \subseteq \tau(s) \wedge V(s)]$

The derived meaning for the top node in (28) is shown below. In prose, given present tense: If reference time is equal to *now*, then truth is yielded in case there exists a state s s.t. *now* is contained in the runtime (temporal trace) of s; there is an event e of rusting, an individual x composed of sub-parts of the car s.t. the amount of x that underwent rusting equals or exceeds a contextually high degree of rusting; the BECOME relation holds between e and s and the free predicate Q holds of s.

(30) $[\![(28)]\!]^{g,w} = \lambda i.\exists s[i \subseteq \tau(s) \wedge \exists x \exists e[rust(x)(e) \wedge$
$part_{\mathbf{part}(\sigma x.^*\text{CAR})(init(\text{e}))}\uparrow(\sigma x.^*\text{CAR})fin(e) \succ\!\succ_{g,c} \mathbf{std}_{c,w}([\![\text{rust part}_{\triangle}\text{(the car)}]\!])$
$\wedge\, \text{BECOME}(s)(e) \wedge Q(s)]]$

3.3. Nature of the QUD

Many analyses of perfects cross-linguistically use the term current relevance (CR) in relation to contrasts resembling the one in (1) (Portner 2003; Nishiyama and Koenig 2010). More specifically, *búinn* seems to impose a current relevance requirement not present with *hafa*. I propose that a type of CR can be derived easily from the scalar approach described in the previous section, coupled with notions of causality: the combined presence of BECOME and a degree argument in the lexical semantics results in a presupposition that there is a degree such that the attainment of this degree is *sufficient* (Nadathur and Lauer 2020) for the perfect state predicate variable Q.

Schaden's (2013) insight is that CR ought to instead be framed in terms of conditional probability with regard to a QUD. Here he builds on Portner (2003: 501) who proposes that the perfect's prejacent p is related to a second proposition, a *discourse topic* or QUD q by an epistemic accessibility relation. Further, it is presupposed that p is a complete or partial answer to the QUD. Schaden (2013) models the relation between propositions probabilistically: the conditional probabilities $(p|\neg q)$ and $(p|q)$ ought to be non-equal. The greater the difference between conditional probabilities, the higher CR value. Given the prejacent *He has eaten* and the state *He is not hungry*, at least a partial answer to the QUD ($(p|q) = 1$) is entailed. If $\neg q$ holds, $\neg p$ is likely also true ($(p|\neg q) \approx 0$)—the conditional probabilities diverge significantly.

As discussed in the previous section, *búinn* is sensitive to a scalar contrast between $\neg p$ and p as this relates to a salient proposition q. I implement this in the form of a presupposition.

[10] I assume universal readings have embedded imperfective morphology (Larsson 2008; Sigurðsson 2017).

(31) **Presupposition**: The existence of a degree (of the extent of change along a quantity scale in the theme/state-holder) s.t. this degree is causally sufficient to give rise to Q

It follows from the presupposition given in (31) that *búinn* has a quantization requirement (when interpreted non-universally).

(32) **Sufficiency**: Causal sufficiency holds if "the effect occurs in the course of normal causal developments" (Nadathur and Lauer 2020: 12)

I contend that both components are necessary in order to capture competition between *búinn* and *hafa*. This is discussed in the next subsection.

3.4. Causal component

In this subsection, I discuss the role of sufficiency. The attentive reader may question why I draw on this notion rather than causal necessity. It seems to me that the relevant relation is one of *inevitability* rather than *counterfactual necessity* in the sense of Lewis (1973). In the *Rusting* example, for instance, it is not so that had it not rusted to such an extent over the winter, that it would necessarily be drivable. Rather, I take this relation to be one of metaphysical settledness, corresponding to *causal sufficiency* in Nadathur and Lauer (2020). That is, the car having rusted to such an extent makes the existence of a new state of affairs certain, as opposed to a mere possibility. In conjunction with the remaining background situation, the prejacent had the ensuing effect of inevitably leading to a state where the perfect state holds.

Let us now consider some of the examples from earlier in the paper in a new light, given the presence of causal sufficiency and the free predicate variable Q. In (1) (the *Eating* example) the extent of change is sufficient to give rise to Q = "He is no longer hungry". In this case, the relationship between the eventuality and state returned by BECOME is still somewhat direct (the state of having eaten). Nonetheless, the perfect state evoked by *búinn* is rather the state of not being hungry, which is related to the state yielded by BECOME by the causal sufficiency relation. With iteratives such as (7) (*Keys*), the relevant intuition is that the perfect state wouldn't hold were it not for the extent of the key-losing. Under normal circumstances, this extent of key-losing gives rise to frustration and thus, Q resolves to *I am fed up with my forgetfulness*.

4. Competition and the QUD

Schaden (2009) proposes that the present perfect and simple past compete with one another and that it is this competition which determines the surface distribution of the two in a given language. The crux of the view in Schaden (2009) is that, in languages with perfect/past variation, there are contexts in which the speaker has a perceived choice between forms, as well as contexts in which the choice of form is pre-determined by surrounding linguistic or contextual material. Given this, it is predicted that the two exist in a complementary relation: a more generalized (in his terms, less restricted) present perfect coincides with a more marked simple past (in English, or vice-versa in German). Markedness here cannot be ascertained solely on the basis of morphological or semantic complexity, otherwise there would be no cross-linguistic variation in *default* perfect forms, instead Schaden (2009) uses a broader notion of markedness on the basis of compatibility with more or fewer situations. Integral to Schaden's (2009) competition account is a contrast between the present perfect, which does give rise to a perfect state, and a simple past that does not. In the following, I will show that *búinn*, *hafa* and the BE-*resultative* compete with one another, as well as with the simple past. The resulting pragmatic division of labour is hence more intricate than what Schaden (2009) describes for English, German, Spanish and French.

4.1. Competition with *hafa*

In order to compare *búinn* and *hafa*, I first briefly spell out my assumptions regarding the semantics of *hafa*. For concreteness, I adopt the analysis in Schaden (2009): I assume compositionally that *hafa* embeds viewpoint aspect, with the lexical entry in (33). It asserts i) that the moment of utterance i included in the runtime of the perfect state and ii) the existence of an interval i' preceding i (the latter interval introduced by a higher tense layer) and iii) the existence of a predicate variable over states $Q(s)$. In this sense, *hafa* is more like a relative tense (cf. Bohnemeyer, 2014).

(33) $\lambda I_{\langle i,t\rangle} \lambda i \exists i' \exists s\, [i' \prec i \wedge i \subseteq \tau(s) \wedge Q(s) \wedge I(i')]$

The scalar sufficiency relation between the prejacent and the perfect state means that *búinn* is especially suited for a particular pragmatic function. Recall that *búinn* presupposes the existence of a degree (an extent of change) which gives rise to a state that itself serves as a (partial or complete) answer to the QUD. As a result, it is an especially suitable assertion when the QUD is of the form: 'What can happen now?'.[11] On the other hand, *hafa* is used when the QUD is 'Has *p* occurred'? In this case, what is relevant is whether there an instantiation of *p* which temporally precedes reference time. The resulting pragmatic division of labour aligns with a contrast between more specific and more general inquiries, or between assertions with higher and lower CR.

I assume the two are in competition, where *hafa* is the unmarked form. The determination of this markedness asymmetry is rooted in the fact that the use of *hafa* is subject to fewer selectional and contextual restrictions. While both convey a perfect state, *búinn* imposes more restrictions on the common ground—*hafa* has no comparable presupposition. Moreover, if *hafa* is used the hearer infers by *Quantity* that a high threshold of CR (as defined in the previous section) does not hold. Given sufficiently high CR, *hafa* is entirely infelicitous. This is illustrated below in (34), which constitutes a canonical high CR context (from Schaden, 2009). On the whole, my approach thus provides an avenue for understanding where the temporal recency inference of *búinn* originates, namely as an epiphenomenon.

(34) **Context:** I am overjoyed, I cannot believe it!
a. Ég vann!
I won
b. Ég er búinn að vinna!
I am BÚINN to win
c. #Ég hef unnið!
I HAVE won
'I won!'

[11] Wide (2002: 248) writes that it occurs "in situations where a problem or turning point in interaction occurs".

The analysis provided in this paper can account for contrasts between *búinn* and *hafa* with regard to adverbial modification. Consider (37), cited by Friðjónsson (1989: 105) as unacceptable without an adverbial to bound the time-span of the assertion, such as *all day*. On my account, unacceptability is not *directly* due to the lack of an adverbial, but rather what is missing is a salient contrast between $\neg p$ and p states, which can be provided by context. Consider the contexts in (35) and (36). The former makes explicit that the simple punctual state transition from the bed not having been lain in to this being the case is sufficient to give rise to a state that, in turn, is a complete answer to the QUD 'Can I lie in my bed?'. I thus predict that *búinn* is licit in this context and that *hafa* ought to be dispreferred. The latter context does not satisfy *búinn*'s presupposition—there is no salient scalar contrast. Rather, the QUD concerns whether p is instantiated at any interval extending into the indefinite past. This is borne out.

(35) I went on vacation and told my house sitter to, under no circumstances, let my dog sit on my new bedsheets. I arrive home and ask: Can I lie in my bed now?

(36) I am curious whether you ever let your dog lie in bed with you.

(37) Hann er búinn að liggja í rúminu.
He is BÚINN to lie in bed:DEF
'He has lain in the bed.' (35): ✓ (36): ?

4.2. Competition with BE-*resultatives*

As discussed in Section 2.5, Larsson (2008) claims that inchoative unaccusatives (i.e. intransitive COS predicates) have resultative readings under both *búinn* and BE. This must be under a wide definition of resultativity, as the interpretive effects of the two markers cannot be equated. I take it that the BE-*resultative* is the unmarked way to refer to target states. Given this configuration, the use of *búinn* triggers pragmatic reasoning to the effect that the speaker had some motivation to refer to a perfect state that goes beyond what is made available from the lexical semantics of the participle. Conversely, use of the BE-*resultative* does not rule out that such a state might exist—this can be bolstered by other elements in the (extra-)linguistic context.[12]

Let us consider the predicate *brotna* 'break', which has a two-valued property scale as part of its lexical semantics. As it is the transition from *not-broken* to *broken* which is relevant, the interpretive effects of *búinn* and BE-*resultatives* may seem to bleed together. It is possible to bring out the relevant interpretive contrasts using targeted contexts, as in (38): In Context 1, *búinn* is natural, as the QUD concerns whether the speaker's expectations are going to be fulfilled or not. (38a) is licit as well but does not address expectations in the same manner. In Context 2, *búinn* again targets the speaker's expectations—now it is degraded, since it seems to suggest that the glass breaking ought to have been the main point of the experiment. (38a) does not suggest as much and is perfectly felicitous here; so is the simple past.

(38) **Context 1**: I learn that I purchased a low quality windshield and I am waiting for it to crack. While driving, I notice a crack starting to form.
Context 2: Scientists are working to develop a new type of glass that can withstand

[12]Diachronically speaking, unaccusatives constitute a relatively innovative context for *búinn* (Thráinsson 2017). Some, especially older speakers find (38b) altogether unacceptable and would instead prefer *hafa* or simple past.

high air pressure, more precisely 2000 psi. After many trials, it looks like the latest model will pass the test. The glass is exposed to 2000 psi and holds its shape, but soon afterwards shatters. One utters: We succeeded...

a. Sjáðu, glerið er brotið.
look, glass:DEF is broken
'Look, the glass is broken.' 1: ✓ 2: ✓

b. Sjáðu, glerið er búið að brotna.
look, glass:DEF is BÚINN to break
'Look, the glass has broken.' 1: ✓ 2: ?

The properties of *búinn* and BE-*resultatives* diverge more saliently when one examines durative COS predicates. Let us take *hækka* 'raise' as an example. It denotes an increase along the property dimension of HEIGHT, a transition whereby a contextual standard on this dimension is reached. I take it that BE-*resultatives* simply assert that the theme argument is in a state which counts as *raised* according to this standard. The presence of a perfect state variable, in combination with the presence of a causal presupposition, triggers pragmatic reasoning under *búinn*: not only does the hearer have to saturate the predicate variable Q, this variable is closely related to the extent of change (which must be delimited in some fashion to fulfil its presupposition). I suggest that this then additionally triggers the hearer to reason that it could not have been the contextual standard that was meant, since if it were, the speaker could have used BE instead. As the context in (39) makes available a degree d that is sufficient for renovations to carry on, *búinn* is felicitous, while (39a) is degraded.

(39) **Context**: Now we can now move on to the next step in our home renovations...

a. #Það er hækkað til lofts.
it is raised to ceiling

b. Það er búið að hækka til lofts
it is BÚINN to raise to ceiling
'The ceiling has been raised.'

5. Conclusion and outlook

The *búinn* construction is an argument-structurally complex derived stative, which has considerable functional overlap with the meaning space of perfects cross-linguistically. It is a participle which contributes a change-of-state, imposing restrictions on the scalar structure of the embedded event description. The analysis presented here supports the view that PERFECT is not strictly speaking a unified class, but the combination of a number of meaning components (Matthewson et al. 2015), among them frequently a change-of-state, which may have differing realizations across languages.

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NPI *any* in the scope of *exactly n*[1]

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Abstract. Both the *even* theory of NPI *any* (Crnič 2011, 2014a, b, 2019a, b) and the exhaustification theory (Chierchia 2013) argue that *any* in non-monotonic contexts lexically requires an *even* operator to be felicitous. A counterexample to this argument is observed. In order to account for the counterexample, this paper proposes that *any* in the scope of a non-monotonic operator in the surface structure is actually located in the restriction of a definite plural description in the logical form. Assuming the generalized definition of Strawson-entailment (Guerzoni and Sharvit 2007; Gajewski and Hsieh 2014; Gajewski 2016), the proposed theory maintains Strawson-downward-entailingness as a necessary condition for the felicity of *any* even in the cases where *any* occurs in the scope of a non-monotonic quantificational determiner like *exactly n*.

Keywords: NPI, *any*, non-monotonicity, Strawson-entailment

1. Introduction

NPI *any* and minimizers share a lot of similarities in distribution. For example, they are both felicitous under a sentential negation, but are infelicitous in simple affirmative sentences, as shown in (1) and (2).

(1) a. John didn't read any book.
    b. John didn't read a single book.

(2) a. *John read any book.
    b. *John read a single book.

In the literature, there are three main views on *any* and minimizers. First, Heim (1984) argues that *any* and minimizers are different beasts. She observes that despite the similarities between the two, minimizers are more restricted in distribution. For example, while *any* is felicitous in the restrictor of a universal quantifier regardless of the main predicate, minimizers are not. As we can see, *any book* is felicitous in both (3)a and (3)b, but *even one book* is only felicitous in (4)a[2].

(3) a. Every student who read any book passed the exam.
    b. Every student who read any book wore blue jeans.

(4) a. Every student who read even one book passed the exam.
    b. ??Every student who read even one book wore blue jeans.

Crnič (2011, 2014a, b, 2019a, b) in a series of work have argued that *any* and minimizers are semantically the same. Both require *even* for their felicity. His theory is built upon Lahiri's

[1]This work was done during my stay at Harvard Linguistics department as a visiting fellow in 2022. I thank Sam Alxatib, Gennaro Chierchia and C.-T. James Huang for their criticisms and comments on this project. I also thank the participants of Sinn und Bedeutung 27 who asked very insightful questions that will help me dig deeper in this research project.

[2]The examples in (3) and (4) are from Crnič (2014a). I do not use the original examples from Heim (1984) because she did not keep the main predicate constant when comparing *any* and minimizers.

(1998) and Lee and Horn's (1995) theories, both of which reduce the semantics of *any* to that of the minimizers. The main motivation underlying the *even* theory of *any* comes from the robust cross-linguistic pattern of the morphological make-up of the NPI *any*. In (5) for example, the Hindi NPI *any* is followed by a morpheme *bhii* which is semantically akin to *even*, as the glosses show. This pattern of NPI formation has been widely observed cross-linguistically. We see the same morphological make-up of the NPI *any* in Japanese, Korean, Bangla, Malayalam and many more languages (Choi 2007; Jayaseelan 2011; Lee and Horn 1995; Ramchand 1997; Shimoyama 2006: a.o.).

(5) maiN-ne kisii-ko bhii nahiiN dekhaa
I any even not saw
I didn't see anyone.
(Lahiri (1998), glosses Crnič's (2019a))

Still a third theory on *any* and minimizers is the exhaustification theory proposed by Chierchia (2013). According to him, *any* is always exhaustified by O(nly) except that in non-monotonic environments, it is exhaustified by E(ven).

I summarize the three main theories on *any* and minimizers in the following table.

Table 1: Three main theories of *any* and minimizers

	Need *even* for felicity?		
	Heim	Crnič	Chierchia
Any	No	Yes	Yes (only in non-monotonic cases)
Minimizer	Yes	Yes	Yes

In this paper, I will argue against both the uniform *even* theory of *any* as well as the mixed view of *any* in the exhaustification theory. Specifically, I will present a novel counterexample with *any* in a non-monotonic context on which both these theories make incorrect predictions. In order to account for the counterexample, I propose that *any* in the scope of a non-monotonic operator *exactly n* in the surface structure is actually located in the restriction of a definite plural description in the logical form. In §2, I will give some arguments against the uniform *even* theory of *any*. Specifically, I highlight an example where *any* is in the scope of *exactly n* as a challenge to the *even* theory. In §3, I will show that the same counterexample also poses a challenge to the mixed view of *any* in the exhaustification theory. §4 will propose a new theory that accounts for a counterexample. §5 discusses some remaining issues of the proposed theory and §6 concludes.

2. Against the uniform *even* theory of *any*

In a series of work, Crnič (2011, 2014a, b, 2019a, b) advocates a uniform *even* theory of *any*. Over the years, he has proposed two variations of the *even* theory. In the first version, *any* is decomposed to a propositional *even* operator and the quantificational determiner *one*, with *one* being the focus associate of *even*. The focus alternatives activated by *any*, therefore, are the numerals bigger than one. In the second version, *any* is decomposed to a propositional *even* operator and the existential quantificational determiner *a* which carries a contextually determined domain variable D. With the domain variable as the focus associate of the *even* operator, the subdomains $D' \subseteq D$ are activated as the focus alternatives. An assumption adopted in both two versions is the Entailment-Scalarity Principle, which states that for any propositions p and q, if p entails q, then p is at most as likely as q.

The uniform *even* theory of *any* accounts for the classical NPI examples like (1)a without any issue. When *any* is in a downward-entailing environment such as in the scope of negation, the prejacent of *even* is logically stronger than all the other alternatives. According to the assumed Entailment-Scalarity Principle, the least likelihood presupposition of *even* is automatically satisfied. The readers can verify this for both of the two versions of the *even* theory presented in (7) and (8) respectively.

(1a) John didn't read any book.

(6) $[\![even]\!] = \lambda p : \forall q \in ALT(p)[q \neq p \rightarrow p \leq_{likely} q].p$

(7) Crnič (2014a, b): any = even+one$_F$
  a. LF: Even [$\neg$ one$_F$ book λx John read x]
  b. ALT = {John didn't read one book, John didn't read two books,...,John didn't read n books}

(8) Crnič (2011, 2019a, b): any = even+a$_{D_F}$
  a. LF: Even [$\neg$ a$_{D_F}$ book λx John read x]
  b. ALT=$\{\neg$John read a book in $D' | D' \subseteq D\}$

Simply reducing the NPI *any* to the combination of a propositional *even* operator and the numeral one or the existential determiner *a*, however, makes incorrect empirical predictions. First of all, *any* and *even...one* have different distributions. For example, in (9), while *even...one* is felicitous, *any* is not. In (10)[3], on the other hand, *any* is felicitous but *even...one* is not (Chen 2019).

(9) Context: Mary asked John to count how many students were present at the seminar. John forgot about it. Mary complained,
  a. John didn't count even one student.
  b. *John didn't count any student.

(10) Context: Mary and Sue are talking about John.
  a. John wasn't born in any big city. (He was born in a small town.)
  b. *John wasn't born in even one big city. (He was born in a small town.)

Although analyzing *any* as *even...a$_D$* has no problem accounting for (9) and (10), it makes incorrect predictions elsewhere. According to Crnič (2019a; cf. Linebarger 1987), *any* in the scope of a non-monotonic operator like *exactly n* gives rise to a so-called "size effect". For example, in (11), when the number ensuing "exactly" is small relative to the context, *any* is felicitous. However, when the number ensuing "exactly" is big relative to the context, *any* is infelicitous.

(11) *Context: There are 12 graduate students in the department.*
  a. Exactly 2 students read any book.
  b. ??Exactly 10 students read any book.

[3]Mats Rooth raised an issue on the example sentence (10a). He said this sentence does not sound like a plain every day use of English. I will have to leave the investigation of this intuition to another occasion.

Crnič (2019a) takes the contrast between (11)a and (11)b as strong evidence supporting the uniform *even* theory of *any*. According to him, *any* is analyzed as *even...*a_D in this case. In a sentence like (11)a, in order for the least likelihood presupposition of *even* to be satisfied, we will need a context where the speaker expects a lot of students, say, 10 out of 12, to have read at least one book. Moreover, the larger the domain of books the speaker takes into consideration, the bigger the number of students who read at least one book from that domain. In such as context, relative to the subdomain alternatives, the proposition that exactly 2 students read a book in D will be less likely since the speaker will expect there to be more students who have read at least one book in D. Crnič argues that since this context that satisfies the least likelihood presupposition of *even* is a natural one and is easy to accommodate, *any* is felicitous.

(11a) Exactly 2 students read any book.

(12) ALT=$\{$Exactly 2 students read a book in $D'|D' \subseteq D\}$

However, when we replace the number 2 with 10, in order to satisfy the least likelihood presupposition of *even*, we will need a very different context. Basically, the speaker expects very few students, say 2 out of 12, to have read at least one book. Moreover, the larger the domain of books the speaker takes into consideration, the smaller the number of students who read at least one book from that domain. This kind of context, however, contradicts our common assumption that the more books we consider, the more readers there should be. Crnič argues that since this context that satisfies the presupposition of *even* is unnatural and extremely hard to accommodate, *any* is infelicitous.

(11b) Exactly 10 students read any book.

(13) ALT=$\{$Exactly 10 students read a book in $D'|D' \subseteq D\}$

If *any* always requires *even* for its felicity, then the so-called "size effect" observed in (11) should always exist. This prediction, however, is not empirically attested. Take a look at (14). In the given context, both the *exactly n* sentences in (14) are felicitous, no matter *n* is big or small relative to the context.

(14) *Context: John is watching a car racing game. There are 12 cars competing. From 100 miles on, there is a gas station every few miles. Bill asks John what the game is like right now.*
  a. Exactly 2 cars are close to any gas station.
  b. Exactly 10 cars are close to any gas station.

Based on the *even* theory of *any*, I give the logical form and the alternative set for (14)a in (15) and those for (14)b in (16). The readers can verify for themselves that in order for the prejacent of *even* in (15) to be less likely than the other alternatives, we need a context where the speaker expects there to be many cars, say, 10 out of 12 cars, to be close to a gas station. Moreover, the larger the domain of gas stations, the more cars that are close to a gas station. On the contrary, in order for the prejacent of *even* in (16) to be less likely than the other alternatives, we need a context where the speaker expects there to be few cars, say, 2 out of 12 cars, to be close to a gas station. Moreover, the larger the domain of gas stations, the less cars that are close to a gas station.

(15) a. LF: Even [exactly 2 students λx a_{D_F} book λy x read y]

b. ALT = $\{$Exactly 2 students read any book in $D'|D' \subseteq D\}$

(16) a. LF: Even [exactly 10 students λx a$_{D_F}$ book λy x read y]
b. ALT = $\{$Exactly 10 students read any book in $D'|D' \subseteq D\}$

The two contexts that can make the presupposition of *even* satisfied in (14)a and (14)b respectively contradict each other. Therefore, the *even* theory predicts that (14)a and (14)b can never be felicitous in one and same context. However, we have seen that they are actually felicitous at the same time in the given context in (14). Analyzing *even...a*$_{D_F}$ makes an incorrect prediction in this case.

Let's take stock. Crnič argues that an indispensable ingredient in the semantics of *any* is an *even* operator. He has analyzed *any* as *even...one*$_F$ or *even...a*$_{D_F}$. However, the *even* theory makes incorrect empirical predictions. First of all, we have seen that *any* and *even...one*$_F$ have different distributions. We find cases where *any* is felicitous but *even...one*$_F$ is not. We also find cases where *even...one*$_F$ is felicitous but *any* is not. Furthermore, analyzing *any* as *even...a*$_{D_F}$ predicts that in sentences where *any* locates in the scope of *exactly n*, there will be always a "size effect". However, in (14), we don't observe such a "size effect". Both the sentences are felicitous in the given context. Thus I conclude that *any* does not require *even* for its felicity.

3. Against the mixed view of *any* in the exhaustification theory

As reviewed in §1, the exhaustification theory (Chierchia 2013) argues for a mixed view of the NPI *any*. In most cases, *any* is argued to be exhaustified by an exhaustifier O with a semantics akin to *only* (cf. Krifka 1995). Basically, this exhaustifier O, when taking a proposition p as its argument, will assert the truth of p and negate any alternative q to p that is logically stronger than p. In the classical examples with an NPI *any* like (1)a, repeated here in (18), the exhaustification theory makes correct predictions without any issue. Since the prejacent of the exhaustification operator O entails all the other alternatives, O will just assert the truth of the prejacent. None of the alternatives will be negated. The resulting truth condition, therefore, is the same as the truth condition of the prejacent itself. The readers can verify this point using the semantics of O and the alternative set given below.

(17) $[\![O_{exh}]\!](p) = p \wedge \forall q \in ALT(p)[q \subset p \rightarrow \neg q]$

(18) John didn't read any book.

(19) LF: $O_{exh} \neg$ a$_{D_F}$ book λx John read x

(20) ALT = $\{O_{exh} \neg$ a$_{D'}$ book λx John read $x|D' \subseteq D\}$

In non-monotonic contexts, exhaustification via the O operator will result in incorrect truth conditions since the alternatives are logically independent of each other. Chierchia (2013) thus adopts Crnič's (2011) theory and proposes that *any* in non-monotonic contexts is exhaustified by an exhaustifier E with a semantics akin to *even*.

However, as §2 shows in detail, simply analyzing *any* as *even...a*$_{D_F}$ makes unattested empirical predictions. When *any* occurs in the scope of a non-monotonic quantifier like *exactly n*, the *even* theory predicts that there will always be a "size effect" of the number n. However, in the example (14), we find that both the sentence containing a small number and the sentence containing a big number are felicitous with *any*. Therefore, the same example also poses a challenge to the exhaustification theory.

4. Proposal

In the previous two sections, I have argued against the uniform *even* theory of *any* as well as the mixed view of *any* in the exhaustification theory. A conclusion we can draw from the discussion is — *any* does **not** require *even* for its felicity[4]. Specifically, the counterexample in (14) shows that *any* does not require *even* for its felicity in non-monotonic contexts. However, a question still remains unanswered. Why is *any* felicitous in non-monotonic contexts?

The good old theory of the NPI *any* is that *any* is licensed in downward-entailing environment (Ladusaw 1980). Later, Von Fintel (1999) updates the definition of downward-entailment to Strawson-downward-entailment. Basically, Strawson-DE assumes the truth of the presuppositions of the proposition under discussion as well as the alternatives when checking whether *any* is in a DE environment. Due to space constraint, I will not give a review of the development of this theory, but I would like to point out that the felicity of *any* in non-monotonic contexts is always a puzzle to the DE theory. Since down-entailingness is argued to be a necessary condition of the felicitous use of *any*, we will expect *any* to be unlicensed in the sentences in (11) and (14). Contrary to this prediction, however, we find that *any* is felicitous in (11)a and (14).

In the following, I will propose a theory that accounts for the felicity of *any* in (14). There are three main ingredients of this theory. First of all, I argue that *any* in the scope of a non-monotonic operator in the surface structure is actually located in the restriction of a definite plural description in the logical form. This means that a sentence like (14) is actually semantically interpreted as (21).

(21) The cars that are close to any gas station are exactly 2 in number.

Second, following Gajewski and Hsieh (2014) and Gajewski (2016), I argue that *any* in the restriction of a definite plural description is licensed very locally, via generalized Strawson-downward-entailment in the nominal domain. Last, *exactly n* comes in after *any* is already licensed.

The three ingredients of the proposed theory will work in tandem to make sure that *any* in the scope of a non-monotonic operator like *exactly n* is still in a Strawson-downward-entailing environment in the logical form. Therefore, the good old theory of the NPI *any* licensing can still be maintained.

4.1. The maximality component and the cardinality component in the semantics of *exactly n*

The three ingredients of the proposed theory are motivated independently. First of all, recent studies have argued that modified numerals are decomposed into three parts in semantics — an indefinite determiner $\mathbf{some}^u$ that introduces a discourse referent, a maximality operator $\mathbf{M}_u$ that selects the maximal plurality satisfying the conditions specified by the sentence containing the modified numeral and a cardinality component $\mathbf{2}_u$ that checks the cardinality of the maximal

[4]This conclusion does not exclude *any* from occurring felicitously in sentences with *even*. It simply argues that if *any* happens to be felicitous in a sentence with *even*, the *even* operator does not come from a lexical requirement of *any*.

plurality selected by $\mathbf{M}_u$ (Zhang 2020). The decompositional analysis of modified numerals is mainly motivated by their use in cumulative sentences (Brasoveanu 2013).

(22) Exactly three students watched exactly six movies.

In a cumulative sentence like (22), neither modified numeral is in the scope of the other. Instead, the interpretation of this sentence suggests that there are two contextually relevant maximal pluralities, one being *the* students who watched *a* movie and another being *the* movies that were watched by *a* student. The cardinality requirement imposed on these two pluralities by the two modified numerals comes after the two pluralities are already formed. This idea of delaying certain semantic evaluation is not unfamiliar. For example, in his analysis of the Haddock sentences like (23), Bumford (2017) argues that the two definite determiners **the** in this sentence should be decomposed into an indefinite determiner and a delayed maximality test.

(23) The rabbit in the hat

Zhang (2020) extends the idea of decomposition to her analysis of comparative sentences with non-monotonic modified numerals in the *than*-clause. In a sentence like (24), she argues that the contribution of the modified numeral *exacly 2* is three-fold. First, it introduces a discourse referent which satisfies the condition specified by the comparative. Second, it imposes a maximality test on the discourse referent. Last, it imposes a cardinality test on the the discourse referent. The latter two tests are delayed as a kind of post-supposed evaluation.

(24) Mary is taller than exactly 2 boys are.

Based on this split semantics of the non-monotonic quantifiers, the truth condition of sentence (24) can be paraphrased as: Mary is taller than *some* boys, and *the* boys are exactly 2 in number. This paraphrase presents the three-fold contribution of *exactly 2* in (24) in a straightforward way. The indefinite determiner *some* introduces a discourse referent. The definite determiner *the* imposes a maximality test and *exactly 2* imposes a cardinality test.

Inspired by Zhang's (2020) analysis of the non-monotonic modified numerals, I argue that *exactly n* in sentence (14) is decomposed in the same way. As we will see later, once we break *exactly n* into an indefinite determiner $\mathbf{some}_u$, a maximality operator $\mathbf{M}_u$ and a cardinality predicate $\mathbf{n}_u$, the NPI *any* in the scope of a non-monotonic quantifier in the surface structure turns out to be in the restriction of a definite plural description in the logical form. This is the first ingredient of the proposed theory.

4.2. Local licensing of *any* in the restriction of a definite plural

The observation that the NPI *any* in the restriction of a definite plural can be licensed very locally is not novel. A strong evidence supporting this hypothesis is that *any* is found to be felicitous in the restriction of a definite plural even if the main predicate is collective (Gajewski and Hsieh 2014; Gajewski 2016).

(25) a. The students with any knowledge of French formed a team.
 b. The students with any knowledge of French in tense formed a team.

The felicity of *any* in (25)a is surprising if we assume Strawson-DEness as a necessary condition on the licensing of *any*. When we replace the restriction of the definite plural in (25)a with its subset, the resulting sentence (25)b is not logically entailed by (25)a. Instead, the two sentences are logically independent of each other. Therefore, the Strawson-DE theory of *any* predicts that *any* is infelicitous in (25)a, contrary to fact.

In order to reconcile between the Strawson-DE theory of *any* licensing and the felicity of sentence (25)a, Gajewski and Hsieh generalize the definition of Strawson-entailment to the nominal domain (Gajewski and Hsieh 2014; Gajewski 2016), an idea initially sketched in a footnote by Guerzoni and Sharvit (2007). According to the generalized definition of Strawson-entailment, as given in (26), for any two entities α and β of type $\langle e \rangle$, if β is a mereological part of α, then α Strawson-entails β.

(26) a. **If α and β are of type e, then $\alpha \rightarrow_S \beta$ iff $\beta \sqsubseteq \alpha$**
b. If α and β are of type t, then $\alpha \rightarrow_S \beta$ iff α=0 or β =1
c. If α and β are of type $\langle \sigma\tau \rangle$, then $\alpha \rightarrow_S \beta$ iff for all $x \in dom(\alpha) \cap dom(\beta), \alpha(x) \rightarrow \beta(x)$

Coming back to sentence (25)a, we see that this generalized definition of Strawson-entailment allows *any* to be licensed locally in the restriction of a definite plural description. Since the plurality consisting of the students with knowledge of French in tense is a mereological part of the plurality consisting of the students with knowledge of French, the definite plural subject in (25)a Strawson-entails the definite plural subject in (25)b. This means that we do not need to look beyond the subject in the sentence because *any* already finds itself in a Strawson-DE environment.

4.3. Putting the ingredients together

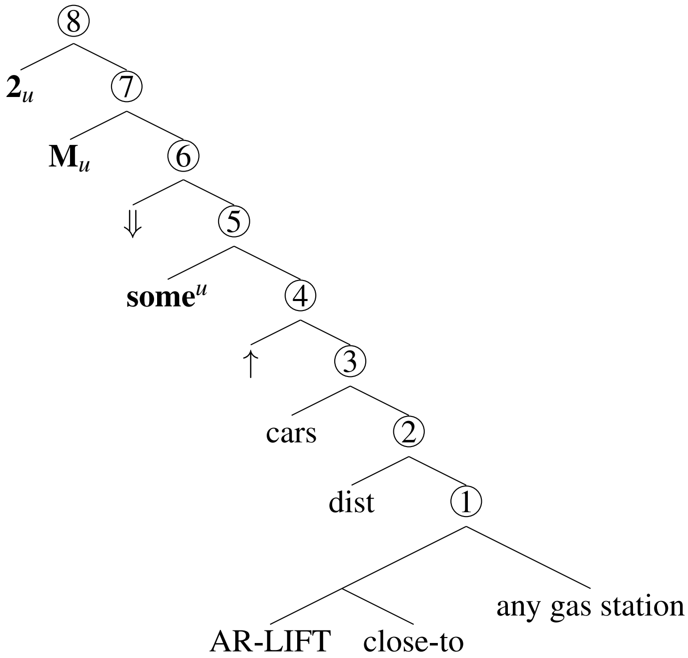
The previous two sections present all the ingredients of the proposed theory. Essentially, the non-monotonic quantificational determiner *exactly n* is decomposed into three parts: an indefinite determiner $\textbf{some}^u$ that introduces a discourse referent; a maximality operator $\mathbf{M}_u$ that selects the maximal plurality satisfying the conditions specified by the sentence, and a cardinality predicate $\mathbf{n}_u$ that counts the number of the atoms in the plurality. Let's put everything together and see how the proposed theory can account for the sentence (14)a. The logical form and the step-by-step composition of the sentence are given on the next page.

From the semantic composition, we can see that a sentence is interpreted as an assignment function dependent set of ⟨Truth value, assignment function⟩ pair. The assignment function carries the information about the discourse referents introduced in the sentence and the predicative content in the sentence applies to the discourse referent as restricting conditions. In the example sentence (14)a, a discourse referent u is introduced by the indefinite determiner $\textbf{some}^u$. The sentence specifies that u are cars and each atomic part of u is close to a gas station. The maximality operator $\mathbf{M}_u$ then selects the maximal plurality consisting of the cars that are close to a gas station. Last, $\mathbf{2}_u$ makes sure that the maximal plurality of cars selected by $\mathbf{M}_u$ has 2 atomic parts in it.

What is most important here is that at the node 7, the NPI *any* is in the restriction of a definite plural. As has been discussed in §4.2., the empirical fact that *any* is felicitous in the restriction of a definite plural regardless of the predicate type strongly suggests that *any* is licensed very locally in this case instead of at the propositional level. I take the arguments in Gajewski and Hsieh (2014) and Gajewski (2016) as an assumption and adopt their generalized definition of

Strawson-entailment given in (26). Once the generalized Strawson-entailment is adopted, it is a natural consequence of this assumption that *any* is felicitous in (14)a, since the restriction of a definite plural is a Strawson-DE environment.

(14a) Exactly two cars are close to any gas station.



(27) $[\![any\ gas\ station]\!] = \lambda P.\exists x[gs(x) \wedge P(x)]$

(28) $[\![close - to]\!] = \lambda y \lambda x.close(y)(x)$

(29) $[\![\text{AR}-\text{LIFT}\ close\ to]\!] = \lambda P \lambda x.P(\lambda y.close(y)(x))$

(30) $[\![①]\!] = \lambda x.\exists y[gs(y) \wedge close(y)(x)]$

(31) $[\![dist]\!] = \lambda P_{et}.\lambda X.\forall x[x \sqsubseteq_{atom} X \rightarrow P(x)]$

(32) $[\![②]\!] = \lambda X.\forall x[x \sqsubseteq_{atom} X \rightarrow \exists y[gs(y) \wedge close(y)(x)]]$

(33) $[\![③]\!] = \lambda X.cars(X) \wedge \forall x[x \sqsubseteq_{atom} X \rightarrow \exists y[gs(y) \wedge close(y)(x)]]$

(34) $[\![\uparrow]\!] = \lambda P \lambda x \lambda g.\{\langle P(x), g\rangle\}$ $\quad [\![\Downarrow]\!] = \lambda m.m(\eta)$ $\quad [\![\eta]\!] = \lambda x \lambda g.\{\langle x, g\rangle\}$

(35) $[\![④]\!] = \lambda X \lambda g.\{\langle cars(X) \wedge \forall x[x \sqsubseteq_{atom} X \rightarrow \exists y[gs(y) \wedge close(y)(x)]], g\rangle\}$

(36) $[\![some^u]\!] = \lambda c \lambda k \lambda g.\bigcup\{k(x)(g')|x \in D_e, \langle T, g'\rangle \in c(x)(g^{u \rightarrow x})\}$

(37) $[\![⑤]\!] = \lambda k \lambda g.\bigcup\{k(X)(g^{u \rightarrow x})|cars(X) \wedge \forall x[x \sqsubseteq_{atom} X \rightarrow \exists y[gs(y) \wedge close(y)(x)\}$

(38) $[\![⑥]\!] = \lambda g.\{\langle X, g^{u \rightarrow X}\rangle|cars(X) \wedge \forall x[x \sqsubseteq_{atom} X \rightarrow \exists y[gs(y) \wedge close(y)(x)\}$

(39) $[\![M_u]\!] = \lambda m \lambda g.\{\langle X, h\rangle|\langle X, h\rangle \in m(g) \wedge \neg\exists\langle Y, h'\rangle[\langle Y, h'\rangle \in m(g) \wedge h(u) \sqsubset h'(u)]\}$

(40) $[\![⑦]\!] = \lambda g.\{\langle X, g^{u \rightarrow X}\rangle|X = \oplus\lambda X.[cars(X) \wedge \forall x[x \sqsubseteq_{atom} X \rightarrow \exists y[gs(y) \wedge close(y)(x)]]\}$

(41)

$$[\![2_u]\!] = \lambda m\lambda g. \begin{cases} \{\langle T,g'\rangle | \langle X,g'\rangle \in m(g)\} & \textbf{if } |atoms(\oplus G_u)| = 2, where\ G = m(g), \\ & G_u = \{g'(u)|\exists\beta.\langle\beta,g'\rangle \in G\} \\ \{\langle F,g\rangle\} & \textbf{otherwise} \end{cases}$$

(42)

$$[\![⑧]\!] = \lambda g. \begin{cases} \{\langle T,g^{u\to X}\rangle\} \textbf{ if } |\text{atoms}(\oplus\{X|\text{cars}(X) \wedge \forall x[x \sqsubseteq_{\text{atom}} X \to \\ \qquad \exists y[gs(y) \wedge close(y)(x)\})| = 2 \\ \{\langle F,g\rangle\} \qquad \textbf{otherwise} \end{cases}$$

5. Remaining issues

There are some remaining issues on the proposed theory. First of all, the proposed theory can well explain why both (14)a and (14)b are felicitous in the given context, but it also predicts that *any* in the scope of *exactly n* in the surface structure will never have the so-called "size effect". Since *any* is licensed very locally, its felicity is already guaranteed before the cardinality predicate $\mathbf{n}_u$ comes in. No matter the number after *exactly* is big or small relative to a given context, *any* is predicted to be always felicitous. However, the "size effect" observed in sentences where *any* is in the scope of *exactly n* has long been accepted as an established empirical fact since Linebarger (1987). This means that either sentence (11)a is a different beast than (14)a and (14)b despite the fact that they look very similar on the surface or the "size effect" is actually illusionary.

Here, I will not decide between these two possibilities, but I would like to point out that a recent experimental study on the licensing of the NPI *any* challenges the *even* theory of *any* and as a result also challenges the accepted "size effect" (Alexandropoulou et al. 2020). The authors give the participants a prompt as given in (43). In the place of QUANT, they put different quantifiers and in the place of $(\text{ANY})_{pol}$, they either keep it unfilled or fill it with *any*. The authors say that the number they use in the quantifiers are all small numbers.

(43) I didn't expect this, but QUANT products had $(\text{ANY})_{pol}$ artificial sweeteners in them. What do you think the writer of the sentence expected? (click on your answer)
- that more products had artificial sweeteners in them
- that fewer products had artificial sweeteners in them

The authors find that when the prompt has *any* in it, about half of the participants choose "more products" and the rest half choose "fewer products". This is very surprising according to the *even* theory because a sentence containing *exactly n* with *n* being small and with *any* in the scope of *exactly n* is predicted to be felicitous only in a context where the speaker expects there to be more products had artificial sweeteners in them. The experimental results, however, suggest that only about half of the participants require such a context to be able to parse the prompt sentence. Moreover, compared with the results from the prompt without *any*, the difference is not significant. This means that the insertion of *any* actually does not bring with it an *even* operator, otherwise significantly more participants will choose "more products". If the "size effect" is a byproduct of the lexical requirement of *any* that the presupposition of *even* has to be satisfied, the experimental results reviewed above suggest that the "size effect" may not be real.

Another remaining issue is the contrast between (44) and (45) in terms of their felicity. It has been observed that *any* in the restriction of a definite singular description is infelicitous when the sentence is interpreted episodically, as shown in(44)). However, *any* is still licensed in the scope of *exactly one*, as shown in (45). This is surprising based on the proposed theory because (45) is analyzed as (44) at logical form. How is it possible that one is felicitous and the other is not?[5]

(44) *The student who read any book is exactly one in number.

(45) Exactly one student read any book.

Here I sketch an idea to resolve this issue. Basically, at the logical form, the nominal predicate of the definite description can be intensionalized. Therefore, we could still get a definite plural, not an extensional definite singular. This idea is actually already discussed in Gajewski and Hsieh (2014). The interested readers can refer to their paper for more details. Still another issue is whether the current proposal gives any insight in the interaction between *any* and other modified numerals[6]. I do not yet have an answer to this question. According to my preliminary survey, my informants who are native English speakers have diverging opinions on the felicity of *any* in the scope of other modified numerals. I have not been able to find a pattern.

6. Conclusion

In this paper, a novel counterexample is presented that challenges both the uniform *even* theory of *any* and the mixed view of *any* in the exhaustification theory. In order to account for the counterexample, I argue that *any* in the scope of *exactly n* in the surface structure is located in the restriction of a definite plural in the logical form. This theory is made possible by the recent decompositional analysis of non-monotonic quantifiers where *exactly n* is broken down into an indefinite determiner, a maximality component and a cardinality component. A consequent of the proposed theory is that the so-called "size effect" is predicted to be non-existent. I give a tentative discussion on this prediction, showing that this prediction may not be so non-orthodox given the recent experimental results in NPI licensing.

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[5]Thanks to Itai Bassi for raising this question to me.

[6]Thanks to Manfred Krifka for asking this question.

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Long-distance cumulativity asymmetry: experimental evidence from Czech [1]

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Abstract. This paper explores conjunctions and the phenomenon of cumulative asymmetry with respect to the subject and object position. The tested conjunction is the Czech *i*, which is postulated to be a D-conjunction. The aim of this paper and the experiment carried out is to test whether Czech speakers observe cumulativity asymmetry at long-distance in ECM constructions and whether monoclausal and long-distance configurations differ in interpretations.

Keywords: conjunction, d-conjunction, c-conjunction, distributivity, cumulativity, cumulativity asymmetry.

1. Introduction: universal quantifiers, distributive conjunctions, and distributivity

Singular universal DPs in subject position, like English *every* in (1a), always allow the distributive reading (formalized under (1a)), therefore would make a sentence true in a distributive context like (1). The same is true for indefinite descriptions (prototypically numerical NPs) in the same syntactic configuration: (1b).

(1) Context (distributive): Alex planted a spruce and a birch, and Bart planted a maple and a walnut.
  a. Every boy planted two trees. — true
  $\forall x[\textsc{boy}(x) \rightarrow \exists Y[{}^{*}\textsc{tree}(Y) \wedge \#Y = 2 \wedge \textsc{plant}(x,Y)]]$
  b. Two boys planted two trees. — true

On the other hand, universal quantifiers in the same syntactic configuration (subject position) are not prone to the cumulative interpretation, unlike indefinite descriptions: (2a) would be false in a cumulative context, (2), while the numerical NP, (2b) is well acceptable there.

(2) Context (cumulative): Alex and Bart planted a spruce and a birch.
  a. Every boy planted two trees. — false
  b. Two boys planted two trees. — true
  $\exists X \exists Y[{}^{*}\textsc{boy}(X) \wedge \#X = 2 \wedge {}^{*}\textsc{tree}(Y) \wedge \#Y = 2 \wedge \textsc{plant}(X,Y)]$

Nevertheless, in a different syntactic position, for example the object of a transitive verb in (3a), the same universal quantifier is allowed to be interpreted cumulatively, as witnessed by the context (3), which is not surprising in case of the indefinite description in (3b).

[1] We would like to express our deepest gratitude to Nina Haslinger for her help with not only the whole experiment, but mainly the theoretical part of this paper and the thesis on which this paper is based. Also thanks to the audiences at Sinn und Bedeutung 27, FASL 31 and Psycholinguistics of Slavic Languages 2022 for relevant comments.

(3) Context (cumulative): Alex and Bart watered a spruce and a birch (the only trees around).
  a. Two boys watered every tree. true
  b. Two boys watered two trees. true

This instance of subject-object asymmetry is well known in the theoretical literature as Schein (1993); Kratzer (2000); Champollion (2010) a.o. and is usually named **asymmetry of cumulative readings**. In this article, we bring new empirical material concerning this asymmetry of cumulative readings. In this respect, we contribute to the growing interest in asymmetry, which until recently was mainly theoretical. Our research focuses on distributive conjunctions. Namely, we follow Dočekal et al. (2023), where it was established that universal quantifiers and distributive conjunctions form a natural class with respect to the asymmetry of cumulative readings. Dočekal et al. (2023) report experimental work on Czech and German distributive conjunctions. The distributive conjunctions in the subject position, like German *sowohl* NP *als auch* NP in (4a) or Czech NP *i* NP in (4b), are obligatorily interpreted distributively: (4).

(4) a. Sowohl Ada als auch Bea haben genau vier Bücher gelesen.
  PRT Ada PRT also Bea have exactly 4 books read
  'Ada and Bea each read exactly four books.'
  b. Aleš i Bedřich přečetli přesně čtyři knihy.
  Alex *i* Fridrich read exactly 4 books.
  'Alex and Fridrich read exactly four books each.'
  c. cumulative scenario: A read 2, B read 2 false
  d. distributive scenario: A read 4, B read 4 true

However, if distributive conjunctions are in the scope of plural denoting NP (in the object position, e.g., outscoped by a plurality denoting NP in a subject position), the cumulative reading for them starts to be available. This shows that both, universal quantifiers and distributive conjunctions, share an important meaning component making their behavior parallel to the asymmetry of cumulative readings. Additionally, it also shows that approaches where obligatory distributivity is an integral part of the distributive conjunctions meaning, like Szabolcsi (2015); Mitrović and Sauerland (2016) or Gruet-Škrabalová (2004) for Slavic, are at least partially wrong.

(5) a. Heute haben die zwei Deutshcen sowohl die Abfahrt als auch den Slalom gewonnen.
  today have the two Germans PRT the downhill PRT also the slalom won
  'Today, the two Germans won both the downhill and the slalom.'
  b. Dva Češi vyhráli sjezd i slalom.
  Two Czechs won downhill *i* slalom.
  'Two Czechs won the downhill and the slalom.'
  c. cumulative scenario: A won the downhill, B won the slalom true
  d. distributive scenario: A won both, B won both true

Our article is organized as follows: section 2 discusses the two theoretical approaches to cumulativity asymmetry presented here and our research questions. Section 3 presents the experiment, its design, example items and results aswell. Both descriptive statistics and fixed effects are provided. Lastly, section 4 aims to answer the research questions, summarize the experiment, and provide the results of a small follow-up experiment.

2. Theoretical approaches

Our article is empirically and experimentally focused, but the research questions it pursues are (of course) derived from the theoretical stances to the problem of asymmetry of cumulative readings. We will now discuss the two possible approaches to the asymmetry. At the core level, we can distinguish the two approaches summarized below.[2]

The first approach stems from the work of Kratzer (2000) and can be found as a recent version in Chatain (2021). The main idea of this approach, with respect to the asymmetry, is to rely on thematic role hierarchies. Universal quantifiers (and distributive conjunctions) can be (according to this view) interpreted cumulatively only if they have a lower θ-role than another plural denoting NP. Consider (6): it has only distributive reading for the universal quantifier (or for distributive conjunction if the natural language has dedicated distributive conjunction) because the distributive expression bears a higher thematic role (agens) than the other plural denoting NP in the sentence (*two trees* with the θ-role patiens). But consider (7), here the universal quantifier (or distributive conjunction) bears the patiens θ-role, is lower in the θ-role hierarchy than the other plurality denoting NP and therefore can be interpreted cumulatively. Generally, the thematic role approach predicts that the cumulative reading of the universal quantifier (or distributive conjunction) is not available if the other plural denoting NP has a θ-role ranking lower than the universal quantifier.

(6) Every boy planted two trees.
  a. AGENS (every boy/boy *i* girl) > PATIENS (two trees) — only distributive

(7) Two boys planted every tree.
  a. AGENS (two boys) > PATIENS (every tree/tree1 *i* tree2) — cumulative possible

The second type of explanation for asymmetry explains it via scope and does not rely on semantic roles. Let's call this approach the derivational hypothesis; the first formulation can be found in Champollion (2010), more recently in Haslinger and Schmitt (2018) (see Dočekal et al. 2023 for experimental support). The derivational explanation of the asymmetry, exemplified in (6) vs. (7) would flow as follows: universal quantifier can be interpreted cumulatively in (7) since it does not c-command the plural expression *two boys*. But in (6) the c-command configuration is reversed, and since the indefinite description is c-commanded by the universal quantifier, the cumulative interpretation is not available. The more general version of the derivational hypothesis works with chains since transformations can change the scope relations. In our experimental work, we scrutinized only base-generated sentences. Therefore, we adhere here to a

[2]We are aware that we simplify here since the theoretical approaches summarized in this section are motivated by more general theoretical goals than to explain just the asymmetry. From this, it follows that our summary is a sort of extraction of the parts of theories that are relevant to our research.

simplified version of the scope/derivational approach (but see Haslinger and Schmitt 2018 for details). See also the closing section of this article for a short explanation of the mechanics of this type of theory that can derive the asymmetry.

2.1. Hypotheses of the experiment

The core idea of our experiment is to test the two kinds of theories discussed in Section 2. In simple transitive clauses discussed above, both approaches yield the same predictions, but once we look into more complex sentences, the predictions of both theories diverge. Since by definition, θ-roles are tied to its predicate, the thematic role approach predicts that the asymmetry should be observed only locally in the sense of arguments of the same predicate. The derivational hypothesis, on the other hand, predicts the existence of asymmetry also at long-distance. We decided to test the distributive conjunctions in the Exceptional Case Marking (ECM) constructions. Czech is a good testing ground for such an experiment since it has a productive inventory of ECM verbs (see Caha 2004) and also has a very prolific distributive conjunction *i* (see Gruet-Škrabalová 2004). We formulate the idea behind the experiment in the form of the research question in (8). The positive answer to the research **question 1** would support the structural theories, and it would directly contradict the strong version of the θ-role approach to the asymmetry. The strong version refers to the idea that θ-roles are the only factor of the asymmetry of the cumulative readings. We note that both Kratzer (2000) and Chatain (2021) are weaker versions of the θ-role approach to the asymmetry problem, but the positive answer to question 1 would go against the grain of their explanations as well.

(8) **Question 1**
Do Czech speakers observe cumulativity asymmetry at long-distance?

While the main research goal of our experiment concerns itself with the empirical testing of the two theories, we also pursued more general questions concerning the current distributivity theories. There is still a divergence in the current approaches to distributivity (ranging from the event-based theories like Champollion (2016) to dynamic accounts like Dotlačil (2012, 2013)), the standard accounts (like Champollion 2016) are still local in the sense that distributivity is explained via the pluralization at the level of the predicate (continuing the classical works on distributivity like Link 1983; Schwarzschild 1996 a.o.). For this reason, examining distributivity/cumulativity acceptance is a fine testing ground for evaluating the locality prediction of the standard distributivity theories. We note that the second question is more exploratory, but no difference in acceptability of the distributive interpretation in the case of local and distance configurations can be problematic for many standard approaches to distributivity. We formulate the research **question 2** in (9).

(9) **Question 2**
How different are monoclausal and long-distance configurations interpretations?

3. Experiment

47 anonymous Czech participants answered 72 questions in a truth value judgement task via Ibex hosted by the Humboldt University's *Institut für deutsche Sprache und Linguistik*. None of the participants were paid or otherwise reimbursed for taking part in the experiment. Their task was to determine whether the presented image corresponded with a sentence in the given context. The null hypothesis stated that the position of *i* in reference to the subject and object does not influence the readings available. We expected that a higher acceptability rate of the cumulative reading of *i* in object position would be observed, rather than in the subject position.

3.1. Design

The design of the experiment followed the structure presented below. The tested sentence was a combination of the factors SUBJ and ECM paired with one of the levels of PIC. Each item contained a D-conjoined NP and another NP conjoined by the *a* 'and' conjunction. The position of the D-conjunction was based on the level of SUBJ. The level WRONG of PIC represented the baseline to which we compared the other levels of PIC; the picture was inherently wrong compared to the tested sentence, be it by the use of wrong verb representation or wrong animal. We used a three-factorial $2 \times 2 \times 3$ design, as detailed in the structure below.

1. Position of D-conjunction — factor SUBJ
   - SUBJTRUE - *i* in subject position
   - SUBJFALSE - *i* in object position
2. Type of structure — factor ECM
   - ECMTRUE - ECM structure
   - ECMFALSE - simple SVO clause
3. Picture condition — factor PIC
   - CUMUL - cumulative picture
   - DISTR - distributive picture
   - WRONG - wrong picture

3.2. Example items

(10) a. Context
Pátá třída základní školy byla na výletě v městské zoologické zahradě.
fifth grade elementary school was on trip at city zoo garden.
Tam se děti mohly na zvířátka dívat a některé nakrmit.
There REFL children could at animals look and some feed
'The fifth grade of an elementary school went on a trip to the city zoo. There, the children could observe the animals and feed some of them.'

(11) a. Sára i Dan viděli Adélu fotit lva a tygra.
Sára *i* Dan see.3PL.PST Adéla.ACC take.picture.INF lion.ACC and tiger.ACC
'Sára and Dan saw Adéla take a picture of a lion and a tiger.'

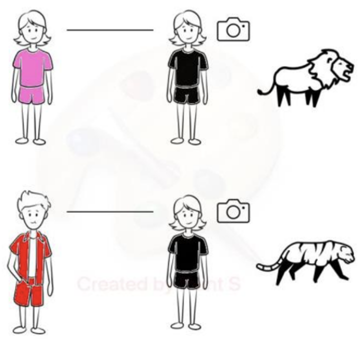

Figure 1: Illustration of item SUBJTRUE & ECMTRUE with PIC CUMUL.

(12) a. Klára a Šimon viděli Tínu natáčet velblouda i žirafu.
Klára and Šimon see.3PL.PST Tína.ACC record.INF camel.ACC *i* giraffe.ACC
'Klára and Šimon saw Tína record a camel and a giraffe.'

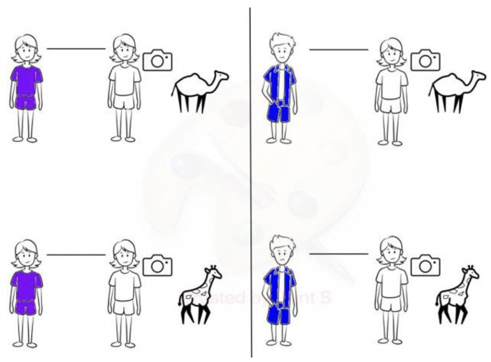

Figure 2: Illustration of item SUBJFALSE & ECMTRUE with PIC DISTR.

(13) a.

Milan	i	Klára	viděli	černého	králíka	a	bílého	králíka.
Milan	*i*	Klára	see.3PL.PST	black.ACC	rabbit.ACC	and	white.ACC	rabbit.ACC

‘Milan and Klára saw a black rabbit and a white rabbit.’

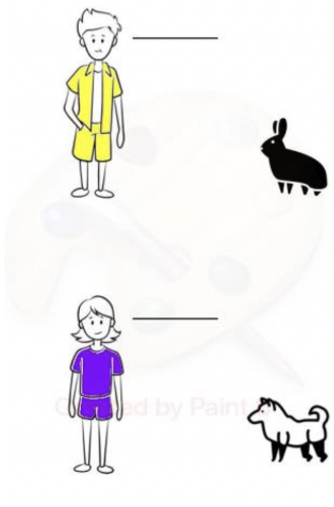

Figure 3: Illustration of item SUBJTRUE & ECMFALSE with PIC WRONG.

3.3. Results

3.3.1. Results: descriptive statististics

The results of the experiment are visualized in Figure 4. The graph is a barplot of responses, and the facets represent the crossing of the factors ECM (the conditions with ECM – ECM: TRUE – or a simple SVO clause – ECM: FALSE) with SUBJ (the distributive conjunction in a subject position – SUBJ: TRUE – vs. non-subject position – SUBJ: FALSE). Green vs. red proportion shows the acceptance of PIC factor with three levels (CUMUL, DISTR, WRONG). As can be seen at the first glance, the reference level (WRONG of PIC) was strongly rejected, while the distributive interpretation (DISTR of PIC) was always accepted. The cumulative interpretation (CUMUL of PIC) is clearly more acceptable than the negative reference level but fares worse than the distributive interpretation of *i*. Moreover, its acceptability decreases if the distributive conjunction appears in the subject position of a simple SVO sentence (ECM: FALSE, SUBJ TRUE).

The descriptive statistics already show that the distributive conjunction (*i*) always allows the distributive interpretation and that its cumulative interpretation is configuration-dependent. These pieces of evidence show that the approaches where distributive interpretation is hard-wired into the meaning of the conjunction are wrong. Next, the degraded cumulative interpretation of *i* proves that the conjunction is not simply ambiguous between the cumulative and distributive interpretations because then we should get approximately similar acceptability both in CUMUL and DIST, contrary to the findings. Therefore *i* is not an ambiguous conjunction similar to English *and* but a genuine distributive conjunction.

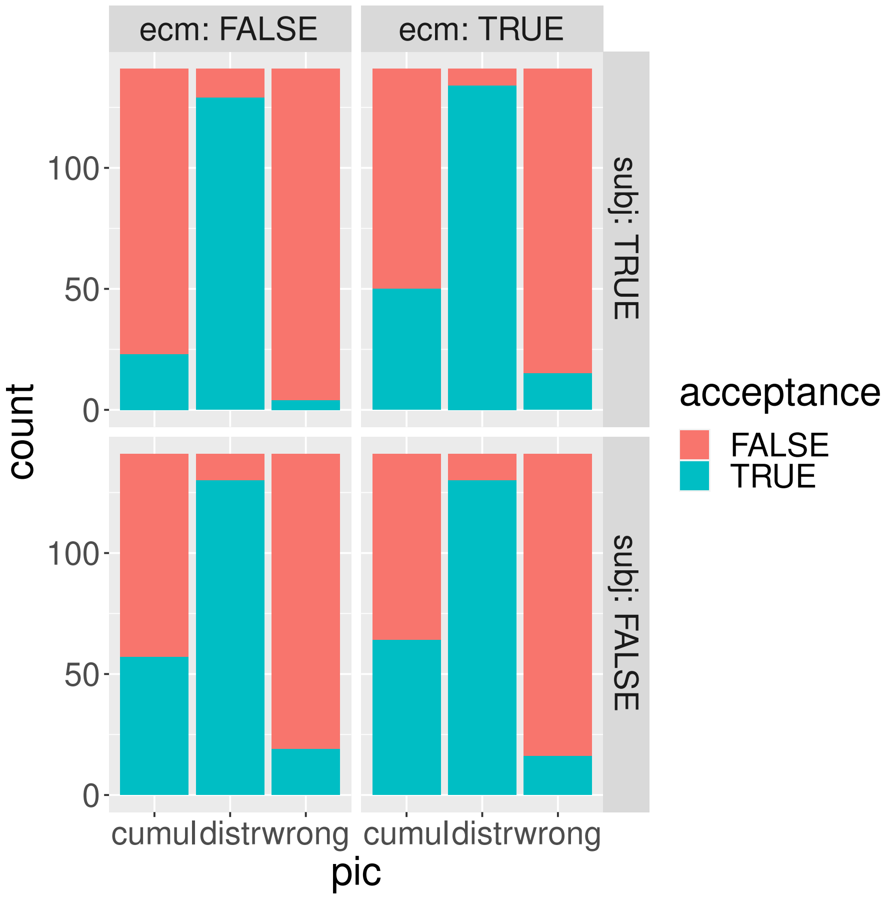

Figure 4: Barplot of responses.

3.3.2. Results: modeling

We analyzed the experiment using generalized logistic mixed models (R package LME4, Bates et al. 2015) with three fixed effects: PIC (DISTRibutive, CUMULative and WRONG, the last being the reference level), ECM (i being in ECM or simple SVO clause, ECM: FALSE as the reference level) and SUBJ (i in the subject position or not, SUBJ: FALSE as the reference level), and their interaction. The dependent variable was the subject's response. The model also included intercept-only subject and item random effects (more complex models did not converge). In the model, WRONG of PIC was reversed (against the descriptive statistics): with the value true/1 we label the subjects' rejections of the wrong picture in accordance with the subject's correct rejection of the wrong picture for a condition (remember that WRONG was distinctly unacceptable in any reading of the tested sentences). We found the following:

First, the main effects. The cumulative interpretation of i in any environment was significantly worse than its correct rejection in WRONG ($\beta = -2.50, z = -7.87, p < 0.001$), while its distributive interpretation was not significantly different from the reference level. The complexity of the clause (simple SVO vs. ECM clauses) was not significant either. Nevertheless, subjects were sensitive to the syntactic status of *i* (SUBJ: TRUE – $\beta = 1.76, z = 3.07, p < 0.01$) but recall that reference level were simple SVO clauses where *i* was not in the subject position (ECM: FALSE, SUBJ: FALSE). The main effects support the descriptive statistics: *i* is a distributive conjunction, not ambiguous between cumulative and distributive interpretations. Nevertheless, the cumulative interpretation of *i* is more or less accessible depending on its syntactic position. All the details about effects, their interactions, standard errors, and random effects can be found in Table 1.

Fixed effects				
	Estimate	SE	z value	p value
Intercept	2.06	0.28	7.31	< 0.001
PIC:CUMUL	-2.50	0.32	-7.87	< 0.001
PIC:DISTR	0.65	0.41	1.59	> 0.1
ECM:TRUE	0.21	0.37	0.55	> 0.1
SUBJ:TRUE	1.76	0.57	3.07	< 0.01
PIC:CUMUL*ECM:TRUE	0.02	0.45	0.05	> 0.1
PIC:DISTR*ECM:TRUE	-0.21	0.59	-0.36	> 0.1
PIC:CUMUL*SUBJ:TRUE	-3.14	0.65	-4.84	< 0.001
PIC:DISTR*ECM:TRUE	-1.86	0.72	-2.57	< 0.05
ECM:TRUE*SUBJ:TRUE	-1.68	0.69	-2.42	< 0.05
PIC:CUMUL*ECM:TRUE*SUBJ:TRUE	2.59	0.80	3.24	< 0.01
PIC:DISTR*ECM:TRUE*SUBJ:TRUE	2.29	0.97	2.36	< 0.05
Random effects				
	Variance	SD		
subject	0.59	0.77		
item	0.000005	0.0023		

Table 1: Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) for the experiment

Let's continue with the interaction effects. We found that speakers strongly dispreferred the cumulative picture if *i* was in the subject position – there is a strong interaction effect of PIC: CUMUL by SUBJ: TRUE, the strongest interaction effect: $\beta = -3.14, z = -4.84, p < 0.001$. This means that speakers (generally non-preferring the cumulative interpretation – see the main effects) rejected the cumulative interpretation of *i* with added interaction coefficient $z = -4.84$ if *i* was in the subject position. But speakers accepted the cumulative interpretation both in simple and ECM constructions to the same extent (the interaction effect between PIC: CUMUL and ECM: TRUE was not significant). The same is true for the distributive interpretation of *i* (again, the interaction between PIC: DISTR and ECM: TRUE is not significant). Recall also that the main effect of ECM was not significant either. The interaction effect can be observed in the Interaction effects graph in Figure 5: the acceptance represents the probability of acceptance yielded by the logistic model (with standard errors).

The results of the experiment show: (i) *i* is a distributive conjunction since main effects of DISTR and CUMUL diverge robustly, DISTR in fact being statistically non-distinguishable from

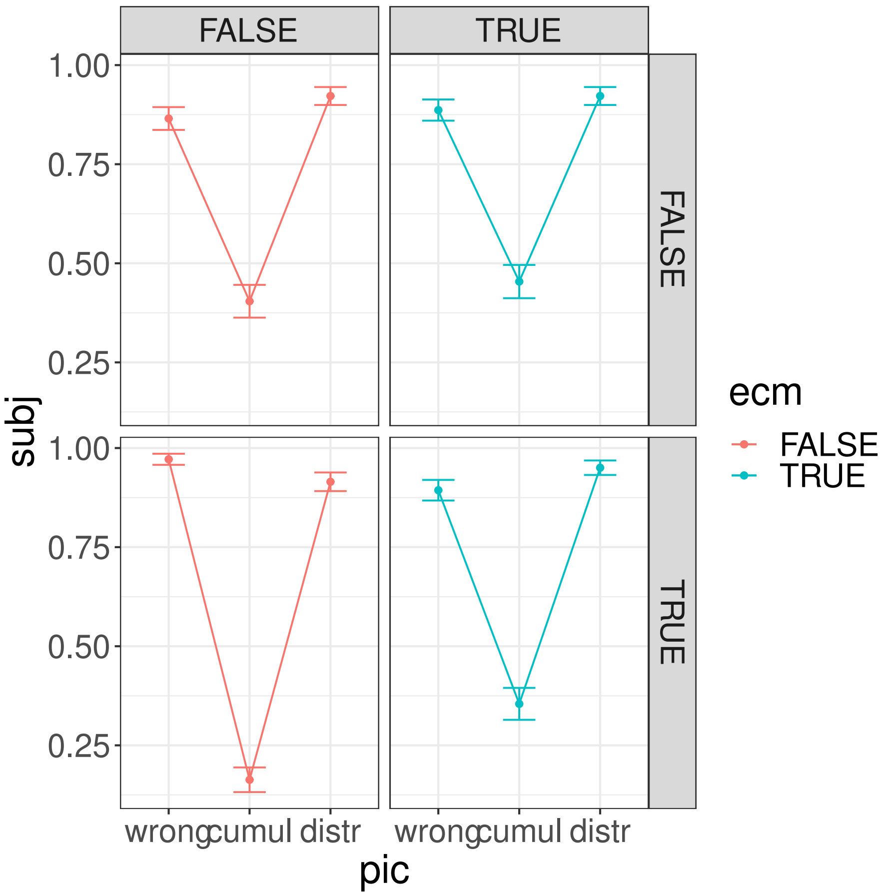

Figure 5: Interaction effects graph.

the reference level (which is true both locally and at distance: the interaction between ECM and DISTR was not significant); (ii) the cumulative interpretation of *i* is much less preferred than its distributive interpretation but its decreased acceptability does not depend on locality (the interaction between CUMUL and ECM was not significant and the main effect of ECM was not significant either); (iii) the cumulative interpretation of *i* is the least acceptable if *i* is in the subject position (the strongest – negative – interaction effect between CUMUL and SUBJ) – the asymmetry of cumulative readings – and the asymmetry is not prohibited by non-locality (non-significance of the interaction between CUMUL and ECM).

4. Discussion

Now we can summarize the results of our experiment by answering the two research questions. Question 1 is repeated below as (14). The experiment clearly brings lot of material which can help us answer it. Generally, we can answer the question positively: *i* cannot be interpreted cumulatively only if it c-commands the other plural denoting DP (see the effects plot in Fig 5 and recall the strongest interaction effect – negative one – between CUMUL and SUBJ). Another piece of evidence comes from the salient cumulative interpretation of the ECM verbs' objects (recall that the interaction between CUMUL and ECM was not significant). That means that cumulative readings add up irrespective of particular predicates. The second and first points are direct evidence for the scope-based theories but they are not decisive evidence against the θ-based theories.

(14) **Question 1**
Do Czech speakers observe cumulativity asymmetry at long-distance?

To fully estimate the consequences of our experimental research with respect to the θ-based theory of the asymmetry we constructed a small follow-up experiment. In this experiment, we tested the effect of subject and object position on the availability of cumulative readings with the conditions SUBJ and PIC. In this experiment both, the subject of the matrix and subject of embedded ECM, are agents. This should provide a clearer picture w.r.t. θ-role approach. 13 native speakers of the Czech language succesfully completed the experiment. The design was identical to the first experiment, in that it was a truth value judgement task and participants had to compare the tested sentence to the image presented. Level WRONG of PIC was once again set to be the baseline and the context was identical to the context in the first experiment.

1. Position of D-conjunction — factor SUBJ
   - SUBJTRUE - *i* in subject position
   - SUBJFALSE - *i* in object position
2. Picture condition — factor PIC
   - CUMUL - cumulative picture
   - DISTR - distributive picture
   - WRONG - wrong picture

(15) a.

Milan	i	Tína	viděli	slona	a	žirafu	pít	vodu.
Milan	*i*	Tína	see.3PL.PST	elephant.ACC	and	giraffe.ACC	drink.INF	water.ACC

‘Milan and Tína saw an elefant and a giraffe drink water.’

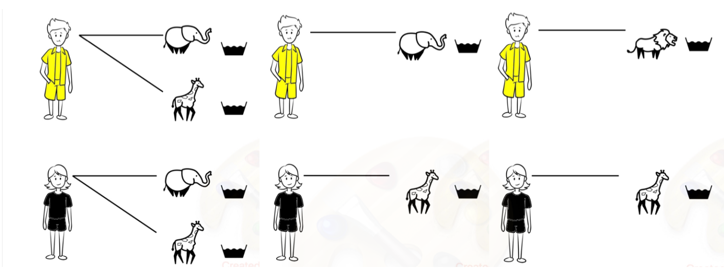

Figure 6: Illustration of item SUBJTRUE with PIC in all levels, DISTR, CUMUL, WRONG respectively.

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The results of the experiment suggest that distributive interpretation is available all-across the board and that θ-roles seem to not affect the cumulativity asymmetry. Cumulative reading was accepted more than the baseline when the D-conjunction was placed in the object position, as we expected in light of the first experiment. The expected observable effect of θ-roles would be similar acceptance of the D-conjunction in SUBJTRUE and SUBJFALSE; however, that is not the case, as can be seen the barplot of acceptance in Figure 7. We used the same model in the follow-up as in the experiment and the inferential statistics output confirms the descriptive statistics: the only significant interaction effect yielded by the model for the follow-up was the negative PIC:CUMUL*SUBJ:TRUE, $z = -2.069, p = 0.039$ – subjects accepted the cumulative interpretation of *i* much better if *i* was in the subject of the predicate embedded under the ECM verb. Since both the subject of the ECM verb and the subject of the embedded predicate bear the identical θ-role, namely agens, we consider this a direct evidence against the strong θ-role approach to the asymmetry.

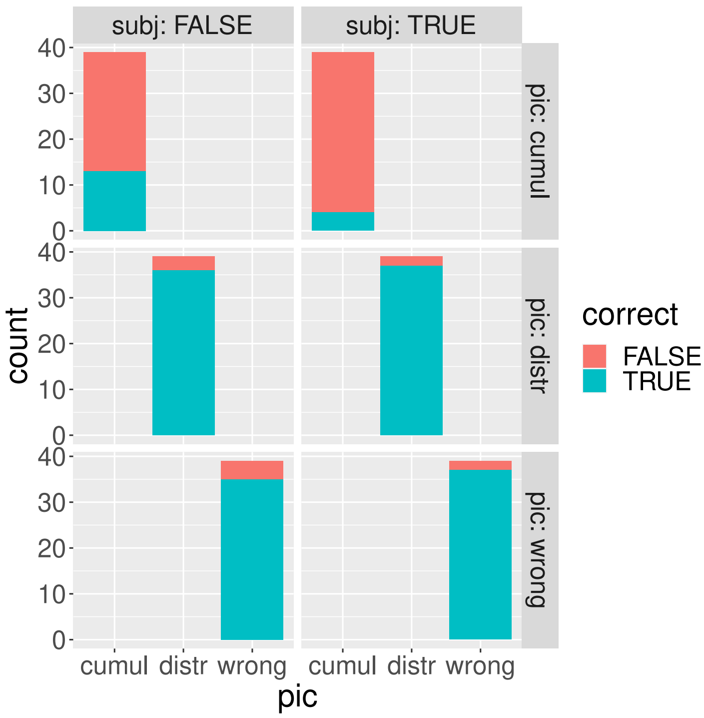

Figure 7: Barplot of responses.

The research question 2, repeated below as (16) concerns the distributivity interpretation and its eventual interaction with the depth of *i* embedding. The data from the experiment and their statistical analysis give us some clues about the possible answers to the question. First, it seems that speakers of Czech accept the distributive interpretation both locally and at long-distance (recall that main effect of DISTR did not differ from the baseline and the main effect covers all the tested conditions; moreover the interaction of DISTR by ECM was not significant). This is just an empirical summary but it goes against the grain of theories where the distributivity is derived with the help of a distributive operator, which scopes over the verbal predicate (be it classical theories like Bennett 1974; Link 1983; Schwarzschild 1996; Winter 2001 or more modern ones like Champollion 2016). What seems to be more promising with this kind of data are the dynamic approaches like PCDRT (see Dotlačil 2012, 2013 a.o.) where the distributivity is freed from being an operator located in syntax and where it quantifies over some abstract formalizations of the pluralities, the sets of assignment functions in PCDRT e.g.

(16) **Question 2**
How different are monoclausal and long-distance configurations interpretations?

4.1. Summary and open questions

Let us now summarize the results of our experiment and introduce some open questions which it naturally yields. First, *i* is a distributive functional element, like English distributive quantifier *each*, which in some configurations allows to be interpreted cumulatively. The experimental data are supportive of configuration based theories where the asymmetry is explained via scope relations. Namely, we believe that the pattern we experimentally confirmed follows from the plural projection framework (Haslinger and Schmitt 2018; Schmitt 2019) where the asymmetry is interpreted in a way that cumulativity is in fact integral part of a semantic composition. The plural projection framework claims that: (i) there are pluralities of any semantic type; (ii) in a semantic composition the part structure of the denotation of a plural expression projects to the denotations of dominating node (the part structure can be cumulative, distributive, etc.); (iii) universal quantifiers (and distributive conjunctions – in our case) block the cumulative composition rule and yield maximal plural set (non-cumulative plurality); (iv) but this plural set is again input to the cumulative composition. Therefore, the asymmetry is expected: the pluralities in the scope of the distributive element (quantifier or conjunction) must be interpreted distributively (with respect to the element) but the plural expressions outscoping the distributive element can be interpreted cumulatively (because of the cumulative composition rule).

At the end, there of course remain some open questions. The first one comes from the model of the experiment: we found a curious positive three-way interaction between CUMUL, ECM and SUBJ (see Table 1 for the values) which shows that subjects accepted the cumulative picture for *i* in the subject of an ECM predicate ([NP *i* NP V [V NumP]]) more than if *i* appeared in the subject of a simple clause ([NP *i* NP V NumP]). This is intriguing since such pattern is unpredictable in any current theories of the asymmetry: all the theories predict just the distributive reading and therefore are not able to explain any preference like this one. We do not have any reasonable explanation for such behavior. Many other open questions appear with respect to the research question 2. Our experiment clearly supports the non-standard theories of distributivity, but we leave proper research in this direction for future work.

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Questions in belief ascriptions[1]

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Abstract. Recent literature (Schmitt 2020; Haslinger and Schmitt 2021; Pasternak 2018b; Marty 2019) has discussed cases in which belief ascription to a plurality of attitude holders can be construed non-distributively. While some of these cases have been accounted for as instances of cumulativity between the attitude holders and a plurality of contents, the cases put forward in Pasternak (2018b) resist an analysis along these lines. This paper builds on Pasternak's (2018b) account, fixing its shortcomings and in so doing argues for a semantics of belief ascriptions in which belief is always interpreted relative to a question (cf. Yalcin 2016) and belief states are not just sets of possible worlds, but sets of classical propositions (as all propositions and questions are for Ciardelli et al. 2019).

Keywords: belief reports, question sensitivity.

1. Two kinds of non-distributive belief

This paper makes two claims about belief ascriptions. The first claim is that the belief state of an individual must be a more complex object than a set of possible worlds; the second, that "aboutness" must be built into the meaning of belief predicates. These claims are argued on the basis of a rather narrow fragment that has received some attention in the recent literature (Schmitt 2020; Haslinger and Schmitt 2021; Pasternak 2018b; Marty 2019), consisting of belief ascriptions to pluralities (sentences of the form NP_{PL} *think that p*). I will start by briefly reviewing what this literature has observed and by addressing the shortcomings of existing proposals we will get to the conclusions above. Without excluding the possibility of alternative implementations, this paper offers a rather conservative improvement over Pasternak's (2018b) approach that uses sets of sets of possible worlds to represent belief states and realizes the aboutness requirement as question sensitivity along the lines of Yalcin (2016).

Ordinarily, belief reports license a distributive inference on the attitude holder:

(1) Ann and Beth think Napoleon was Italian.
  a. $\rightsquigarrow$ Ann thinks Napoleon was Italian.
  b. $\rightsquigarrow$ Beth thinks Napoleon was Italian.

Recent literature (Schmitt 2020; Pasternak 2018b) however has noticed that sometimes a belief report is judged true even if its distributive inferences are false: in other words, that sometimes belief attribution can be construed non distributively.

1.1. Non-distributive belief as cumulativity

One kind of non-distributive (ND) reports is one in which a plural attitude holder seems to enter a cumulative relation with a plurality in the scope of *think*—(2) is such a case, adapted from Schmitt (2020).

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(2) SCENARIO: Independently of one another, Ann thinks she saw a griffin at the castle, Beth a zombie. Neither monster actually exists.
Ann and Beth think two monsters were in the castle. (true)

What makes (2) an ND report is precisely that it is judged as true in the given scenario, which at the same time does not support the truth of, for instance, *Ann thinks two monsters were in the castle*. There are two crucial features of (2). First of all, it is important that Ann and Beth make their observations independently and each excludes the possibility of other monsters roaming the castle—the notion of conceptual distinctness that is required to interpret (2) is characterized as a counterfactual one in Haslinger and Schmitt (2020, 2021): it must be the case that Ann would be able to distinguish griffins from zombies, if she believed zombies exist (and the same, in reverse, for Beth).

The second feature, more important for our purposes, is that the NP *two monster* is read de dicto, i.e., it is interpreted in the scope of the attitude predicate. As Schmitt (2020) argues, this makes an analysis of its truth conditions that relies on standard accounts of cumulativity problematic, because it would involve scoping both plural denoting expressions over the pluralized predicate *think* (see e.g. Beck and Sauerland 2000), thus failing to generate the de dicto reading which is the true one in the given scenario. Data like (2) are thus taken by Schmitt (2020) to motivate a particular theory of "plural projection" which, generalizing the notion of pluralities to all types of expressions, allows the denotation of *Ann and Beth* to enter a cumulative (belief) relation with a plurality of propositions.

1.2. Non-distributive belief as quantification over plural belief states

There are however ND belief reports of a different kind, first observed in Pasternak (2018a), that this approach cannot capture, because they do not involve any plural denoting expression in the complement of *think*.

(3) SCENARIO: Ann, Beth and Chloe never met Sarah's girlfriend (there is no girlfriend: Sarah is single but they don't know it). Ann and Beth think she is some French person, Chloe thinks she is a painter. This is all they think (they have no beliefs more specific than that).
  a. Sarah's cousins think she is dating a French painter. (% true)
  b. Sarah's cousins think she is dating a painter. (false)
  c. Sarah's cousins each think she is dating a French painter. (false)
  d. Ann thinks Sarah is dating a French painter. (false)

I give the judgment for (3a) with a "%" because not every speaker I have consulted is comfortable with saying that the truth of (3a) is supported by a scenario like (3). The analysis developed in section 5 will predict (3a) to be true "by default" in the given scenario, but it will permit derivations in which it is false, simply by allowing a predicate level distributivity operator scoping above the attitude predicate, thus deriving the same truth conditions that (3c) has. Speakers who systematically judge sentences like (3a) false can be thought of applying this distributivity operator in the interpretation of every belief report.

Certainly there are conversational contexts in which precision in reporting what each individual person thinks is required, and (3a) would then be, at best, a sloppy way of representing Ann, Beth and Chloe's beliefs. It is important to note, however, that even restrictive speakers who do not judge (3a) as true in the given scenario find there is an obvious contrast between (3a) on one hand and (3b), (3c) and (3d) on the other. As Blumberg and Lederman remark, talking about what they call "revisionist reporting", even if an ascription like (3a) is to be considered false but marginally acceptable "for some kind of pragmatic reason" (Blumberg and Lederman 2020: 761), we need to make sense of why then the other ascriptions in (3) are sharply different in that they are just false.

For the rest of the paper, I will follow the existing literature and I will assume a judgment of "true" for sentences like (3a) in these kinds of scenarios: as the uncontroversial falsity of (3c) demonstrates, this true reading is one in which belief is construed non-distributively.

Again, in the examples in (3) there is no plurality that the plural attitude holder can enter in a cumulative relation with, so the mechanism of plural projection formulated in Schmitt (2020) falls short of accounting for this phenomenon. In fact, these examples lead Pasternak (2018a, b) on a very different analytical path: one in which belief predicates have a plural-sensitive meaning and belief states are defined of singular as well as of plural individual.

I think that indeed (2) and (3) are instances of two different phenomena. This paper will focus on belief ascription li (3), proposing an improvement of Pasternak's (2018b) analysis that accounts for (3) as well as other cases that neither account is equipped to deal with.

2. Pasternak's (2018b) recipe for plural belief states

Pasternak's (2018b) intuition about cases like (3) is that we can retain a mostly Hintikkian meaning for *think*, but with the important addition of belief states defined of plural individuals. The fundamental idea is that (3) is true in the given scenario because Ann, Beth and Chloe's individual belief states (each defined as the set of worlds compatible with someone's beliefs), as described in the scenario, "add up" to the content expressed by the proposition *Sarah's dating a French painter* (which is the complement of *think*).

The challenge Pasternak (2018b) faces, of course, consists in providing an adequate definition of this "adding up". An important observation is that compatible beliefs, such as those individually held in the scenario in (3) (there is no incompatibility, in ordinary context, between being French and being a painter), can be conjoined in an ND report, whereas incompatible beliefs end up being disjoined. This is shown by the following more involved example:

(4) SCENARIO: Ann, Beth and Chloe never met Sarah's girlfriend (there is no girlfriend: Sarah is single but they don't know it). Ann thinks she is some French person, Beth that she is a French painter, and Chloe thinks she is Dutch. This is all they think (they have no beliefs more specific than that).
Sarah's cousins think she is dating a French or a Dutch painter. (true)

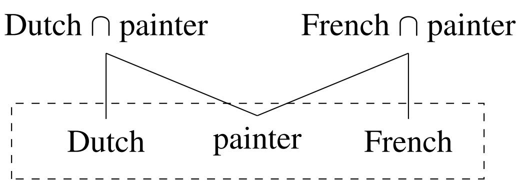
Pasternak (2018b) takes this fact as evidence that the way individual beliefs are put together is through a mechanism of premise negotiation analogous to the one employed in standard analyses of modality (Lewis 1981; Kratzer 1981). Premise negotiation just means finding one proposition that characterizes all those worlds that best comply with a potentially inconsistent set of requirements (propositions), i.e., the premise set. If two requirements are compatible, then the possible worlds that comply best are those that comply with both (hence, the conjunction of the two premises, an intersection set-theoretically). As soon as two requirements are incompatible, then we have to be content with having worlds that respect one but violate the other (hence the disjunction, or union of the two sets of worlds characterized by the two premises). More generally, any set of propositions (i.e., of premises) induces a preorder on the domain of possible worlds, according to which world w' is better than w'' if and only if the set or premises satisfied in w' constitutes a proper superset of the one satisfied by w''''.

(5) Given a set of propositions B, we have an ordering $\prec_B$ s.t.
$$\forall w, w'[w \prec_B w' \longleftrightarrow \{p : w \in p \wedge p \in B\} \supset \{p : w' \in p \wedge p \in B\}]$$

(6) Given a set of propositions B and the set of all possible worlds W, $\text{Best}(B)$ is the proposition $\{w : \neg\exists w' \in W[w' \prec_B w]\}$

If we take the individual beliefs as premises, the content that can be ascribed non distributively to the plurality must be entailed (Hintikka 1969) by the Best proposition in the sense of (6), which is the plural belief state. To take (4) as an example, we have (7) as the premise set.

(7) $\{p = \{w : \text{French}(w)\}, q = \{w : \text{Dutch}(w)\}, r = \{w : \text{painter}(w)\}\}$



No possible world satisfies all of the three premises: the French-and-painter and the Dutch-and-painter worlds are equally good and we cannot do better, so taking them together is the best we can do. Hence, the truth of (4).

This still needs a small fix: since any two people's belief states are very unlikely to have a non-empty intersection (they would have to agree on everything they happen to have an opinion about), we would almost never be able to obtain a plural belief state that is logically stronger than any of the individual ones. But in fact the judgments seen so far are preserved if Ann, Beth and Chloe happen to disagree about something irrelevant to the identity of the putative girlfriend of Sarah.

What Pasternak (2018b) assumes to avoid this problem is that every belief (state) is actually "about" a situation, in a way that, for example, allows Ann's belief state about Sarah's girlfriend to not discriminate between whether Toronto is in Canada or in the US (even though she has an opinion about that). Aboutness makes belief states coarse enough to make the premise negotiation mechanism viable, but I won't go into the details of how this aboutness relation may be implemented, because the analysis I will offer sidesteps this issue somehow. Next, we examine the shortcomings of Pasternak's (2018b) analysis.

3. Overgeneration problems

A key prediction of Pasternak's (2018b) can be schematized as:

(8) x thinks p
y thinks q
$p \cap q \neq \emptyset$

$\therefore$ x and y think $p \cap q$

Schmitt (2020) and Marty (2019) point out several cases in which the strong prediction represented by (8) is simply not borne out. The first kind of counterexample also tests the reliability of the aboutness requirement: (9), adapted from Schmitt (2020), shows that even when two compatible individual beliefs are about the same situation (dogs at the party), their intersection cannot be truthfully ascribed to the plurality.

(9) SCENARIO: Ann thinks that every dog at the party will play with Jane, Beth thinks that Fido will be the only dog at the party.
Ann and Beth think Fido will play with Jane at the party. (false)

It's quite clear that this is false: while the two beliefs are logically compatible and to some extent about the same thing, it feels like we cannot attribute to both a belief this specific.

(10) SCENARIO: Ann thinks that if Jane is a linguist, she is rich, Beth thinks that Jane is a linguist.
Ann and Beth think Jane is rich. (false)

(11) SCENARIO: Ann thinks that Jane is either Dutch or French, Beth thinks that Jane is French.
Ann and Beth think Jane is French. (false)

In the case of the last two examples it is really impossible to claim that the individual beliefs are not about the same situation, however this aboutness relation is defined—equally clear is that they are compatible and their intersection amounts to the proposition falsely ascribed to Ann and Beth in the two examples respectively.

What is the problem with (10) and (11)? In (10), we reject the ND report because Beth has no opinion about Jane being rich or not: in fact we are ignoring her opinion completely and ascribing to both the belief that she is rich. Similarly, in (11), we are completely erasing "half" of Ann's opinion: the possibility of Jane being Dutch, which she entertains, is completely missing in the belief ascription. Something true that could be said in the scenario in (11) is, perhaps, *Ann and Beth think that Jane is either Dutch or French*, in which we at least preserve both possibilities entertained by Ann. In a general sense, the problem is that the clauses embedded under *think* just do not represent the individual beliefs appropriately.

The conclusion that Schmitt (2020) draws from cases like (9) is that all of the Pasternak-type ND ascriptions (those that, as discussed in section 1, do not easily lend themselves to an explanation in terms of cumulativity, simply because there are no two pluralities that can enter such a relation) are "extremely rare" and "restricted to predicate modification configuration"

(Schmitt 2020: 19). In other words, we observe them when the contributions of the individual beliefs are properties that end up being intersected in the denotation of some nominal phrase.

I want to use this observation to start thinking about this problem in a different way: perhaps what we should take this restricted distribution to indicate is that this type of ND ascription involves "adding up" beliefs that are formally related to one another in a similar way as different answers to a same question are.

4. Belief and questions

We just saw that "being about the same thing" (or situation) is too weak a requirement on individual beliefs to avoid clear overgeneration problems when we attempt to ascribe belief to pluralities; and that perhaps we should think of this aboutness requirement as being a secondary effect of a more restrictive one, namely, that the individual beliefs be appropriate answers to the same question. Questions, intuitively and regardless of what approach one takes to their semantics, determine a class of possible answers and thus which propositions are relevant and which are not (a.o. Lewis 2008; Roberts 2012; Groenendijk and Stokhof 1984). We can tell that two propositions are "about the same thing" (they have the same subject matter) if they are different (partial or complete) answers to the same question.

Conveniently for us, Yalcin (2016) already makes the case (on different grounds than what we are concerned with here[2]) that belief is always defined relative to a question—arguing, in his words, for the question sensitivity of belief. The most straightforward formulation of this concept is assuming that a belief state of an individual x in world w (which we so far have taken to be the set of possible worlds compatible with x's beliefs in w, as per Hintikka (1969)) is always defined relative to a question. This means that any individual has, in any world, as many belief states as there are questions: B is a belief state relative to Q if B could be an answer to Q.

Now, several things should be noted before moving on to a precise formulation of this idea. Answering a question (be it an overt question or a so called Question Under Discussion), on an intuitive level, means providing some information that resolves an issue open in the conversational context. "Having an answer" to a question Q (not necessarily the true answer, but an answer) minimally means being opinionated about Q: if you are not opinionated, then you cannot exclude any answer to Q. But when it comes to thinking about belief states as answers to questions, then we want to represent unopinionatedness too (after all there are countless issues on which a regular person has no opinion). In that case we will say that the belief state is just not informative, in the sense that it does not exclude any possibility raised by the question.

We can think of an unopinionated state of x relative to Q as being the set of all possible worlds. In a sense, thus, it is strictly speaking improper to say that belief states in the system we are sketching are answers to a question: if I am asked a question that I have no answer to, I cannot signal my unopinionatedness by asserting a tautology (it would just not be an appropriate answer). Thus, the sense in which a belief state is an answer to a question is not the same as an

[2]Yalcin is primarily concerned with capturing the correct closure properties of belief. I will not review the motivations for his approach since the use I am making of it constitutes an independent motivation in itself, I think.

actual answer does. This is a caveat for the rest of the paper.

It is obvious at this point that retrieving the Hintikkian belief state, the one that represent beliefs in a maximally fine-grained way, is very straightforward. If $\mathrm{Dox}(x,w)$ is the set of worlds compatible with x beliefs in in world w, and $\mathrm{B}(Q,x,w)$ is x's belief states relative to Q in world w:

(12) $\bigcap\{\mathrm{B}(Q,x,w) : Q \in D_{((\mathsf{s}\to\mathsf{t})\to\mathsf{t})}\} = \mathrm{Dox}(x,w)$

One immediate payoff of using these question-sensitive belief states in our belief reports is of course that they represent a person's belief in a very coarse way: Ann's belief relative to *What is the capital of France?*, given that it is a proposition that answers this question, will entail nothing about any other issue Ann has an opinion about. Suppose that she believes that Nantes is the capital of France and Bonn of Germany: we want her belief state relative to *What is the capital of France?* to contain worlds where Bonn is the capital of Germany, but also any other city. It is straightforward to see how this sidesteps the issue of irrelevant disagreement which made Pasternak assume the existence of an "aboutness" relation that relates belief states and situations: in a way, we are directly building in this aboutness in the shape of question sensitivity.[3] So far, thus, we are just moving from a traditional Hintikkian entry as (13) to one like (14):

(13) $[\![\mathrm{think}]\!]^w := \lambda p.\lambda x.\mathrm{Dox}(x,w) \subseteq p$

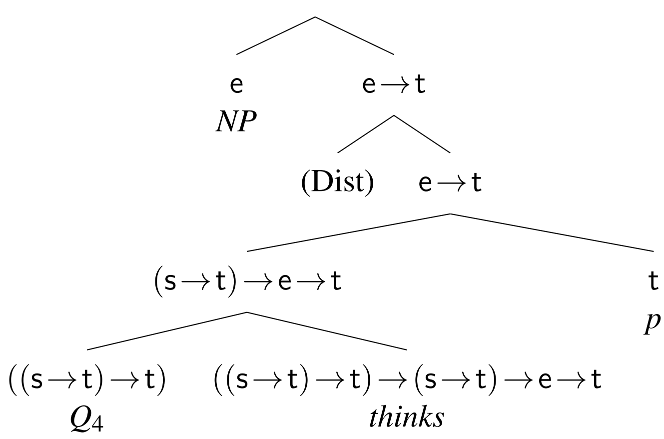
(14) Question sensitive denotation for *think* (to be revised):
$[\![\mathrm{think}]\!]^w := \lambda Q.\lambda p.\lambda x.\mathrm{B}(Q,x,w) = p$ $\quad((\mathsf{s}\to\mathsf{t})\to\mathsf{t})\to(\mathsf{s}\to\mathsf{t})\to\mathsf{e}\to\mathsf{t}$

It is safe to assume that the value of the question, relative to which the belief report is to be interpreted, is contextually supplied, but of course it can be made explicit:

(15) As far as [who Jane is dating]$_{Q_j}$, Ann thinks Jane is dating Sarah.

Assuming for concreteness a system with the rules of composition of Functional Application and Intensional Functional Application (Heim and Kratzer 1998), the LFs of belief reports like *NP think(s) p* will have this form:

(16)



[3]This coarseness of representation is in fact the main motivation put forward in Yalcin (2016).

We can already make the point of why (9) is a false ascription. If belief is always relative to a question, it is fairly natural to assume that a plural belief belief state can be obtained only out of individual beliefs that are relative to the same question. Now, *that every dog at the party will play with Jane* and *that Fido will be the only dog at the party* are compatible, but are not answers to the same question: hence the truth of the belief report in (9) is not supported by the scenario given.

We have now taken care of one class of counterexamples to Pasternak's (2018b) proposal, just by translating the aboutness requirement into a formal (albeit still not explicitly stated) requirement that beliefs be about the same question: this gives us not only coarse belief states that can have non-empty intersections even if there is irrelevant disagreement, but also a condition strong enough to avoid counterexamples like (9). Now we must consider counterexamples like (10) and (11): the same-question requirement alone does not help us here, and this brings us to the second claim of this paper—that belief states cannot just be sets of possible worlds.

5. Belief states as higher order propositions

The goal now is to predict the falsity of (10) and (11) by maintaining the core of Pasternak's account, rooted in a plural sensitive meaning for *think* and belief summation as premise negotiation. Let's first consider (11).

5.1. Disjunctive belief

Intuitively, what makes (11) false is that we are completely disregarding the *Dutch* possibility that Ann entertains alongside the *French* possibility. Clearly the premise semantics mechanism rooted in the ordering of possible worlds allows this: *French*-worlds satisfy both premises (both Ann's and Beth's belief), and any *non-French*-world satisfies at most one of the two. I claim that what this case shows is that belief states must be objects that distinguish between determinate and indeterminate beliefs (in the scenario in (11), Beth's and Ann's beliefs respectively).

The belief that *Jane is either Dutch or French* is indeterminate because it involves entertaining multiple possibilities without any commitment to one. To be sure, Beth's belief that *Jane is French* also leaves many things open as to a plausible subject matter like *What kind of person is Jane?*, in that it entails nothing about, for instance, her profession, her age etc. But what the data suggest so far is that the presence of disjunction makes Ann's belief in (11) special as far as belief summation is concerned. Because her belief is expressed as a disjunction of two properties, we feel like summing her belief with Beth's in a way that results in one of the two possibilities being "erased" is not a licit move.

Once again, that the disjunction of properties is somehow the culprit here is suggested by contrasting this case with the one we started with, namely (3a). There too, the non distributive ascription can be said of erasing possibilities the individual attitude holders were entertaining. For example, Ann has no opinion about Sarah's girlfriend's profession (she just thinks she's French): so in a way, by ascribing to the plurality of which she is a part the *French painter* belief we are erasing some options that Ann was not excluding. But the difference in the acceptability of the two reports is due to the fact that in (11) we are dealing with an individual belief that is expressed as a disjunction of properties.

In order to preserve Pasternak's (2018b) intuition that premise negotiation is what is involved in belief summation, we have to abandon the notion that belief states are sets of possible worlds, simply because these objects don't make the important distinction that underlies the contrast between (3a) and (11). In other words, we need a semantic object that reflects our intuition that the problem in (11) is the entertaining of different possibilities in a belief expressed disjunctively. The framework of Inquisitive Semantics (Roelofsen 2013; Ciardelli et al. 2019: a.o.) treats propositional content in a way that proves useful for our narrow purposes.

5.2. Content in Inquisitive Semantics

In Inquisitive Semantics (IS), both declaratives and questions characterize downward closed sets of states, where a state is a set of possible worlds. This means that both assertions and questions denote expressions of type $(\mathsf{s} \to \mathsf{t}) \to \mathsf{t}$, which I shall refer to as the type of higher order propositions. The central notion that ties together assertions and questions is that both can be *settled* by an information state:

(17) An information state s settles a proposition A iff $s \in A$.

For example, the proposition denoted by *It's raining* is settled in w iff there is a state in the proposition that contains the world w. Downward closure is important, because we want it to be the case that if a state s settles A, any stronger state s' (i.e., such that $s' \subset s$) will settle A too:

(18) A set of states $A = \{s_1, \ldots, s_k\}$ is downward closed iff $\forall s \in A : s' \subset s \to s' \in A$.

If we indicate with $[\![\cdot]\!]_I$ the interpretation function that returns higher order propositions for assertions and questions, we can define the basic connectives, beside some other key notions, as in (19). Note that the informative content of a higher order proposition expressed by ϕ is, in this system, equivalent to the classical proposition expressed by ϕ: by taking the grand union of all the states in $[\![\phi]\!]_I$ we obtain the set of worlds where ϕ is true. For any proposition *phi* we also identify a special subset of its states: the set of alternatives alt(ϕ), which is the set of the states that are not contained in any other state in $[\![\phi]\!]_I$.

(19)
a. $[\![\phi]\!]$ is the set of possible worlds where ϕ is true
b. $[\![\phi]\!]_I := \{s : s \subseteq [\![\phi]\!]\}$ (abbreviated as $\{\phi\}^{\downarrow}$)
c. $\text{info}(\phi) := \bigcup \phi$ (the informative content of ϕ)
d. ϕ is true at w iff $w \in \text{info}(\phi)$
e. $[\![\phi]\!]_I$ entails $[\![\psi]\!]_I$ iff $[\![\phi]\!]_I \subseteq [\![\psi]\!]_I$
f. $[\![\neg\phi]\!]_I := \{s : s \cap \phi = \emptyset\}$
g. $[\![\phi \wedge \psi]\!]_I := [\![\phi]\!]_I \cap [\![\psi]\!]_I$
h. $[\![\phi \vee \psi]\!]_I := [\![\phi]\!]_I \cup [\![\psi]\!]_I$
i. $[\![\phi \to \psi]\!]_I := [\![\neg(\phi \wedge \neg\psi)]\!]_I$
j. $\text{alt}(\phi) := \{s : s \in [\![\phi]\!]_I \wedge \neg\exists s'[s' \in [\![\phi]\!]_I \wedge s \subset s']\}$

(20)
a. ϕ is informative iff $\text{info}(\phi) \neq \mathscr{W}$
b. ϕ is inquisitive iff $\text{info}(\phi) \notin \phi$
c. ϕ is a question iff it is non-informative

d. ϕ is an assertion iff it is non-inquisitive
e. ϕ is hybrid iff it is both inquisitive and informative
f. ϕ is a tautology iff it is neither inquisitive nor informative

We can see from (20b) that as soon as a proposition has more than one alternative (more than one maximal state in its denotation), it is inquisitive. And from the other definitions we also see that the presence of disjunction guarantees inquisitiveness, and that a negated formula always denotes a proposition that is not inquisitive (by the definition of negation in (19f), we are guaranteed to have only one maximal state). The proposition expressed by *Ann lives in Paris or Nantes* is thus a hybrid, according to the definition above:

(21) $[\![\text{Ann lives in Paris or Nantes}]\!]_I = \{s : s \subseteq [\![\text{A. l. in Paris}]\!] \vee [\![\text{A. l. in Nantes}]\!]\}$

It is inquisitive, because it contains more than two alternatives and its informative content is not itself in (21), and informative because its informative content does not cover the logical space (for instance, there is no state in (21) of all worlds where Ann lives in London). Something non informative would be a question:

(22) $[\![\text{Where does Ann live?}]\!]_I = \{s : \exists x[x \text{ is a place} \wedge s \subseteq \{w : \text{live}_w(\text{Ann}, x)\}]\}$

If we union the states in (22), we get back the logical space: there are as many alternatives in (22) as there are places that Ann could live in. This is what makes (22) non-informative and thus a question. But this does not mean, of course, that all possible states are in (22): only those that entail Ann living somewhere. So to settle the issue raised by the question *Where does Ann live?* I must provide a piece of information that entails her living somewhere, which is guaranteed by (17). A proposition qualifies as an answer to (22) (for our purposes) if it is a subset of (22).

5.3. Back to belief

What is now a belief state relative to a question? We want it to be an answer to the question, because that encodes aboutness we were after, and to be in some relation with the individual's doxastic set. Here is a possible definition:

(23) Definition of a question-sensitive belief state:
$\text{B}(Q, x, w)$ is the logically strongest proposition p s.t.
$\text{Dox}(x, w) \subseteq \text{info}(p)$ and
$\forall s[s \in \text{alt}(p) \rightarrow \exists s', \ldots, s'' \in \text{alt}(Q)[s = \bigcap\{s', \ldots, s''\}]]$

To see what (23) gives us, suppose the question we are interested in is something along the lines of *What kind of person is Jane?*: this is a question that asks for a property holding of Jane.

(24) $[\![\text{What kind of person is Jane?}]\!]_I = \{s : \exists f_{\text{s}\to\text{e}\to\text{t}}[s \subseteq \{w : f_w(\text{Jane}) = 1\}]\}$

Now suppose Ann has no clue as to who Jane is: the strongest proposition whose informative content is entailed by Ann's doxastic set and such that each of its alternatives is the result of the intersection of some alternatives in (24) is (24) itself. She cannot rule out any property when it comes to Jane, precisely because she is unopinionated on the matter.

If instead Ann thinks that Jane is a French painter, her belief state relative to (24) is $\{\text{French}\}^{\downarrow} \cap$

$\{\text{painter}\}^{\downarrow}$, the strongest proposition whose informative content is entailed by her doxastic set and whose only alternative is the result of the intersection of two alternatives in (24), the ones corresponding to the properties of being French and of being a painter. Here it's clear why we need the last clause of (23): since these are all downward closed sets, we cannot just demand the belief state be the strongest proposition, because that would pick out a proposition that is way too informative and we would lose on the coarse representation of content, for which we have moved towards question-sensitive belief states. For instance, what Ann thinks about what the capital of France is is irrelevant as far as (24) is concerned, but without the last clause in (23) we would get a belief state that represents Ann beliefs about that too.

Finally, suppose that Ann is not sure whether Jane is Dutch or French, just like in the scenario in (11). This does not mean she is unopinionated: she clearly has some opinion but cannot commit to any one. In this case we get a belief state like (25). Once again this conforms with the definition in (23), because both the alternatives in (25) are the result of the intersection of some alternatives in (24) (the two alternatives being intersected with themselves).

(25) Ann's belief in (11):
$[\![\text{Jane is either Dutch or French}]\!]_I = \{\text{dutch}\}^{\downarrow} \cup \{\text{french}\}^{\downarrow}$

At this point we can give our final version of the meaning of *think*. So, *x think(s) p*, interpreted relative to a question Q, asserts that the informative content of x's belief relative to Q is p and that x or every member of the plurality x is opinionated as to Q.

(26) Question sensitive definition for *think*:
$[\![\text{think}]\!]^w := \lambda Q.\lambda p.\lambda x.\text{info}(\text{B}(Q,x,w)) = p \land \forall y \sqsubset x[\text{B}(Q,y,w) \subset Q]$

At this point we see that (26) and (23) together result in predictions that are seemingly somewhat counterintuitive. Consider the case in which Ann thinks Jane is a French painter, and let us indicate with Q_4 the question in (24).

(27) a. Ann thinks Q_4 that Jane is a French painter. (predicted true)
b. Ann thinks Q_4 that Jane is French. (predicted false)
c. Ann thinks Q_4 that Jane is a painter. (predicted false)

It is not clear that we want to predict (27b) and (27c) to be false, but it is certainly clear why they are, given our definitions: the embedded clauses there are not the strongest propositions among those that meet the requirements posed by (23). The issue here is that (27b) and (27c) are false interpreted relative to Q_4, which is the most general property-seeking question possible, but they are correctly predicted to be true if interpreted relative to *What country is Jane from?* and *What does Jane do for a living?* respectively.

5.4. Tackling the counterexamples

There is another concern with (26): why have we bothered introducing higher order propositions from the IS framework if what (26) does at the end is comparing the informative content with the embedded classical proposition? The reason is that now we have the tools to understand what goes wrong in the counterexamples to Pasternak (2018b) we have seen in section 3, and especially we are able to develop an empirically better mechanism for belief state summation. What makes Ann's belief in (11) crucially different from the other ones is that it is an inquisitive proposition, where each of its two alternatives corresponds to one of the possibility that she entertains as to where Jane is from.

Intersecting (25) with Beth's belief (that is, $\{\text{french}\}^{\downarrow}$) simply gives us back $\{\text{french}\}^{\downarrow}$: once again the *Dutch*-possibility is erased. But this is not how belief summation is done—we do not intersect compatible belief, but rather, we make the best we can given the premises. And now we have have a way to do this that prevents the *Dutch*-possibility from being discarded.

The ordering in (5), which Pasternak (2018b) takes to be the way in which plural belief states are derived, can be generalized to the domain of states, provided we have premises of a suitable type. Suppose that the premise set that is relevant for belief summation is indeed made of higher order propositions like the ones assumed across the board in the IS framework. Now we can order sets of states just like possible worlds are ordered in (5):

(28) Given a set of (higher order) propositions B, we have and order $\prec_B$ s.t.
$$\forall s, s'[s \prec_B s' \longleftrightarrow \{p : s \in p \wedge p \in B\} \supset \{p : s' \in p \wedge p \in B\}]$$

(29) Given a set of (higher order) propositions B and the set of all possible states $\mathscr{P}(W)$, $\text{Best}(B)$ is the proposition $\{s : \neg\exists s' \in \mathscr{P}(W)[s' \prec_B s]\}$

This if not enough, however. If the two premises are the two individual belief states we still derive that the best proposition is the one expressed by *Jane is French*:

(30)
$$\begin{array}{c} \{\text{french}\}^{\downarrow} \\ \boxed{\{\text{french}\}^{\downarrow} \qquad \{\text{french}\}^{\downarrow} \cup \{\text{dutch}\}^{\downarrow}} \end{array}$$

In the case of (11) we want to derive a plural belief state expressed by *Jane is either French or Dutch*: the crucial step to do this in terms of "best set of states" given an ordering like the one defined as in (28) is to make sure that in the premise set the *French*- and the *Dutch*-possibilities are each a premise in its own right. This means, on an intuitive level, that whenever one individual entertains different possibilities, each of them has to "count" whenever we derive a plural belief state.

(31) Definition of belief states for plural individuals:
$\text{B}(Q, x, w) := \text{Best}(\{\{s' : s' \subseteq s\} : \exists y_{\text{at}} \sqsubset x[s \in \text{alt}(\text{B}(Q, y, w))]\})$

The key to accommodating counterexamples like (11) in a system based on premise negotiation is thus to have semantic objects representing belief states that allow us to treat the disjuncts can as premises in their own right, and the downward closed higher order propositions defined in IS are one possible such object.

This consequence of the system we have set up does not surface, however, only when an individual belief is expressed as a disjunction. Consider the following false ascription, which is predicted to be true if we take Pasternak's (2018b) system:

(32) SCENARIO: Ann thinks Jane is from Europe, but has no clue from what country. Beth thinks Jane is French.
Ann and Beth think Jane is French. (false)

(33) a. What continent is Jane from?
b. What country is Jane from?

Let us try to interpret this ascription relative to the question (33a): clearly, Ann is opinionated there, but Beth is not. The one alternative in Beth's belief cannot be obtained by intersecting some alternatives in (33a). Of course it is enough to assume that Beth knows France is in Europe to conclude that she is opinionated relative to (33a), but her belief in (32) is not relative to that question.

If we interpret (32) relative to (33b) the picture is different: now Beth is opinionated, but what about Ann? Her belief can be "translated" as *Jane is from* $x_1 \vee \ldots \vee x_k$ with $x_1, \ldots, x_k$ being all European countries. Now we are in the same configuration as in (11): we must sum a disjunctive belief and the belief in one of the disjuncts. Each disjunct (here: every European country) must be considered a premise in the calculation of the plural belief state. We then correctly predict that in the context sketched in (32) *Ann and Beth think Jane is from Europe* is true.

What about (10), where Ann thinks that *If Jane is a linguist, then she is rich*? If Beth thinks that *Jane is a linguist*, we cannot truthfully say that *Ann and Beth think Jane is rich*. Here, neither belief is inquisitive: the conditional, as defined in (19), does not introduce inquisitiveness, and Ann's belief in (10) is the proposition (34).

(34) $\{s : s \subseteq \{w : \neg(\text{linguist}_w(\text{Jane}) \wedge \neg\text{rich}_w(\text{Jane}))\}\}$

We are now back to a familiar problem: if we search for the best proposition in the sense of (29), we make the wrong prediction. The states that entail that Jane is a rich linguist satisfy both (34) and Beth's belief state $\{s : s \subseteq \{w : \text{linguist}_w(\text{Jane})\}\}$. Thus, from such a premise set we wrongly predict *Ann and Beth think Jane is a rich linguist* to be true.

Once again, however, it's question sensitivity, and specifically the assumption that beliefs have to be relative to the same question, that blocks this wrong prediction. Ann and Beth's beliefs, as presented in (10), are not relative to the same question.

Ann's conditional belief certainly is not an answer to *What kind of person is Jane?*: its only alternative is not in the denotation of that question. In fact, it can only be an answer to a conditional question like *If Jane is a linguist, is she rich?* or *If Jane is a linguist, what kind of person is she?* This is not just an artifact of how we have defined answerhood: Ann, in (10), is not committed to any property holding of Jane, quite differently from Beth. Beth is committed to a property: she thinks Jane is a linguist, and her belief cannot be relative to the conditional question.

Let's make another example that involves negation instead of conditional belief. Once again, the system in Pasternak (2018b) wrongly predicts (35) to be true.

(35) SCENARIO: Everyone thinks that Jane is either French, Belgian or Dutch. Ann thinks that Jane is not French, Beth thinks that Jane is not Belgian.
Ann and Beth think Jane is Dutch. (false)

It is tempting to say that in this case the individual beliefs are relative to the same question *Where is Jane from?*: unlike the conditional form in (10), both Ann and Beth are equally committed to some answer. But what we have is this:

(36) a. $[\![\text{Where is Jane from?}]\!]_I = \{\text{French}\}^{\downarrow} \cup \{\text{Belgian}\}^{\downarrow} \cup \{\text{Dutch}\}^{\downarrow}$
b. Ann's belief in (35): $\{s : s \cap [\![\text{Jane is French}]\!] = \emptyset\}$
c. Beth's belief in (35): $\{s : s \cap [\![\text{Jane is Belgian}]\!] = \emptyset\}$

Neither Ann's nor Beth's beliefs are subsets of the question. One can see how these are not appropriate answers by imagining an actual question-answer pair:

(37) A: Where is Jane from?
B: ? She is not French.

An interaction like (37) is certainly not optimal, especially compared to an answer like *She is either Dutch or Belgian*. While both answers are equally informative (if we all accepts she can either be Dutch, Belgian or French), the acceptability of the answer in (37) improves much if B were to signal that they are actually answering a different question (namely, the polar question *Is Jane French?*) because they cannot completely answer A's question, as in:

(38) A: Where is Jane from?
B: Well, she is not French…

Going back to (35), we now see what the problem is: counterintuitive as it may seem, both Ann and Beth are unopinionated as to (36a). Both are opinionated instead about the respective polar question.

6. Forcing the non distributive construal

Just like the distributive construal of a belief report can be forced with an expression that marks the presence of a distributivity operator, as is the case in (3c), it is also possible to force the non distributive one (Martin Hackl, p.c.). For example, the use of certain adverbials can make the counterexamples seen in section 3 true. Consider, (39), which is judged true in the given scenario:

(39) SCENARIO: Ann thinks that every dog at the party will play with Jane, Beth thinks that Fido will be the only dog at the party.
Jointly/taken together, Ann and Beth think Fido will play with Jane at the party.

In discussing similar set ups concerning "distributed knowledge", von Fintel and Gillies (2011) use this real life example: *We knew more than is being owned up to. But nobody put the pieces together*. The second clause here clearly signals that that the knowledge is not to be intended distributively: the referent of *we* only has that knowledge if the ascription is intended non-distributively, like in (39). We want to have the flexibility to be able to make these belief reports where the logical conclusions of the individual beliefs are ascribed to the plurality.

Essentially, we want the system developed in the previous section to replicate Pasternak's (2018b) predictions, whenever needed (or rather, whenever this is forced). To do this, we may assume that, through these adverbials, the same-question requirement is circumvented. Cases like (39) can be taken to assert that there is a set of questions such that for each of Ann and Beth there is a question in the set relative to which they are opinionated, and taking both belief states as premises results in the plural belief state whose informative content is the proposition embedded under *think*.

7. The distribution of non distributive ascriptions

7.1. Other predicates

One obvious thing that we should ask ourselves is how what we have seen so far about *think* applies to other propositional attitudes. The first place to look is of course declarative embedding *know*. To the extent that the corresponding *think*-reports are possible (more on this in the next section), it seems to me that *know*-reports present the same possibility for ND ascription:

(40) SCENARIO: Sarah is dating a French painter. Ann only knows she is French, Beth only knows she is a painter.
Ann and Beth know that Sarah is dating a French painter. (true)

In connection with *know*, it should be noted that in ND *think*-ascriptions Maximize Presupposition (Heim 1991) is checked at the level of the individual beliefs:

(41) SCENARIO: Sarah is dating a Dutch painter. Ann mistakenly thinks she is French, Beth knows that she is a painter (and nothing else).
Ann and Beth think that Sarah is dating a French painter. (?)

The problem with (41) seems to be that MP is violated at the level of Beth's belief: in (41)'s scenario, *Beth thinks Sarah is dating a painter* is ruled out by MP (which favors *Beth knows that Sarah is dating a painter*), and this makes the ascription to *Ann and Beth* impossible.

What about other propositional attitudes like *want*, *hope*, *fear*, *wish* etc.? Focusing on *want* (which seems to me makes the point for all other), we can see they do not allow ND ascriptions of the kind that we have been concerned with here. If this were not the case, we would expect (42) to be true, while it clearly is not.

(42) SCENARIO: Ann wants to have a black pet, and she doesn't care about the species, as long as it is black. Beth wants to have a cat, and she doesn't care about the color.
Ann and Beth want to have a black cat. (false)

While I do not have anything compelling to say about this fact, I want to point out that the difficulty in building "plural desire" (and the corresponding mental states for the other attitudes) may lie in the fact that an attitude of desire (and fear, hope, etc.) is just more complex than the one of belief. Whether *want* is modeled through a comparative semantics (cf. Heim 1992) or not (cf. von Fintel 1999), an ascription of desire (and fear, hope etc.) necessarily involves projecting the agent's preferences over their doxastic domain.

7.2. The best questions for non distributive ascriptions

It is worth noting that the interesting aspect of ND ascriptions, namely that in certain cases the content ascribed to the plurality can be stronger than the contents believed by the individuals, only obtains if the belief states are non-exhaustive answers to the question. This is because two distinct and exhaustive answers to a question will never be compatible, and thus the mechanism of premise negotiation will not deliver a stronger content to be the plural belief state.

(43) SCENARIO: There are five students: C, D, E, F and G. Ann thinks only C and D came. Beth thinks only E, F and G came.
Ann and Beth think every student came. (false)

(44) SCENARIO: There are five students: C, D, E, F and G. Ann thinks C and D came, and has no opinion as to the others. Beth thinks E, F and G came, and has no opinion as to the others.
Ann and Beth think every student came. (true?)

Whatever the status of the "true" judgment for (44), every consultant I asked agrees that there is a distinction between (43) and (44), and this is predicted. In (43), both belief states are clearly described as exhaustive answers to the question *Which students came?*, and premise negotiation will not derive a plural belief state that corresponds to *Every student came*. In the latter case, on the other hand, such belief state is indeed derived.

The relative difficulty one observes with (44), compared with other true ND ascriptions we have seen so far, can be explained once we recognize the difference between a question like *Which students came?* and the one we have been dealing with throughout the discussion, namely a *What-kind-of* question. While an answer to the former usually licenses an inference of exhaustivity (however this is modeled), an answer to a question that asks for a property holding of someone or something arguably can never be exhaustive:

(45) What kind of person is Jane dating?
a. A French person.
b. A French painter.
c. A rich French painter.
d. . . .

One can add more and more properties to the answer, so that it becomes more and more specific, but every such answer feels equally appropriate. These are the questions relative to which ND ascriptions of the kind first observed in Pasternak (2018a) are most easily construed, precisely because the naturalness of non exhaustive answers to these questions allows the premise negotiation mechanism to surface, in that the belief ascribed to the plurality is stronger than the individual belief. At the same time, this also explains why this kind of ascription is "rare", as Schmitt (2020) points out: they are at least as rare as questions of this kind are.

8. Conclusion

This paper has argued that a plural-sensitive analysis for *think* in the spirit of Pasternak (2018a, b) is viable for non distributive reports that cannot be accounted for in terms of cumulativity, despite the problematic cases put forward by Schmitt (2020); Marty (2019). Building an adequate account has led us to make more general claims about belief ascription.

First, we have seen that we need more complex objects than just sets of possible worlds to adequately model one person's beliefs (about something). In particular, we need to be able to distinguish in the semantics, whether an opinionated agent can commit to one possibility and when they cannot, and we need to access each individual possibility that an agent is entertaining in their beliefs, in order for plural belief states to be correctly derived.

The second claim is that aboutness must be encoded as a formal property that goes beyond the property of "being about something" and it must be part of the meaning of belief reports (Yalcin 2016; Mari and Portner 2021), because it has truth conditional import. Following much existing work, I have modeled the required aboutness property as a form of question-answer congruence. The theoretical relevance of the small fragment of ND ascriptions that was the focus of this paper is precisely that it is with these ascriptions to pluralities that this truth conditional import becomes visible.

I have implemented these two ideas in a rather conservative possible worlds semantics. In doing so, I have borrowed especially from Yalcin (2016), as far as subject matter sensitivity is concerned, and the large body of work in Inquisitive Semantics (Ciardelli et al. 2019) as far as the distinction between inquisitive and non inquisitive content is concerned, leveraging on one fundamental assumption of that framework (in particular, downward closure of propositions which allows a straightforward generalization of the premise negotiation mechanism to the ordering of classical propositions). Especially as far as the choice of the Inquisitive Semantics approach is concerned, alternative theoretical avenues are certainly viable. I contend, however, that any empirically adequate account of the fragment considered here must retain the results that the present implementation has delivered.

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Vanilla rules: The "no ice cream" construction[1]

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Abstract. This paper is about what we call Deontically-flavored Nominal Constructions (DNCs) in English, such as *No ice cream* or *Dogs on leash only*. DNCs are often perceived as commands and have been argued to be a type of non-canonical imperative, much like root infinitives in German or Russian. We argue instead that DNCs at their core are declaratives that cite a rule but can be used performatively in the right context. We propose that DNCs contain an elided deontic modal, i.e., *allowed*, whose presence explains their distributional restrictions and interpretational properties. Among other things, we speculate on the licensing conditions of DNCs (the presence of *only* or the negative determiner *no*), suggesting that these are tied to the properties of discourses in which rules can be used naturally.

Keywords: deontic modality, ellipsis, normativity, performativity, speech acts.

1. Introduction

The proper analysis of imperatives is a matter of a long-standing debate in linguistics and philosophy, tied to a broader context of research on speech acts and clause typing (Charlow 2014; Harris 2022; Kaufmann 2012, 2020). More recently, there has been substantial interest in so-called 'non-canonical imperatives', which exhibit a mismatch between form and meaning such that, for example, a non-imperative clause has the illocutionary force of a directive speech act. In this paper, we focus on an English construction that seems to naturally fit this description, dubbing it Deontically-flavored Nominal Construction (DNC).[2] (1) illustrates.

(1) a. No ice cream!
  b. No hazardous waste dumping!
  c. Compost only!
  d. Electrical vehicle charging only!

None of (1a)–(1d) has the morphological markings of an imperative, yet the overall interpretation resembles that of a directive speech act or a statement with a priority modal (2).

[1]For discussing the ideas presented in this paper, we would like to thank Pranav Anand, Cleo Condoravdi, Berit Gehrke, Remus Gergel, Patrick Grosz, Paul Portner, Florian Schwarz, Hedde Zeijlstra and audiences in Stuttgart and at *Sinn und Bedeutung 27*. All errors are ours. The authors acknowledge the following funding sources for research leading to this paper: the University of Konstanz for the Research Initiative "Universal Preferences for Natural Concepts" (for Korotkova and Skibra); DFG project MU1816/8-1 "Different kinds of conditionals: Coin tosses and kangaroos ...." (for Karawani); DFG project KO 5704/1-1 (for Koev).
[2]Previous labels include 'general prohibitives' (Donovan 2020) and 'negation-licensed commands' (Iatridou 2021). We do not consider these labels accurate, hence the new term, which we hope will stick.

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(2) a. No ice cream!
≈ Don't consume ice cream here! / One shouldn't consume ice cream here.
b. Compost only!
≈ Don't deposit anything but compost here! / One should only deposit compost here.

As discussed in detail in Donovan (2020) and Iatridou (2021), DNCs have the following properties. First, they convey a sense of normativity even though there is no overt expression that would be responsible for it. Second, they require strictly nominal surface material, either ordinary nominal phrases (1a,c) or gerunds (1b,d). Finally, DNCs have strict licensing conditions and mostly occur with the negative determiner *no* (1a,b) or the focus-sensitive operator *only* (1c,d). Unless there is prosodic focus (3), 'bare' counterparts are out (4).

(3) Smoking on the BALCONY (only)! (adapted from Iatridou 2021: 542)

(4) a. No concealed weapons! / Concealed weapons only! / #Concealed weapons!
b. No walking in this area! / Walking only in this area! / #Walking in this area!

DNCs are common in, but not limited to, signs (Neale 2013), and our primary concern in this paper is their linguistic content. Our central claim is that normativity in DNCs is conventionally encoded via an elided deontic modal. We limit ourselves to English and will not discuss possible variation in the form and/or function of similar constructions across languages (Iatridou 2021; Pak, Portner, and Zanuttini 2022). We do not take nominal constructions of the form *Attention!* to be instances of DNCs (see discussion in the Appendix).

The paper proceeds as follows. In Section 2, we consider the speech acts performed by DNCs, arguing that DNCs do not always have directive force and therefore are not non-canonical imperatives (pace Donovan 2020; Iatridou 2021). In Section 3, we examine the internal structure and the overall semantics of DNCs. Capitalizing on parallels with overt deontic modals, we argue that DNCs are declaratives with an elided *allowed* whose primary semantic contribution is referencing a pre-existing rule (cf. Pak et al. 2022 on Italian and Korean). Section 4 concludes.

2. Speech acts with DNCs

What kinds of speech acts are performed by DNCs? The existing literature can be grouped into two camps: (i) the DESCRIPTIVE VIEW, advocated by Pak et al. (2022) for Italian and Korean, and (ii) the DIRECTIVE VIEW, advocated for English DNCs by Donovan (2020) and Iatridou (2021). Our own proposal falls squarely into the first camp; we argue that DNCs simply express vanilla rules. In this section, we motivate it by showing that DNCs pattern like declaratives with overt modals and unlike directives.

2.1. Not conventional directives

Donovan (2020) argues that, despite obvious syntactic differences with canonical imperatives, DNCs have a similar underlying semantics. More specifically, he assumes a Kaufmann-style modal operator at LF. This analysis predicts that DNCs would exhibit the functional heterogeneity of imperatives, contrary to fact. Let us unpack. Across languages, imperatives convey a range of directive speech acts (e.g., commands, requests, suggestions, permissions), along with some non-directive ones (Kaufmann 2012; Schmerling 1982). The imperatives-as-modals view captures this by allowing the operator to have a universal or an existential force as well as different flavors depending on context. However, unlike true imperatives, while DNCs are natural as commands, they cannot be used as suggestions, as (5) and (6) illustrate.[3]

(5) ***Command.*** *Lifeguard, to people jumping into an area with rip currents:*

a. Don't swim! [imperative]

b. No swimming! [DNC]

(6) ***Suggestion.*** *I have to swim, run and cycle to train for a triathlon. But since my time is limited on weekends, could you suggest which of these I could drop?*

a. Maybe don't swim. [imperative]

b. #Maybe no swimming. [DNC]

According to Iatridou's (2021) take on the directive view, DNCs are specialized for commands, much like nominal directives *Hands up!* (see Appendix). Under this view, DNCs are similar to root infinitives in adult speech, which tend to have a universal force and are used in orders, commands or instructions (in German, the modal force may change in the presence of certain modifiers or special intonation; see Gärtner 2014 and Kaufmann 2022). (7)–(8) illustrate the pattern for German and Russian.[4]

(7) *Order from a commanding officer:*

a. Einzeln reinkommen! [German]
single come.in.INF
'Come in one at a time!'

b. Zaxoditj po odnomu! [Russian]
come.in.INF for single.M.DAT.SG
'Come in one at a time!'

(8) *Instruction on a package of oats:*

a. Fünf Minuten kochen. [German]
five minute.PL cook.INF
'Cook for five minutes.'

b. Gotovitj pjatj minut. [Russian]
cook.INF five minute.GEN.PL
'Cook for five minutes.'

In what follows, we will argue against the directive view of DNCs, drawing in particular on contrasts between DNCs and root infinitives.

[3]Note that the use in suggestions is constrained not only by modal force but also by modal flavor. The imperative operator has been argued to be a priority modal that typically admits a range of flavors (cf. Portner 2007: 135–141), while DNCs have a strictly deontic interpretation (see Section 3).

[4]Glosses: 1,2,3 person, ACC accusative, DAT dative, DEF definite, GEN genitive, F feminine, INF infinitive, M masculine, NEG negation, PL plural, PRS present, SG singular.

2.2. Not necessarily directives

The starting point of the directive view is the assumption that DNCs always perform (a subset of) directive speech acts, which in turn necessitates an analysis wherein the illocutionary force must come from somewhere in the structure. Below, we prove this assumption inaccurate. We show that DNCs are not always interpreted as directives to begin with. Overall, they pattern like declaratives with overt deontic and priority modals, or 'modalized declaratives' for short.

Directive speech acts, when performed by imperative clauses or root infinitives, have several distinctive features. These include the following: they cannot be evaluated for truth, require the speaker to behave as though the addressee will comply, typically indicate the speaker's endorsement of the prejacent's coming true, and cannot be modified by hedges. Modalized declaratives, when used descriptively as assertions and not performatively, behave the opposite way: they are truth-evaluable, are compatible with possible non-compliance, allow for the lack of endorsement, and can be modified by hedges.[5]

TRUTH-EVALUABILITY The content of directive speech acts is not easily evaluated for truth (Charlow 2014; Kaufmann 2012). As such, the possibility of explicit denials can be used as a one-way diagnostic of descriptive uses.[6] Constructions that only have performative uses ban denials, including imperatives in matrix clauses or root infinitives (9). DNCs and modalized declaratives allow them, which shows that such constructions can have descriptive uses (10).

(9) A: Don't smoke! [imperative]

A′: Nicht rauchen! [root infinitive; German]
NEG smoke.INF
'Don't smoke!'

B: #That's not true.

(10) A: No smoking here! [DNC]

A′: You shouldn't / aren't allowed to smoke here. [modal]

B: That's not true, this is not prohibited here. There are even ashtrays on the tables.

ADDRESSEE'S COMPLIANCE As discussed in detail in Kaufmann (2022) and Mandelkern (2019), directive speech acts, and especially commands, require the speaker to be an authority with respect to a salient decision problem and to expect the addressee to comply (we are not concerned here with the exact source of this constraint, its existence being enough to establish the empirical point). When this requirement is not met, we end up with what Mandelkern calls 'practical Moorean sentences' which defy the purpose of issuing a command—or, in some cases, with an optative reading (Kaufmann 2022). If DNCs were specialized for commands,

[5]Like Kaufmann (2012), we distinguish between descriptive and performative uses of modals, where the former changes the context by means of an assertion, and the latter issues an obligation or permission to the addressee by means of a directive speech act. When talking about performative content, we mean the content of such directive speech acts (cf. also Portner 2007: 137).

[6]This is not just at-issue content. Propositional anaphora targets a variety of contents, including implicatures (Snider 2017), but never exclusively performative content, such as the one conveyed by imperatives. That said, the infelicity of denials is not unique to performative content and also characterizes self-attributions (Korotkova 2016).

as Iatridou (2021) claims, we would expect the same pattern as with imperatives (11) and especially root infinitives (12). This prediction is not borne out as DNCs behave like modalized declaratives. That is, when used descriptively, they are compatible with the expectation of non-compliance (13).

(11) #Don’t smoke here! But I know that you will smoke anyway. [imperative]

(12) #Nicht rauchen! Aber ich weiß, daß du sowieso rauchst. [root infinitive; German]
NEG smoke.INF but I know.1SG.PRS that you anyway smoke.2SG.PRS
Intended: ‘Don’t smoke! But I know that you will smoke anyway.’

(13) a. No smoking here. But I know that you will smoke anyway. [DNC]
b. You shouldn’t / aren’t allowed to smoke here. But I know that you will. [modal]

SPEAKER’S ENDORSEMENT Broadly speaking, one of the properties of directive speech acts is that the speaker wishes the prejacent to come true and commits to a preference (Condoravdi and Lauer 2017; Starr 2020).[7] Again, we are not concerned here with the exact formalization of this intuition, given that obligatory endorsement is uncontroversial for commands. Iatridou’s (2021) analysis predicts that DNCs give rise to the same effect. Using the availability of disavowals as a diagnostic of endorsement, we show that this prediction is wrong. With command uses of imperatives and with root infinitives (see also discussion in Kaufmann 2022) endorsement is present and disavowals are infelicitous (14). DNCs, on the other hand, pattern like modalized declaratives and are compatible with disavowals of commitment (15).

(14) a. #Don’t smoke in this bar! But I don’t care if you do. [imperative]
b. #Nicht rauchen! Aber es ist mir egal, wenn du es tust. [root infinitive; German]
NEG smoke.INF but it be.3SG.PRS me equal if you it do.2SG.PRS
Intended: ‘Don’t smoke! But I don’t care if you do.’

(15) a. No smoking here. But I don’t care if you do. [DNC]
b. One shouldn’t / isn’t allowed to smoke here. But I don’t care if you do. [modal]

HEDGING Assertions, but not other speech acts (16), allow modification by declarative hedges, parenthetical constructions that signal the level of the speaker’s commitment to the asserted proposition (Bary and Maier 2021; Benton and van Elswyk 2020; Koev 2021; a.o.).[8] Again, DNCs pattern in this respect like modalized declaratives (18) and unlike imperatives and root infinitives (17), which shows that they can perform the speech act of assertion.

[7] One apparent exception comes from indifference and acquiescence uses (von Fintel and Iatridou 2017). However, as Condoravdi, Jarvis, and Jeong (2019) show, commitment to preference is present even in those cases.

[8] Notice that *non-declarative* hedges may target non-assertions (see, e.g., Haddican et al. 2014 on hedged polar and constituent questions).

(16) a. It's raining, I believe. [assertion]
b. #Is it raining, I believe. [question]
c. #Let it rain, I believe. [wish]

(17) a. #Don't smoke, I believe. [imperative]
b. #Nicht rauchen, glaube ich. [root infinitive; German]
NEG smoke.INF believe.1SG.PRS I
Intended: 'Don't smoke, I believe.'

(18) a. No smoking in this bar, I believe. [DNC]
b. You shouldn't / aren't allowed to smoke in this bar, I believe. [modal]

To recapitulate, the directive view maintains that DNCs always perform directive speech acts. We have demonstrated that this is not the case. DNCs pattern neither like commands (pace Iatridou 2021) nor like regular imperatives (pace Donovan 2020)—they behave like declaratives with overt modals. Like declaratives, they can perform assertions, which explains why they do not always meet conditions required for a directive speech act. The relevant empirical contrasts are summarized in Table 1.

	imperatives	root infinitives	DNCs	modalized declaratives
Possibility of truth-evaluability	no	no	yes	yes
Expected addressee's compliance	yes	yes	no	no
Obligatory speaker's endorsement	yes	yes	no	no
Possibility of hedging	no	no	yes	yes

Table 1: Constructions with a directive flavor

2.3. Sometimes directives

Despite our arguments against it, the directive view has some appeal precisely because DNCs *can* perform directive speech acts. However, they do so only in a performative context, one that satisfies the relevant felicity conditions. A minimal requirement for a DNC to function as a request is that the speaker is in a position of authority, otherwise the speech act, if meant as a request, will misfire. When used performatively, DNCs check all the boxes of a directive speech act. They are not truth-evaluable (19a) and cannot be modified by hedges (20). Also, the speaker endorses the outcome (19c) and expects the addressee to comply (19b).

(19) *Bar owner to a guest:* [AUTHORITY]
No smoking here!
a. *Guest, replying:* [TRUTH-EVALUABILITY]
#That's not true! There is no such rule here.
b. *Bar owner, following up:* [ADDRESSEE'S COMPLIANCE]
#But I know that you will anyway.
c. *Bar owner, following up:* [SPEAKER'S ENDORSEMENT]
#But I don't care if you do.

(20) *Bar owner to a guest:* [AUTHORITY, POSSIBILITY OF HEDGING]
#No smoking here, I think!

Donovan (2020) treats DNCs as hybrid constructions that incorporate both a directive component (due to the presence of an imperative operator) and an assertive component (due the embedded declarative clause). We maintain that the attested interpretational ambiguity is pragmatic and entirely expected if DNCs are underlyingly modalized declaratives. Deontic modals are well-known to have performative uses in performative contexts and descriptive uses elsewhere (Kaufmann 2012; Portner 2007). Thus, the declaratives in (21), when uttered by a person with authority, are undoubtedly requests and not statements.[9]

(21) *Bar owner to a guest*:
You shouldn’t / may not / are not allowed to smoke here.

That modalized declaratives can perform a variety of directive speech acts has played an important role in the debate about the proper analysis of imperatives. We would like to sidestep this debate entirely and focus on the parallel between DNCs and declaratives with overt modals. Neither construction is specialized to perform directive speech acts, but each can in the right circumstances. This is compatible with a wide range of frameworks for directives, and whatever can be said about modalized declaratives can be said about DNCs. The next section develops a proposal that explains these facts by treating DNCs precisely as modalized declaratives.

3. Proposal

Here is the puzzle, again: DNCs only contain nominal material on the surface, yet they function like normative claims, down to directive uses. Is the normativity component a matter of pragmatic enrichment (cf. Pak et al. 2022; Reis 2003) or is it conventionally encoded (cf. Bhatt 2006; Gärtner 2014)? We will take the latter route and analyze DNCs as a case of ellipsis (22).

(22) a. No smoking. $= \neg$ [[$\exists$ smoking] ~~allowed~~]
b. Compost only. $=$ only [[$\exists$ [compost]$_F$] ~~allowed~~]

Our key motivation for ellipsis, rather than covert modality, is that DNCs have the same distribution and idiosyncrasies as the *X allowed* construction and it therefore makes sense to treat them along the same lines. We would like to emphasize that, despite several conceptual and implementational differences, our analysis owes much to that in Donovan (2020), which assumes the presence of *allowed* as well. Section 3.1 motivates each consequential part of our claims about the internal structure of DNCs, Section 3.2 spells out their formal semantics, and Section 3.3 discusses some of the effects of their rule-based interpretation.

3.1. Internal structure

Iatridou (2021) points out that DNCs could be just nominal constructions. We argue that DNCs must have propositional content. First, as (10) already demonstrates, DNCs allow propositional anaphora such as *That’s not true* (or *That is surprising/frustrating*, etc.), and propositional anaphora needs propositional content. Second, as mentioned in the introduction, one of the licensors of DNCs is *only*. As von Fintel (1997) shows, *only* is an adverb of quantification, not a determiner, and functions as a propositional operator. For DNCs with gerunds, one could argue that *only* gets its proposition from the verb. But for truly nominal DNCs, such as *Compost only!*, we will have to postulate more structure. We aim for a unified analysis of both kinds

[9] As the reader can check, the pattern is the same as in (19)–(20).

of DNCs and therefore will assume from now on that all DNCs are propositional. The next question is what additional structure DNCs have, if any. We propose that they have an elided deontic modal (i.e., *allowed*) and argue for each step of this proposal below.

NORMATIVITY HARD-WIRED One could derive the normativity component of DNCs through pragmatic enrichment (cf. Reis 2003 on *wh*-infinitives in German). According to this view, DNCs are descriptive statements reinterpreted as rules, e.g., as in (23).[10]

(23) No smoking here. $\approx$ There is no smoking here. $\rightsquigarrow$ No smoking is allowed here.

There are two pieces of evidence against this view. First, as pointed out by Iatridou (2021), the normative flavor of DNCs is always there and their intended use as something other than describing a rule is infelicitous (24a), just like with overt normative modals (24b). The existential construction, on the other hand, is more flexible and allows a circumstantial reading (24c).

(24) a. #No whispering in this house as everybody is by nature loud.
b. #You shouldn't / must not whisper in this house as everybody is by nature loud.
c. There is no whispering in this house as everybody is by nature loud.
(based on Iatridou 2021: 539)

Second, if DNCs were non-modal statements, the unmodalized proposition should be available for anaphora. This is not what we find: anaphora can only target the normative claim, not the putative existential claim (25). This is in line with the behavior of deontics and root modals at large, which only make the modal claim available for anaphora but not the prejacent alone (Snider 2017).

(25) A: No smoking here.
B: That's not true.
(i) *that* = 'that there is such rule here' [normative claim]
(ii) *that* $\neq$ 'that there is no smoking here' [existential claim]

Together, the properties above strongly suggest the presence of a normative modal in DNCs.

MODAL FORCE Negative DNCs could in principle be analyzed as having a necessity or a possibility modal, with negation taking narrow or wide scope (respectively), as shown in (26).

(26) No compost!
$[\ \Box\ [\ \neg\ [\ \text{compost.present}\ ]]] \approx [\ \neg\ [\ \Diamond\ [\ \text{compost.present}\ ]]]$

Based on their behavior with *only*, we argue that DNCs in fact contain a possibility modal. Here is why. *Only* presupposes that its prejacent is true (Horn 1969; von Fintel 1997). Given that, assuming that *only* scopes above the modal, the presupposition with a necessity modal is too strong (27a). This is unlike the presupposition we get with a possibility modal, which seems intuitively correct (27b).[11]

[10] (23) is just a version of this view, and we argue specifically against the existential analysis below.
[11] As the reader can check for themselves, narrow-scope *only* yields incorrect presuppositions regardless of the modal force.

(27) Compost only.

a. $\approx$ [only [$\Box$ [compost.present]]] [necessity]
Presupposes: presence of compost required (not met if the receptacle is empty)

b. $\approx$ [only [$\Diamond$ [compost.present]]] [possibility]
Presupposes: presence of compost possible (met even if the receptacle is empty)

The fact that DNCs are interpreted as prohibitives ($\neg > \Diamond$), rather than permissions of negation ($\Diamond > \neg$), exhibits the standard split scope effect (Iatridou and Sichel 2011; Penka 2012). Negation in negative determiners usually scopes above certain possibility modals, including deontics (28). The same holds for *only* (29).

(28) No visitors are allowed after 8 pm. = It’s not allowed to have visitors after 8 pm.

(29) Only one item of luggage is allowed. = Taking more than one item isn’t allowed.

On its own, the narrow scope of negation is not possible, with DNCs or otherwise (30). This construal is only licensed in specific contexts (31), with the help of particles like *also* (Repp 2013). DNCs have a minimal surface structure, so such means of forcing the narrow scope of negation or *only* are not available. This explains why we only observe the split scope readings.

(30) No ice cream (allowed). $\neq$ It is allowed not to eat ice cream.

(31) *To a friend who doesn’t want to dress up at a Halloween party:*
No costume is also allowed. = It is also allowed not to wear a costume.

MODAL FLAVOR Normative modality comes in a variety of flavors, and it is common to talk about priority modals that have a wide range of uses including, but not limited to, deontic contexts (Portner 2007; Rubinstein 2012). We argue that DNCs constitute a case of deontic modality proper, bearing a striking resemblance to constructions with overt *be allowed*. Thus, both DNCs and *be allowed* are natural in contexts where the QUD is about rules (32).

(32) A: What are the rules in this park?
B: No littering, no barbecuing on the grass, no dog poop, … [DNCs]
B′: You are not allowed to litter, barbecue on the grass, leave dog poop, … [*be allowed*]

However, whereas most priority modals (*can, have to, need, should*) admit teleological and bouletic interpretations, DNCs and *be allowed* do not. The latter cannot answer QUDs about goals and lack the ‘compatibility with goals’ reading altogether (33). This also explains why, when used performatively, DNCs are bad as suggestions (6) or advice (pace Donovan 2020). Those uses are hallmarks of polyfunctional priority modals (including the imperative operator; Kaufmann 2012), and are not expected of a dedicated deontic modal.

(33) A: What is the best way to get to Stehekin?
B: You can only take the boat or walk. / You need to take the boat or walk.
B′: #Only taking the boat or walking.
B″: #You are only allowed to take the boat or walk.

DNCs and *be allowed* may receive what looks like a goal-oriented interpretation (34a,b), reminiscent of typical priority modals, which can have a teleological interpretation (34c).

(34) *Burglars in a house*: [context from Kratzer 1981]

a. No whispering (is allowed), or we will get caught.

b. In order not to get caught, no whispering (is allowed).

c. We shouldn't / cannot / may not whisper, or we will get caught.

Our claim is that the modal in (34a,b) is still deontic and refers to rules instantiated in order to meet some goal, along the lines of *Because we don't want to get caught, we created a new rule such that no whispering is allowed.* This is different from standard priority modals as in (34c), which simply indicate that no whispering is preferable if not getting caught is a mutually recognized goal.

ELLIPSIS VS. COVERT MODALITY We have established that DNCs contain a deontic possibility modal. The next question is how exactly this meaning is encoded, and there are at least two routes here. One is to postulate a covert modal operator at LF, as it has been done for many other constructions (Bhatt 2006; Gärtner 2014; Kaufmann 2012; Šimík 2010). Another is to postulate ellipsis of an actual modal. We opt for the latter solution, capitalizing primarily on the striking parallels between DNCs and the *X allowed* construction (note the absence of a copula).

But first, a note on the nature of ellipsis is in order. Many types of ellipsis, such as gapping or VP ellipsis, require a linguistic antecedent which is clearly not present with DNCs. However, there is another type of ellipsis that is sometimes referred to as 'constructional' ellipsis (Goldberg and Perek 2019; cf. also Hankamer and Sag's 1976 notion of 'deep anaphora'). In this latter variety the elided content must be easily recoverable from the context, as is the case with *Which floor?* on an elevator (Pranav Anand, p.c.) or question truncation of the form *Anybody want a cup of tea?* (Fitzpatrick 2006). This type of ellipsis is often conventionalized and limited to certain genres (cf. Goldberg and Perek's 2019 *Well, I never*). As mentioned in the introduction, DNCs are common on signs or other contexts where a deontic modal would be natural. As such, they are easily amenable to this construction-like analysis.

As discussed in Iatridou (2021), treating DNCs as elliptical immediately explains why they only have nominal remnants, since *allowed* requires nominal subjects. However, Iatridou further argues against ellipsis based on some discrepancies between DNCs and *X is/are allowed*. Capitalizing precisely on those discrepancies, we argue that DNCs inherit some idiosyncrasies from the *X allowed* construction and it therefore makes sense to analyze DNCs as elliptical.[12] First, DNCs allow both *of*-gerunds and ACC-gerunds (35). As Iatridou points out, reconstructing a full finite clause is possible with *of*-gerunds (36a) but not with ACC-gerunds (36b).

(35) DNCs: both types of gerunds OK

a. No touching of any surface! [*of*-gerund]

b. No touching any surface! [ACC-gerund]

(36) Overt copula: only *of*-gerunds OK

a. No touching of any surface is allowed. [*of*-gerund]

b. #No touching any surface is allowed. [ACC-gerund]

[12] It could be that the idiosyncrasies in question are somehow derived from the fact that we are dealing with deontic possibility in both cases (Hedde Zeijlstra, p.c.). At this stage, we consider the ellipsis route a simpler alternative.

Our point is that *allowed* (sans copula) is good in both cases (37). We are not offering an explanation of the contrast between (36) and (37), but simply use it as a rejoinder to Iatridou’s objection to the idea of ellipsis resolution. We claim that resolution is possible, after all, but only if there is no overt copula present on the surface.

(37) *X allowed*: both types of gerunds types OK
  a. No touching of any surface allowed. [*of*-gerund]
  b. No touching any surface allowed. [ACC-gerund]

Second, DNCs and *X allowed* ban singular count nouns in the presence of *no* (38) (singular mass nouns are fine, as in *No ice cream*). Again, this is in contrast with the overt copula (39).

(38) a. #No dog (allowed) on the premises. / ✓No dogs (allowed) on the premises.
  b. No patron #allowed / ✓admitted without a tight fitting mask!

(39) a. No dog is allowed on the premises.
  b. No patron is allowed without a tight fitted mask.

Finally, DNCs and *X allowed* are non-embeddable unless under speech reports (40). The construction with an overt copula has no such restrictions (41).

(40) a. We said no smoking in the apartment after you torched the throw rug doing push-ups. (TV Series *How I Met Your Mother*, Season 5, Episode 11)
  b. #Mary knows that no smoking (allowed) here.
  c. #If no biking (allowed), I’m not coming.

(41) a. Mary knows that no smoking is allowed.
  b. If no biking is allowed, I’m not coming.

To sum up, there are several contrasts between DNCs and *X allowed*, on the one hand, and *X is allowed* with an overt copula, on the other. DNCs and *allowed* sans copula are compatible with *of*-gerunds and ACC-gerunds, ban singular count nouns and are generally not embeddable. We propose that the source of those restrictions is the same (albeit without explaining them) and therefore analyze DNCs as an instance of ellipsis.[13]

NO ‘THERE IS’ Before concluding, we would like to provide an argument against assimilating DNCs to existential *there*-constructions. Above we argued that DNCs cannot be simple

[13] Another piece of evidence in favor of the ellipsis analysis is the ambiguity of DNCs with non-deverbal nouns (42). A similar ambiguity is not found with gerunds due to the selectional restrictions of *available*, which requires physical objects (43).

(42) No ice cream.
  a. = No ice cream allowed (e.g., on public transit or in a museum).
  b. = No ice cream available (e.g., at a beach kiosk).

(43) No smoking.
  a. = No smoking allowed.
  b. ≠ *No smoking available.

An ellipsis analysis can easily handle the ambiguity in (42), the relevant reading being recoverable from the context. A covert modal analysis may also be possible, but it is not clear what kind of modal—and why—would be naturally ambiguous between a deontic (≈ allowed) and a dispositional (≈ available) flavor.

existential constructions since, unlike simple existentials (24c), they always have a normative flavor (24a). Donovan (2020) makes a more elaborate proposal and argues that DNCs have the underlying structure in (44), with two layers of ellipsis.

(44) No smoking. ≈ ~~There is~~ no smoking ~~allowed~~. (plus a silent imperative operator)

We argue that DNCs cannot be reduced to an existential construction, with or without a modal, because DNCs allow nominal phrases that cannot be pivots of existential *there*. In particular, DNCs with *only* allow generic bare plurals (45). The noun phrase in (45) is generic as it licenses the weak NPI *any*, and non-generic bare plurals, with or without *only*, do not (von Fintel 1997).

(45) Only students who have any siblings (allowed)! (based on von Fintel 1997: 23)

Existential *there* bans generic expressions (Milsark 1979), so (46) cannot be the source of (45).

(46) *There are only students who have any siblings allowed.

The bottom line is that there is no (elided) *there* in DNCs.[14]

We have argued that DNCs instantiate a case of constructional ellipsis, where (in most cases) the nominal remnant is associated with elided *allowed*. This account is motivated by the following properties of DNCs: (i) they have propositional content (based on propositional anaphora and *only*), (ii) they have a normative modal in their semantics (based on the obligatory normative flavor and on propositional anaphora), (iii) this is a possibility modal (based on interaction with *only*), (iv) this is a dedicated deontic modal (based on the lack of other readings typically associated with priority modals), and (v) this is an instance of ellipsis and not covert modality (based on parallels with the *X allowed* construction).

3.2. Formal semantics

Following Donovan (2020), we assume that *allowed* is the passive form of active *allow*, whereby, e.g., *Smoking or vaping in the office is allowed* is derivationally related to a transitive construction like *This company allows smoking or vaping in the office*. Importantly, we assume that the internal argument of *allow* (the only argument present in the passive counterpart) denotes a full-blown proposition, as visible from variants like *Mary allowed John to kiss her*.[15]

The cornerstone of our analysis of DNCs is (elided) *allowed*, which we treat as a regular existential deontic operator in the style of Kratzer (1991). For concreteness, we adopt the semantics in (48), where f_{circ} is a circumstantial modal base and g_{deon} is a deontic ordering source. The

[14] Donovan (2020: 12) provides a potential argument from tags for the presence of existential *there* in DNCs, citing examples as in (47). The argument is based on the assumption that tags match the TP material of their host clause (Culicover 1992).

(47) a. No smoking allowed! Actually, is there? / *are you? / *is it?
b. Three passengers only allowed in the cockpit! Actually, are there? / *are you? / *is it?

However, since here the putative tags are not directly attached to the DNC and instead appear in a follow-up clause, the force of this argument remains unclear.

[15] This last variant may be a ditransitive object-control construction or a transitive subject-to-object raising construction. If the former, one possibility is that the underlying structure of *allow* is always ditransitive, with the oblique object sometimes being a generic covert pronoun. For concreteness, we adopt the latter option here. For relevant discussion on whether deontics are raising or control predicates, see Bhatt (1998) and Wurmbrand (1999).

default anchoring for *allowed* is the time and world of evaluation. But this can be shifted by intensional operators, like *according to the law that comes into effect on Monday*.

(48) $[\![\text{allowed}]\!]^{\langle w,t\rangle}(p) = 1$ iff for some $\langle w',t'\rangle \in Best_{f_{circ},g_{deon},\langle w,t\rangle} : p(\langle w',t'\rangle) = 1$

Another important bit of our analysis is how to construct the prejacent proposition of *allowed*. We assume that it results from the nominal predicate composing with a covert existential operator. This is stated in (49).[16]

(49) $[\![\exists]\!]^{\langle w,t\rangle} = \lambda P\,.$ for some $x : P_{\langle w,t\rangle}(x)$

For DNCs licensed by *no* we adopt the agreement approach to split scope of negative indefinites (Penka 2012). According to this approach, negative indefinites make an existential contribution locally and are licensed by higher negation, which takes scope above modal operators, like *allowed*. This is illustrated in (50).

(50) No ice cream.
   a. $\neg$ [[$\exists$ ice cream] allowed]
   b. $\approx$ There are no circumstances among the deontically best options compatible with the current circumstances in which ice cream is present.

DNCs licensed by *only* have a parallel structure, with the complication that *only* associates with focus and triggers alternatives, which are factored into its exclusivity implication (Horn 1969; von Fintel 1997). We adopt the simple semantics for *only* in (51).

(51) a. $[\![\text{only}]\!]^{\langle w,t\rangle}(p)$ is defined just when $p(\langle w,t\rangle) = 1$.
   b. If defined, $[\![\text{only}]\!]^{\langle w,t\rangle}(p) = 1$ iff for all $q \in FocAlt(p) : q(\langle w,t\rangle) = 0$.

The semantics for DNCs with *only* now amounts to its intuitively correct meaning, as illustrated in (52).

(52) Compost only.
   a. only [[$\exists$ [compost]$_F$] allowed]
   b. $\approx$ Given that compost is allowed, no compost-alternatives are allowed.

3.3. Rule-based interpretation

In this section we discuss three additional restrictions on DNCs, suggesting that they are all linked to the rule-based semantics.

FAITHFUL TO SOURCE There is a bit of behavior that distinguishes DNCs from standard deontic sentences. Consider a situation where the circumstances are such that A and B are in a bar and B picks up a cigarette, being about to light it. There is one relevant rule, which is that the bar prohibits smoking. Now consider the following as responses uttered by A.

(53) a. You shouldn’t light that cigarette.
   b. You shouldn’t smoke.

[16] A similar approach is discussed in Schwarz (2006) for intensional transitive verbs like *need*. While *need* takes DP-arguments on the surface, Schwarz argues that semantically it always combines with a proposition. One way of achieving this is through existential closure over the individual argument of a property-denoting expression.

(54) a. ??No lighting that cigarette.
b. No smoking.

According to the Kratzer-style modal semantics we suppose, (53a) is true. That is, all of the deontically best possibilities compatible with the circumstances are ones where B does not light the cigarette. (53b) is similarly true, modulo the content of the prejacent. Yet, however close the overt modal sentences (53a,b) are in meaning to the respective DNCs in (54a,b), only (54b) is perfectly felicitous. (54a) is decidedly odd, if not worse. The generalization seems to be that DNCs need to be faithful to the source rule. That is, utterances of DNCs seem most natural when citing an actual rule, as opposed to describing a proposition that would merely rank highly based on its comportment with the rules.

The following observations might point to an explanation. DNCs are often found on signs. Typically, when we encounter an utterance of an overt modal sentence, we presume that all manners of contextually salient circumstances could figure in the calculation of its circumstantial modal base. In contrast, when we encounter a sign, we interpret the pertaining utterance as less sensitive to the various particular features of the circumstances. In the example above, if (54b) were printed on a sign, it may be that the sign's presence in the bar is part of the circumstantial modal base, but not that A and B are there, nor that B is picking up a cigarette. This would make a few options available for explaining the oddness of (54a). It could be that the utterance would violate the maxim of relation. Or, perhaps it is just false, as would be the case if there are possibilities in $\bigcap f(\langle w,t\rangle)$ where B is presently somewhere where smoking is permitted, and therefore not all the best worlds rule out this behavior. While these observations pertain to DNCs printed on signs, it may be that spoken DNCs are no different in this regard and have a similarly impoverished modal base.

Similarity to i-level predicates Another idiosyncrasy of DNCs is the kind of negation they are compatible with. As observed by Iatridou (2021), DNCs are not compatible with non-nominal negation, including *never*. This is illustrated in (55).

(55) a. *Never dogs.
b. *Never walking.

Intuitively, such examples are unacceptable because *never* quantifies over some sort of abstract entities (events, cases, situations, etc.) that draw relevant contrasts (Lewis 1975), and arguably DNCs do not make such entities available. Notice that the same idiosyncrasy holds for overt *allowed*. It is odd, if not entirely off, with *never* if meant to state a rule. This is shown in (56).

(56) A: What are the rules in this establishment?
B: ??Smoking (is) never allowed.

Our account does not currently predict this restriction, and we will not offer a full-throated explanation. Rather, we will content ourselves with drawing a suggestive parallel to individual-level predicates, which we think falls out from the rule-based story we have told so far.

The key observation is that individual-level predicates across the board are bad with temporal adverbials, including *never* (Czypionka and Lauer 2017).

(57) a. #Miles is never tall.

b. #My hair is never blue.

We speculate that such data may provide a clue for the negation licensing in DNCs. That is, according to several prominent accounts of individual-level predicates (cf. Chierchia 1995; Kratzer 1995), the behavior in (57) has to do with the unavailability of an abstract-entity argument that can be bound by *never*. The reason for this unavailability follows from the underlying semantics, i.e., individual-level predicates denote stable properties that do not change over time. In a similar way, DNCs may pattern with individual-level predicates in this regard simply because the former cite rules that remain stable across contexts. Furthermore, if *allowed*, which we postulate in DNCs, is in fact an adjectival, and not a verbal, passive, then we only expect it to behave like an individual-level predicate (Fernald 2000), which in turn will explain the data in (55) in a straightforward way. We hope to explore this hypothesis in future research.

NO BARE DNCS Here is a potential issue for our proposal. We do not exclude (58a), yet we do not find bare DNCs that express permissions simpliciter. In order to express such a meaning, *allowed* has to show up on the surface, as in (58b).

(58) a. #Smoking ~~allowed~~.

b. Smoking allowed.

This observation has led to the assumption that negation (Iatridou 2021) or exhaustification (Donovan 2020) is an integral part of the targeted construction. Here we want to consider a pragmatic solution, the key idea being that QUDs and focus structure have an effect on the licensing of DNCs.

We start with the following question: when is it felicitous to state a permission? Usually, this requires a situation in which there is uncertainty as to whether something is allowed or disallowed. Assuming that much, imagine the following situation, where what is at-issue is whether smoking is allowed.

(59) *Most, but not all, establishments have banned indoor smoking. We enter a pub, wondering whether smoking is allowed. After asking around, one of us says:*

a. Smoking IS allowed.

b. Smoking ALLOWED.

c. #Smoking.

The QUD in (59) requires verum focus or narrow focus on the predicate. This requirement can be satisfied in the presence of an overt auxiliary, as in (59a), or an overt modal, as in (59b). But since elided material cannot be focused, the minimal counterpart in (59c) is out. This could explain the lack of bare DNCs.

Even in the absence of a finite auxiliary or *allowed*, the situation changes for DNCs with locative or temporal modifiers, see (60).

(60) a. Smoking on the BALCONY! [=(3)]

b. Two-hour parking Monday through Friday. [common sign]

While these examples are fully acceptable, they can be plausibly assumed to be licensed by an EXH operator, a covert counterpart to *only* (Chierchia et al. 2012). The result is an exhaustivity effect. That is, (60a) means that smoking is allowed on the balcony and nowhere else, while (60b) allows parking only within the indicated time frame. In other words, the examples in (60) are not bare DNCs. They are essentially *only*-DNCs in disguise.

4. Conclusion

We have argued that DNCs in English are underlyingly modalized declaratives that contain an elided *allowed*. Their core semantic contribution is to invoke a pre-existing rule. Just like constructions with overt normative modals, DNCs can convey directive force in the right circumstances, but this effect is not hard-wired, unlike with true imperatives or with root infinitives in languages like German or Russian. We have also speculated that several idiosyncratic restrictions on the distribution of DNCs are intimately linked to their rule-based semantics and, crucially, are replicated with the overt *allowed* (but without the copula). We hope to further explore those restrictions in future research and to see whether our proposed analysis can be applied to similar constructions in other languages.

Appendix: Nominal directives

(61) exemplifies a construction that we dub 'nominal directives' (Iatridou 2021 considers this construction unproductive but we disagree).

(61) a. Attention!
b. Silence!
c. Water!
d. Hands up!
e. Keys in the basket!
f. Dogs on leash!

Nominal directives differ from DNCs in that they (unlike DNCs; see Section 2.2) always perform directive speech acts and cannot be used as mere assertions about rules. As such, nominal directives are not truth evaluable (62), they require the addressee's compliance (63) and the speaker's endorsement (64), and cannot be modified by declaratives hedges (65).

(62) A: Attention!
B: #That's not true.

(63) #Silence! But I know that you will keep talking anyway.

(64) #Attention! But I don't care if you don't listen.

(65) #Attention, I believe.

Fortmann (2018) argues that nominal directives with a directional modifier (61d–f) contain a covert verb of motion/location, as in (66), which in turn makes this an imperative construction:

(66) Dogs on leash! = Keep dogs on leash.

Likewise, German nominal directives are likely an instance of root infinitives:

(67) Hunde an der Leine ~~führen~~! [German]
dog.ACC.PL at DEF.F.DAT leash lead.INF
'(Lead) dogs on leash!'

Further support for the underlying structure in (67) comes from the fact that nominal directives (but not DNCs) license *mindestens* ‘at least’ (68). It requires the presence of a universal modal (Geurts and Nouwen 2007), and German RIs have been argued to contain a modal precisely of this sort (Gärtner 2014; Kaufmann 2022). Importantly for us here, nominal directives do not pattern like DNCs and hence are not discussed in the main body of the paper.

(68) Mindestens zwei Meter Abstand! [German]
at.least two meters distance
≈ ‘The distance must be at least two meters!’

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What does *vajon* contribute?[1]

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Abstract. The Hungarian particle *vajon* can be added to interrogatives to render the question acts they are used for "reflective" in the sense of geared to raising a question without answer request (Lyons 1977: 755), i.e., with weakened "call-on-addressee" (cf. Beyssade and Marandin 2006; Truckenbrodt 2006). This effect puts *vajon* in close proximity with triggers of "non-intrusive" questions (NIQs), as noted by Farkas (2022: 313; 2023: 114), and "conjectural" questions (CQs) (Eckardt 2020). Studying *vajon* against this theoretical background (i) uncovers difficulties for content-based approaches to particle/clause type (in)compatibilities, (ii) demonstrates the usefulness of distinguishing different types of rhetorical questions, (iii) identifies obstacles to analyzing *vajon* as either an NIQ- or a CQ-trigger, and (iv) adds another example to the inventory of cross-linguistic indirect speech act discrepancies.

Keywords: special questions, particles, sentence types, speech acts

1. Introduction

The Hungarian particle *vajon* can be added to interrogatives to render the question acts they are used for "reflective" in the sense of geared to raising a question without answer request (Lyons 1977: 755), i.e., "issue-rasing in a pure form" (Szabolcsi, Whang and Zu 2014: 138) with weakened "call-on-addressee" (cf. Beyssade and Marandin 2006; Truckenbrodt 2006). Evidence for this is provided by examples such as (1) and (2) (Gärtner and Gyuris 2012: 415), where the latter is taken as an utterance of one's computer's operating system.[2] *Vajon* shows up where a question comes without answer expectation, (1), and is blocked when information seeking is the sole purpose, (2).

(1) A: Have you been in touch with John lately?
  a. B: Not at all.
  b. A: #(**Vajon**) Elvégezte már az egyetemet?
    VM.finished already the university.ACC
    'Has he already received his degree? #(I wonder.)'

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[2] VM is used as gloss for "verb modifier," i.e., an instance of a particular class of verbal particles, bare nouns, and other predicative items that, if present, fill the immediately preverbal position in "neutral" clauses (cf. É. Kiss 2002: section 3).

(2) (#**Vajon**) Folytatja a leállítást? Igen / Nem
continue.SUBJ.3SG the closing.ACC yes no
'Would you like to shut down (this application) now? (#I wonder.) Yes / No'

The illustrated effect puts *vajon* in close proximity with triggers of "non-intrusive" questions (NIQs), as noted by Farkas (2022: 313; 2023: 114), and "conjectural" questions (CQs) (Eckardt 2020). In the following *vajon* will be studied against this theoretical background, a strategy which, as is going to be shown, (i) uncovers difficulties for content-based approaches to particle/clause type (in)compatibilities; (ii) demonstrates the usefulness of distinguishing different types of rhetorical questions; (iii) identifies obstacles to analyzing *vajon* as either an NIQ- or a CQ-trigger, and (iv) adds another example to the inventory of cross-linguistic indirect speech act discrepancies. These points will be addressed in Sections 2-5, respectively. Section 6 explores a modification of the NIQ-approach and Section 7 contains a brief conclusion.

2. *Vajon* and the declarative/interrogative distinction

As indicated in (3) and (4), *vajon* is strictly excluded from declarative clauses (**vajon*-DEC), while being optional – modulo pragmatic effects – in interrogatives. In fact, *vajon* may serve as diagnostic of interrogativity.[3]

(3) (***Vajon**) Ezeknek a furcsa szimbólumoknak van jelentésük. (\)
these.DAT the strange symbol.PL.DAT be.3SG meaning.their
'These funny symbols have a meaning. (*I wonder.)'

(4) (**Vajon**) Ezeknek a furcsa szimbólumoknak van jelentésük? (/\)
these.DAT the strange symbol.PL.DAT be.3SG meaning.their
'Do these funny symbols have a meaning? (I wonder.)'

A deeper account of **vajon*-DEC may adopt an ingenious proposal by Farkas (2022: 313f.), who derives analogous behavior of the Romanian counterpart particle *oare* from a constraint ruling out necessarily redundant discourse effects (cf. Farkas 2023: 120). This is formulated within a version of the "table model" of discourse (Farkas and Bruce 2010) combined with "inquisitive semantics" (Ciardelli, Groenendijk and Roelofsen 2019; Farkas and Roelofsen 2017).

Consider first the (bare essentials of the) formal treatment of polar interrogatives.

[3] A globally falling contour, (\), identifies declaratives. (\) may not occur with interrogatives unless they are marked by particle *-e* on the finite verb (or an appropriate alternative host where such a verb is missing). Interrogatives without *-e*, such as the one in (4), require a characteristic global "rise-fall" contour, (/\), peaking on the penultimate syllable (cf. Ladd 2008: 81ff.). For further discussion, see Gärtner and Gyuris (2012: 400ff.; 2022: 1.1) and works cited there. That *vajon* is incompatible with non-interrogatives has, for example, been shown wrt its ban from exclamatives (Farkas 2023: 115; cf. Gärtner and Gyuris 2007).

(5) INTERROGATIVE
 a. $I(\mathrm{S_{INT}}) = \{\, p, \overline{p} \,\}$
 b. $info(I(\mathrm{S_{INT}})) = \bigcup\{\, p, \overline{p} \,\} = p \cup \overline{p}$
 c. $\mathrm{ps} = \{\, \mathrm{DC}_{Ad} \cup \{\, p \,\}, \mathrm{DC}_{Ad} \cup \{\, \overline{p} \,\} \,\}$
 d. $\mathrm{ps}^{+} = \{\, \mathrm{DC}_{Ad} \cup \{\, p \,\}, \mathrm{DC}_{Ad} \cup \{\, \overline{p} \,\}, \mathrm{DC}_{Ad} \cup \{\, p \cup \overline{p} \,\} \,\}$

As shown in (5a), the "issue" (*I*) denoted by a polar interrogative ($\mathrm{S_{INT}}$) is the familiar set made up of the prejacent proposition and its complement.[4] The "informative content" of an issue is arrived at by applying set union to the propositions it contains. In the case of polar interrogatives this "cover[s] the whole logical space provided by the context" (Farkas 2022: 303), i.e., the context set, CS. The follow-up moves governed by question acts based on canonical interrogatives are captured by the "projected set," ps, (5c). Addressees are offered the choice of committing to one of the issue's options, i.e., of adding either p or $\overline{p}$ to their "discourse commitments," DC_{Ad}. And, crucially, if *vajon* is modeled on its "non-intrusive" counterpart *oare*, its discourse effect consists in granting the addressee the "trivial" option of leaving things open. This is achieved by adding $\mathrm{DC}_{Ad} \cup \{\, \mathrm{CS} \,\}$ to a thus modified ps^{+}, as can be seen in (5d).

The constraint **vajon*-DEC, then, emerges from the formal analysis of declaratives in (6).

(6) DECLARATIVE
 a. $I(\mathrm{S_{DEC}}) = \{\, p \,\}$
 b. $info(I(\mathrm{S_{DEC}})) = \bigcup\{\, p \,\} = p$
 c. $\mathrm{ps} = \{\, \mathrm{DC}_{Ad} \cup \{\, p \,\} \,\}$
 d. $\mathrm{ps}^{+} = \{\, \mathrm{DC}_{Ad} \cup \{\, p \,\}, \mathrm{DC}_{Ad} \cup \{\, p \,\} \,\} = \{\, \mathrm{DC}_{Ad} \cup \{\, p \,\} \,\}$

(6a), (6b), and (6c) are obvious consequences of declaratives being taken to denote singleton issues, i.e., sets just containing the prejacent proposition. The redundancy in (6d) follows from the technical assumption that *vajon* induces ps^{+} by contributing $\mathrm{DC}_{Ad} \cup \{\, info(I) \,\}$ (Farkas 2022: 312; 2023: 120). In the case of interrogatives this results in an additional addressee option whereas in the case of declaratives it doesn't. And thus, "[t]he non-occurrence of [*vajon*] in declaratives is explained by the fact that speakers would never have any reason to use it in such sentences" (Farkas 2022: 314).

Now, given its principled nature, the ramifications of this approach to **vajon*-DEC deserve further exploration.[5] Importantly, first of all, *vajon* must equally be absent from Hungarian-style "rising declaratives" (RDs). Thus, the ban on *vajon* persists if (3) is turned into what Goodhue (2021: 954) calls an "incredulous inquisitive" (II) RD. As for grammar, this would

[4] In keeping with Farkas (2022), the downward closure of issues, one of the hallmarks of inquisitive semantics (cf. Farkas and Roelofsen 2017: 251f.), will be abstracted away from.

[5] Investigating the broader scope and viability of such redundancy accounts is beyond current concerns. The possibility, for example, of inserting *vajon* into the interrogative complement of matrix predicates translating as 'I wonder' – as in *Azon tűnődöm/gondolkodom, hogy (vajon)* ... ('I'm wondering about whether ...') – would have to be made consistent with the restriction in question. Matters of this kind have recently been discussed wrt "language logicality" (cf. Pistoia-Reda and Sauerland 2021). Note that the distribution of *vajon* in clause combining is limited to "embedded root environments" (Heycock 2017; McCloskey 2006; Woods 2016) as indicated by Gärtner and Gyuris (2012: 417, fn.46) and confirmed by Farkas (2023: 123).

require a change in prosody such that a rise-fall contour is associated with each accentable word. The English rendering of the resulting "II-RD(3)" is provided in (7).[6]

(7) These funny symbols have a meaning!?

As for interpretation, it has to be pointed out that, given **vajon*-DEC, II-RD(3) would not be amenable to the "bipolar" treatment of RDs envisaged by Farkas and Roelofsen (2017: 261) and Ciardelli, Groenendijk and Roelofsen (2019: 104, Table 6.1). This is because if $I(S_{DEC}\uparrow) = I(S_{INT}) = \{ p, \overline{p} \}$, then the contribution of *vajon* to II-RD(3) would result in the ps^+ in (5d) and thus be non-redundant.

Of course, in order to reconcile the above approach to **vajon*-DEC with a bipolar treatment of RDs, one might appeal to construction-specific pragmatic factors. This, however, is not as straighforward as might initially appear. II-RD(3)/(7) may be uttered among a group of scholars studying the field notes of an absent colleague. Here it is hard to see why the speaker should not grant the addressees the option introduced by *vajon* of leaving the issue unresolved, reflected in the putatively non-redundant component $DC_{Ad} \cup \{ info(I(S_{DEC}\uparrow)) \}$ being a member of ps^+. This is independently confirmed by the fact that using the polar interrogative in (4) including *vajon* would be perfectly fine in the same context.[7]

Second, attempts at combining the redundancy account of **vajon*-DEC with a monopolar analysis of interrogatives (Krifka 2015: 336f.; Krifka 2021: 76) would face the opposite challenge. If $I(S_{INT\mu}) = I(S_{DEC}) = \{ p \}$, *vajon* should be excluded from this kind of interrogative, given that the resulting ps^+ will equal the one in (6d). Again, however, the facts disconfirm such a prediction. As shown in (8), *vajon* is unexceptionable in biased questions involving propositional ("inside") negation, one of the prime candidates for monopolar treatment.

(8)	**Vajon**	nem	volt	itt	senki?	(/\\)
		not	be.PAST.3SG	here	nobody	

'Was nobody here? I wonder.'

It is not obvious how to categorically rule out signaling bias while at the same time allowing addressees to refrain from committing to an answer.[8]

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[6] Further categories from the typology presented by Goodhue (2021) are "confirmative inquisitive" and "assertive" RDs. In Hungarian, the former are realized by declaratives to which the question-tag-like particle *ugye* (cf. Gyuris 2009) is added, the latter by declaratives intonationally modulated by a slight final rise (Gyuris 2019: 266). There are reasons to believe that the (multiple) rise-fall pattern of Hungarian II-RDs is indicative of (presumptive) echoicity, which would account for the need to resort to different forms for both CI-RDs and A-RDs. Note also that matters of "surprise" and "incredulity" are likely to have to be treated as independent parameters (cf. Gunlogson 2003: 68; Rudin 2022: 347). Finally, it has been observed that the use of inquisitive RDs can convey positive or negative bias or (dis)agreement (cf. Rudin 2022: 3.3.1/2).

[7] Analogous difficulties in accounting for the absence of NPIs from RDs under the bipolar approach are addressed by Farkas and Roelofsen (2017: 280) and critically assessed by Rudin (2018: 2.7; 2019). Rudin (2022: section 5) develops a variant of the analysis by Farkas and Roelofsen without relying on bipolarity.

[8] Interestingly, Krifka (2021: 2.12) opts for a bipolar analysis of the German counterpart of reflective questions (see Section 6 below).

3. *Vajon* and rhetorical questions

Consider next the interaction of *vajon* and rhetorical questions (RHQs), a type of questions that, quite relevantly, has been taken to "seek no answers" (cf. Maynard 1995). In line with the discussion so far, one may say that the "special characteristic [of RHQs] is that the input context resolves the issue they raise in an obvious way" (Farkas 2022: 330). One way of illustrating this in terms of the approach to polar interrogatives in (5) is to assume that $p \cap$ CS = $\varnothing$, and CS $\neq \varnothing$, i.e., CS $\subseteq \overline{p}$. Importantly, the contribution of *vajon* to the ps of $\mathrm{S_{INT}}$ in such a situation would be redundant too, as the corresponding ps^{+} in (9) shows. (Remember that *info*(I($\mathrm{S_{INT}}$)) = CS.)

(9) $\mathrm{ps}^{+} = \{\ \mathrm{DC}_{Ad} \cup \{\ \varnothing\ \},\ \mathrm{DC}_{Ad} \cup \{\ \mathrm{CS}\ \},\ \mathrm{DC}_{Ad} \cup \{\ \mathrm{CS}\ \}\ \}$

And, as it turns out, *vajon* is indeed infelicitous in such RHQs. (10) could, for example, be used by the speaker to dismiss a childish request by her friend.

(10) (#**Vajon**) Az anyád vagyok? (/\)
the mother be.PRS.1SG
'Am I your mother? (#I wonder.)'

A categorical ban on *vajon* from RHQs, however, would go against much of the more descriptive Hungarian literature, where "rhetorical uses" are standardly counted among the central functions of that particle (for references, see Götz 2019). And indeed, RHQs of the kind in (11) are attested.

(11) (**Vajon**) Megtett a kormány mindent, hogy elkerülje a válságot? (/\)
VM.did the governm. everything that VM.avoid.SUBJ.3SG the crisis
'Has the government done everything to avoid the crisis? (I wonder.)'

The difference between (10) and (11) can be captured by noting that if (11) were uttered by a member of the opposition during a parliamentary session, $p \cap$ CS $\neq \varnothing$ would be a likely contextual state. And thus, the use of *vajon* would create the by now familiar additional option for addressees.[9]

Now, it is possible to subsume these different types of RHQs under a common denominator by slightly rephrasing the above characterization along the lines of Biezma and Rawlins (2017: 308): "[...] rhetorical questions presuppose that the answer is entailed in the context of utterance (and hence available to all participants) [...]." The type exemplified in (10) would come with direct presupposition satisfaction, while the one shown in (11) requires accommodation-like adjustments.[10]

What is not so clear, however, is whether "necessary redundancy" in the account for **vajon*-DEC should be extended to "accidental (contextual) redundancy" in an account for **vajon*-

[9] See Sections 5 and 6 for further remarks on the particular pragmatics of example (11).

[10] Prosodically, Hungarian RHQs are marked by higher onset as well as greater F0 excursion. The former property fits the diagnosis of "divergent initial pitch" for non-standard questions by Sicoli et al. (2015: 205). Relevant cross-linguistic work has recently been carried out by Dehé et al. (2022).

RHQ to cover cases like (10).[11] In fact, this strategy may face empirical challenges. Thus, consider (12).

(12) Do men gather grapes of thorns, or figs of thistles?

This interrogative-based question from the gospel of St. Matthew (7:16) ("Authorized King James Version") constitutes a good candidate for an RHQ that requires no accommodation.[12] Nevertheless, the Hungarian "Károli Bible" from 1590 and several modern translations contain *vajon* here. Adding that particle arguably explicitly supports the didactic function of having addressees "reflectively" contemplate the "message" of the RHQ. An utterance of (10) in the context described earlier would, on the other hand, be a fairly blunt indirect way of saying "no," without any attention to the content of the question intended.[13] This kind of difference will be picked up again at the end of Section 5 on indirect speech acts.

4. NIQ- vs. CQ-trigger

The discussion so far has followed Farkas (2022; 2023) in treating *vajon* as a trigger of "non-intrusive questions" (NIQs), the formal hallmark of which is captured by ps^+ in (5d): addressees are given the explicit option of leaving an NIQ unresolved. The pragmatic intuition behind this mechanism is that NIQs weaken one of the defaults of canonical question acts, namely, the "addressee compliance assumption," formulated in (13) (Farkas 2022: 297).

(13) *Addressee compliance:*
The speaker assumes that the addressee will provide this information in the immediate future of the conversation as a result of the speaker's speech act.

And indeed, this fits well with the uses of *vajon* presented above. However, there are contexts that stand in the way of an NIQ-trigger analysis. Consider (14), taken as an utterance in a phone conversation.

(14) #**Vajon** hol vagy?
'Where are you? I wonder.'

In the direct Romanian counterpart of (14), the bona fide NIQ-trigger *oare* felicitously serves as a means through which "the speaker [...] tactfully signals that she is aware the addressee might have reasons not to provide the answer" (Farkas 2022: 322). This, it seems, does not

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[11] Technically, the latter approach requires something like the "project+discard" mechanism mentioned by Farkas (2022: 330), which reduces $ps^{(+)}$ to viable options. A suitable kind of dynamic system for working this out is presented by AnderBois et al. (2015).

[12] Note that CS derives from "the discourse commitments of all participants *augmented by background assumptions*" (Farkas 2022: 304) [italics ours, HMG/BGY].

[13] On this kind of employing RHQs as "retorts," see Schaffer (2005). The difference between (10) and (11) does not simply follow from *vajon* being confined to "initiating" – as opposed to "reactive" – dialog acts, as indicated by the following exchange. A: *Are there going to be any surprises in the presidential race?* B: (*Vajon*) *Van Magyarországon több mint egy jelölt?* ('Does Hungary have more than one candidate? (I wonder.)').

apply in the case of *vajon*. Instead, an utterance of (14) gives the (odd) impression of the speaker having started a soliloquy, disregarding the interlocutor on the phone.[14]

Another challenge for the NIQ approach to *vajon*-interrogatives are what can be called "equal expertise" effects. (15), uttered in the context of a job search committee, may serve as illustration.

(15) **Vajon** Smith fogja megkapni az állást?
'Will Smith get the job? I wonder.'

Curiously, (15) would be adequate if uttered between either two outsiders to or two members of the committee, whereas it is infelicitous in a mixed situation. Why weakening the addressee compliance assumption should be ruled out in the latter case, especially if the question is asked by an outsider to a committee member, is quite unclear.

At the same time, equal expertise effects of the type just described would speak in favor of considering *vajon* a trigger of "conjectural questions" (CQs) as analyzed by Eckardt (2020). Core ingredient here is the assumption that CQs invite "defeasibl[e] infer[ences] from *pooled knowledge of speaker and addressee*" (Eckardt 2020: 35). Such invitations do not make (much) sense in contexts of unevenly distributed "priviledged knowledge," which would be a good basis for explaining the constraints on uses of (15).

However, the idea that *vajon* constitutes a CQ-trigger turns out to be dubious as well. Thus, although German interrogative root (*wohl*-)VF-clauses,[15] i.e., the prime instance of CQ-triggers according to Eckardt (2020), behave like Hungarian *vajon*-interrogatives wrt the diagnostics in Section 1 – preferred option in the context of (1) (cf. Truckenbrodt 2006: 274), infelicitous in counterparts of (2) – the principles putatively guiding their overall distribution lead to clear divergences. In particular, as discussed in detail by Farkas (2022: 5.3.2), CQs differ from NIQs in that, at the level of speech act defaults, CQs suspend the "addressee competence assumption," stated in (16) (Farkas 2022: 297).

(16) *Addressee competence:*
The speaker assumes that the addressee knows the information that settles the issue she raises.

This is directly reflected in the empirical assessment by Eckardt (2020: 35) that German root (*wohl*-)VF-interrogatives "cannot be used as rhetorical questions." By contrast, examples like (11) and (Hungarian versions of) (12) show that *vajon* does occur in RHQs.[16] It must

[14] Farkas (2023: 5.1.1) explicitly discusses evidence that *vajon*-interrogatives are not exclusively used in self-addressed questions. For further recent work on the latter, see Eckardt and Disselkamp (2019).

[15] These structures are dealt with in some detail by Oppenrieder (1989), Truckenbrodt (2006), and Zimmermann (2013). They can be considered a variety of "insubordination" (cf. Evans 2007), given that they are root constructions displaying the (finite) "verb final" (VF) order characteristic of subordination. The modal particle *wohl* is obligatory in *wh*- and optional in polar (*ob* "whether") instantiations.

[16] Rendered by German (*wohl*-)VF-interrogatives, none of the examples in (10)-(12) would be felicitous in the contexts in question. An additional constraint on counterparts of (11) and (12) appears to be that in situations of public speaking, VF is blocked by verb-first or verb second structures. Meibauer (1986: 78) presents a potential (journalistic) counterexample to Eckardt's categorical assessment.

therefore be concluded that, close affinities notwithstanding, *vajon* neither reduces to an NIQ- nor to a CQ-trigger.

5. Indirect speech acts

Question acts without answer request, performed to reflect upon an issue, tactfully signal non-intrusiveness, or invite joint conjecture, could easily be taken to function as extra polite directives. This, at least, is what Oppenrieder (1989: 182) argues on the basis of examples like the following, involving a German (*wohl*-)VF-interrogative. (17) might be uttered by a speaker carrying some piece of heavy luggage reaching a door next to which the addressee is standing.

(17) Ob Du mir wohl die Tür öffnest?!
whether you I.DAT the door open.PRS.2SG
'Could you open the door for me?! I was wondering.'

Directive cues like *bitte* 'please' or the mitigator *mal* 'once,' 'just' (König, Stark and Requardt 1990: 88f.) may be added for purposes of disambiguation. And indeed, similar uses are attested for the functionally closely related Danish *mon*-interrogatives (Beijering 2012:126). However, strikingly, directive uses of Hungarian *vajon*-interrogatives are infelicitous (cf. Gärtner and Gyuris 2012: 417f.). This is illustrated in (18), which directly translates (17).

(18) (#**Vajon**) Kinyitod nekem az ajtót?!
'Will you open the door for me?! (I was wondering.)'

In this case, addition of cues like *kérlek* or *kérem* 'please' would only increase incompatibility with the presence of *vajon*.

Now, cross-linguistic variation regarding the licensing of indirect speech acts is usually considered a matter of (more or less arbitrary) conventionalization (cf. Searle 1979; Wierzbicka 1985). At the same time, understanding the kind of communicative failure involved in attempts at using *vajon*-interrogatives as requests may help reaching a more substantive and differentiated analysis of such phenomena. Thus, consider frameworks that capture the interaction between sentence types, particles, and speech acts in terms of use conditions (e.g. Gutzmann 2015). Here, the switch from reflectivity to indirect request in cases like (17) implies that Gricean mechanisms are able to operate on the output of such conditions. The question then arises as to what could prevent the same kind of process from applying in cases like (18).

One clue for giving an answer stems from work on "the intonational disambiguation of indirect speech acts" by Sag and Liberman (1975: 496): "These conclusions suggest the following hypothesis: some intonation contours can "freeze" an utterance pragmatically, i.e., require a literal interpretation [...]." A tool that could in principle bring about such "freezing" effects would be strictly "nondisplaceable" (Potts 2007: 166) use conditions, which persist and remain valid throughout all semantico-pragmatic interpretation. A candidate for such a "shielded use condition" accompanying uses of *vajon* is formulated in (19).

(19) Uses of *vajon*-interrogatives concern information.

(19) has the potential of explaining what would go wrong with an utterance of (18) in the given situation were it to include *vajon*. The addressee would have to find the speaker's exclusive interest in matters of fact misleading. The same shielded use condition could actually serve as basis for an alternative account of the infelicity of the rhetorical question in (10): The speaker's purpose of saying "no" would be flouted by *vajon* drawing the addressee's attention to the informational content of the interrogative. This clearly distinguishes (10) from (11) and (12), with the strategic and didactic nature of the latter favoring reflection upon the presented issues themselves.

6. Projected sets again

Section 4 concluded that to analyze *vajon* as either an NIQ-trigger or a CQ-trigger faces obstacles. It therefore makes sense to explore the extent to which the two approaches can be modified to yield better coverage. Concentrating on the NIQ-analysis, one radical change here would have *vajon* allow nothing but the "trivial" option into the projected set ps^+, as shown in (20).[17]

(20) $ps^+ = \{ DC_{Ad} \cup \{ p \cup \overline{p} \} \}$

This way, speakers explicitly signal – rather than just defeasibly implicate[18] – that they do not expect addressees to resolve the issue introduced by the *vajon*-interrogative. And clearly, with such a suspension of "addressee competence," (16), one arrives at a variant of the CQ-approach. But then, of course, the pros and cons regarding the latter have to be revisited.

To begin with, lack of a specific mechanism for the pooling of knowledge prevents the new analysis from deriving the "equal expertise" effect in (15). At the same time, it matches the CQ-analysis in predicting infelicity of *vajon* in instances of "tactful" non-intrusiveness like (14), given that addressee competence seems to have to be assumed to adequately characterize such contexts. Also, recall from the discussion in Section 4 that the same holds for rhetorical questions. Thus, (20) would be tool for blocking *vajon* from RHQs like (10), but cannot improve on the CQ-approach regarding RHQs (11) and (12).

The latter impasse warrants a further look at (11). On the basis of (20), *vajon* could here be taken to turn what is a rhetorical question at the level of content into a provocative display of mockful pretense puzzlement. This would correspond well with the strategic goals of antagonistic political discourse. However, such a fundamental revision (mutatis mutandis) is less intuitive in the case of (12), where addressee competence and didactic "reflectivity" are of equal importance.

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[17] A related suggestion has independently been made by Woods and Haegeman (2023). In contrast with (5d), (20) implements a non-monotonic discourse effect (cf. Farkas 2022: 310; Rudin 2022: 358f.).

[18] Assuming that the projected sets of standard questions, (5c), and NIQs, (5d), compete under appropriate "maxims for projection" (Rudin 2022: 6.2).

An even more radical approach is promoted by Krifka (2021: 2.12), who suggests that German (*wohl*-)VF-interrogatives could simply trigger a record of the speaker's interest in the issue via creation of a multiply rooted commitment space, without any introduction of present or projection of future commitments (see also Faller 2023). Given that this proposal is designed to capture the German case, it is unclear how it could derive the kind of cross-linguistic variation in the realm of indirect speech acts discussed in Section 5 without additional appeal to something like condition (19). Approaches based on (20) possess no advantage here either.

7. Conclusion

This short paper has studied uses of the Hungarian "reflective" question particle *vajon* by investigating its affinity to closely related triggers of "non-intrusive" questions (NIQs) (Farkas 2022; 2023) and "conjectural" questions (CQs) (Eckardt 2020). This has (i) uncovered difficulties for content-based approaches to particle/clause type (in)compatibilities. In particular, doubts were cast on the possibility of extending the ban on "necessarily redundant discourse effects," potentially responsible for keeping *vajon* out of declaratives, to semantically bipolar analyses of "rising declaratives" and monopolar analyses of interrogatives displaying "inside negation" (Section 2). (ii) The usefulness of distinguishing different types of rhetorical questions has been demonstrated, with presence vs. absence of presupposition accommodation in resolving questions as one core ingredient (Section 3). (iii) Obstacles to analyzing *vajon* as either an NIQ- or a CQ-trigger have been identified. Concretely, its exclusion from contexts of "tactful non-intrusiveness" weigh in against the former, and its occurrence in (some) rhetorical questions against the latter approach (Section 4). (iv) Another cross-linguistic indirect speech act discrepancy has been pointed out, showing that *vajon*-interrogatives are ruled out under while their German counterparts, (*wohl*)-verb final interrogatives, allow directive construal. To account for this difference, it has been proposed that a radically nondisplaceable "shielded use condition" confines uses of *vajon* to the realm of information (exchange) (Section 5). (v) A variant of the NIC-approach, which eliminates the "addressee competence assumption" and thus moves it closer to the CQ-approach, has been explored, with mixed results regarding better coverage (Section 6). A comprehensive treatment of *vajon* that ties together the above loose ends will have to await further research.

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A pitch accent beyond contrastive Focus marking: experimental evidence from auditory rating[1]

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Abstract. This paper presents two auditory rating experiments investigating the meaning contribution of the L*H pitch accent. Adapting previous work, we hypothesize the L*H to contribute an evaluative scale. The first experiment tests this hypothesis by drawing a connection to the ambiguity of epistemic and concessive *at least*, based on the intuition that the concessive interpretation correlates with a L*H accent. The data corroborate this intuition by showing that an L*H accent receives lower ratings than an H* accent in contexts that are more compatible with an epistemic interpretation of *at least*. The second experiment extends this pattern to the contribution of the L*H accent in the same contexts but without *at least*, with the L*H accent receiving higher ratings than the H* accent in concessive contexts. The results thus provide evidence for an independent contribution of the L*H accent, which resembles that of concessive *at least*. We consider two analyses. One situates the effect at the level of focus, and distinguishes two squiggle operators: one without a scale presupposition with H* accents on the Foci it associates with, and one with a scale presupposition with L*H accents on the Foci it associates with. The second analysis situates the scale presupposition at the level of the utterance contour, in an operator that always takes utterance-wide scope. The two analyses make different locality predictions, which remain to be tested.

Keywords: alternatives, focus-particles, intonation.

1. Introduction

The semantic effect of sentence stress in English is commonly taken to indicate Focus, which on the widely adopted Alternative Semantics account (Rooth 1985, 1992) is treated as evoking alternatives, illustrated in (1).[2]

(1) a. A: Who will succeed Logan Roy?
B: $[\text{K}\textsc{endall}]_F$ will succeed Logan Roy.
b. $[\![\ [\text{Kendall}]_F$ will succeed Logan Roy. $]\!]^f$ =
{Kendall will succeed Logan Roy,
Roman will succeed Logan Roy,
Shiv will succeed Logan Roy}

However, English intonational phonology offers multiple ways to mark stress given its repertoire of available pitch accents. For instance, the commonly adopted ToBI system (Beckman et al. 2005) distinguishes between at least four different types: H*, L*, L*+H, and L+H*. The resulting question then is whether all pitch accents simply indicate Focus. We take this to be

[1]We want to thank Emma Nguyen and Katy Carlson for providing the audio recordings, audiences at the Princeton LIN Lunch, SuB 27 at the Charles University in Prague, XPrag 2022 at the IUSS Pavia, and SURGE at Rutgers for comments and feedback on the project, as well as a Feodor-Lynen Fellowship of the Humboldt-Foundation to the first author and an SERC Discovery Grant to the second author for funding. All errors are our own.

[2]Complicating factors such as the question how to derive the underlying Focus structure of a sentence from its stress pattern, i.e. Focus projection, will be put aside here, but see Féry and Samek-Lodovici (2006) for more on this issue.

an empirical question: are there instances where a difference between two pitch accents results in a difference in acceptability or interpretation, or even aspects of language processing? Prior research argues in favor for such differences, for instance in the case of contrastive topics (Büring 1997) or psycholinguistic research on contrastive accents (Watson et al. 2008). The present work extends this research by focusing on the less studied L*+H pitch accent. Two auditory rating studies provide evidence for the hypothesis that the L*+H accent evokes an evaluative scale (cf. Pierrehumbert and Hirschberg 1990), looking first at its interaction with the epistemic/concessive ambiguity of *at least* (Nakanishi and Rullmann 2009), which will serve as an entry point, and second at its effect in the absence of *at least*.

2. Background

This section briefly reviews relevant prior research on meaning differences of pitch accents in English (2.1) and then sets up the background directly pertaining to the first experiment (2.2).

2.1. Prior research on pitch accent differences

As noted above, the question about how pitch accents in English may have different semantic and pragmatic effects is not novel, going back at least to the distinction between A-accents and B-accents by Bolinger (1965) and Jackendoff (1972) and their correspondence with Contrastive Topics (CTs, Büring 1997). Prosodically, CTs have been argued to be marked by a fall-rise accent — L+H* in ToBI terms — rather than the simple falling accent used for Focus. Although formal details vary across accounts (e.g. Büring 2003; Wagner 2012; Constant 2014), one shared analysis component concerns how the interaction of CT and Focus results in a hierarchically structured discourse: CTs are taken to indicate strategies of approaching an issue by dividing things into super- and subquestions, as made explicit in (2).[3] As a result, dialogues lacking the need or possibility for such a strategy are restricted to Focus-accents, see (3).

(2) A: What about Fred? What did he eat?
B: [Fred]$_{CT}$ ate [the beans]$_F$. [AUDIO]

(3) A: Did Knut break up with Allessa? (Büring 2003: (32)
a. B: No, ALLESSA$_F$ broke up with KNUT$_F$. [AUDIO]
b. B: #No, ALLESSA$_{CT}$ broke up with KNUT$_F$. [AUDIO]

However, recent research by Martens (2022) raises doubt about the validity of some of the prior characterizations of CTs as a concept distinct from Focus. For instance, production data show qualitatively indistinguishable results for classic CT cases like (2) compared to multiple Focus questions (e.g. *Who ate what?*). While other sources of evidence such as the contrast in (3) may require further investigation, the experiments presented in Section 3 crucially make a clearer case for pitch accent differences correlating with a difference in meaning.

[3] Here, we provide audio recordings of relevant sentences and indicate semantic labels, rather than give prosodic labels. The issue with prosodic labels such as ToBI is that there may still be some underspecification of relevant properties and more crucially that they require additional background, whereas we hope that audio recordings can make relevant intuitions more accessible to naive readers. However, given the frequent prior practice of only providing prosodic labels without audio recordings means that recordings are our rendition of what we think how examples from prior papers were intended, which may be inaccurate. We hope that providing audio recordings where relevant becomes a more common practice to avoid such issues of interpretation in the future.

A different source of data that supports the necessity to distinguish different pitch accents comes from psycholinguistic research on the activation of alternatives by so-called contrastive accents (see also Sedivy et al. 1999 for the influence of contrastive accents on implicature calculation). For example, Watson et al. (2008) provide evidence from a visual world experiment that a contrastive L+H* accent facilitates the recognition of relevant alternatives in online processing relative to a non-contrastive H* accent. They conceptualize a contrastive accent as one involved in corrective exchanges like (4a), whereas a non-contrastive accent occurs in replies to questions (4b).[4] A sample item with used audio recordings to illustrate how contrast was employed is given in (5).[5]

(4) a. A: Did Carmen cook risotto? B: No, he cooked SPAGHETTI. [AUDIO]
b. A: What did Carmen cook? B: He cooked SPAGHETTI. [AUDIO]

(5) Click on the camel and the dog.
Move the dog to the right of the square.
Now, move the CAMEL/CANDLE to the left of the diamond.
[CONTRASTIVE], [NON-CONTRASTIVE]

Additional evidence for the influence of contrastive accents on aspects of language comprehension come from a cross-modal priming study from Husband and Ferreira (2016) and recognition studies by Fraundorf et al. (2010). Similar effects have also been found for Dutch and German by Braun and Tagliapietra (2010); Braun et al. (2018); Braun and Biezma (2019), in addition to effects on exhaustivity by Gotzner (2019). Although the majority of the findings of these studies primarily pertain to processing, they nonetheless point to the relevance of distinguishing pitch accents and their semantic and pragmatic contributions, and hence constitute relevant evidence against the idea that all pitch accents equally indicate Focus.

2.2. Setup for experiments

As the review above shows, previous research has mostly focused on effects of the L+H* accent, at least in terms of prosodic labels. The present study will instead investigate the L*+H accent, which differs from the H* and L+H* in the accented syllable being at a low pitch level rather than a high one and then rise in pitch afterwards, often such that the pitch peak falls on the following syllable. An illustration of the difference between H* and L*+H from Ladd (2008) is given in (6), with pitch tracks in Figure 1.

(6) Wonderful. [H*], [L*+H] (Ladd 2008: 95)

Although the L*+H accent has been less studied in a minimal contrast to H* or L+H*, it is featured in the so-called rise-fall-rise contour (RFR, Ward and Hirschberg 1985) and its contribution hence studied indirectly as part of this contour. Prior research has characterized the RFR as conveying uncertainty (Ward and Hirschberg 1985) or incompleteness (Constant 2012; Wagner 2012). In contrast, recent work by Göbel and Wagner (2023) has highlighted limitations of these accounts for dialogues like (7) where the RFR is used to provide a counterpoint to a previous (evaluative) statement, but is only felicitous when the counterpoint is positive in

[4] Note that both instances would count as Focus in Alternative Semantics. The authors discuss that this difference hence would not have to be about a binary distinction between evoking alternatives or not but potentially in the restrictions on the contrast set (see also Repp 2016).

[5] Thanks for Duane Watson for sharing the audio files.

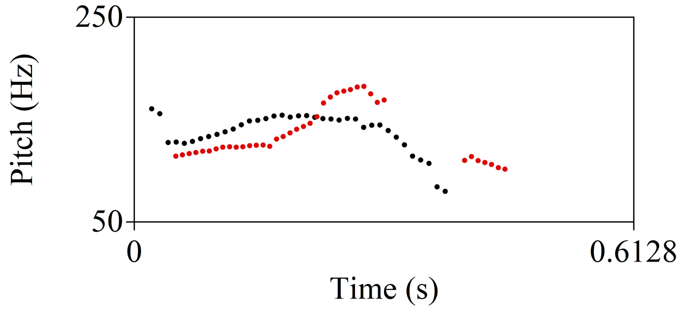

Figure 1: Pitch tracks for (6): H* in black, L*+H in red.

reply to a negative statement (7a) and not vice versa (7b). Göbel and Wagner, following Göbel (2019), hence argue that the RFR requires a higher alternative on a scale.

(7) a. A: The new iPhone is really terrible.
B: It has a lot of storage... [AUDIO]
b. A: The new iPhone is really great.
B: #It has little storage... [AUDIO]

By virtue of its occurrence in the RFR, Pierrehumbert and Hirschberg (1990) in their account of assigning meanings to individual subcomponents of contours propose that the L*+H evokes a scale. Building on this proposal, we adopt the more specific hypothesis that the L*+H evokes an evaluative scale.

The way in which this hypothesis will be tested here is in relation to an intuition about the interaction of pitch accents with the interpretation of the English Focus-particle *at least*. *At least* is in principle ambiguous between an epistemic interpretation, which can be paraphrased as "this much and maybe more", and a concessive interpretation, paraphrasable as "it could've been worse".

(8) a. Grover ate **at least** [the chicken]$_F$ (maybe even the tuna).
b. **At least** Grover ate [the chicken]$_F$ (he could've eaten nothing at all).

The intuition we aim to test in Experiment 1 is that concessive at least correlates with the use of the L*+H accent. Such a correlation would be in line with the hypothesis, and it crucially allows us to render the subtlety of any pitch accent difference more concrete. While the meaning difference between L*+H and other pitch accents is hard to pin down intuitively, the difference between epistemic and concessive *at least* seems quite clear. As a result, if the L*+H correlates with *at least* being used concessively, we can use the interpretation of *at least* as way to tap into the effect of the pitch accent. Experiment 1 aims to do so by employing an auditory rating task.

3. Experiments

3.1. Experiment 1: accent comparison with *at least*

3.1.1. Materials & design

The goal of this experiment was to assess the hypothesis that the L*+H accent evokes an evaluative scale by testing its effect on the interpretation of *at least*. To do so, we used dialogues as in (9) that varied in the assumed compatibility of a context sentence with the interpretation of *at least* in the target sentence: Context sentences were either *how many* questions taken to be more compatible with an epistemic interpretation of *at least* (9a), or assertions expressing some negative attitude toward the falsity of a higher alternative taken to be more compatible with a concessive interpretation (9b). To render *at least* principally ambiguous, the target sentence contained *at least* sentence-initially associating with the subject, to avoid the influence of syntactic cues for disambiguation as used in (8) above. As a second factor, the target sentence varied in intonation: The target word — here *some* — either carried an H* accent preceded by an accent on *at least*, or an L*+H accent with *at least* deaccented.[6] Pitch tracks of the relevant parts of the target sentence for both conditions are shown in Figures 2 and 3. The remainder of the target sentence was deaccented and ended with a fall.

(9) <u>Sample Item, Experiment 1</u>
  a. *Epistemic context*
    A: How many of the children do you think ate their broccoli?
    B: At least SOME of the children ate their broccoli. [(LH*+)H*], [(∅+)L*H]
  b. *Concessive context*
    A: I'm surprised that not all of the children ate their broccoli.
    B: At least SOME of the children ate their broccoli. [(LH*+)H*], [(∅+)L*H]

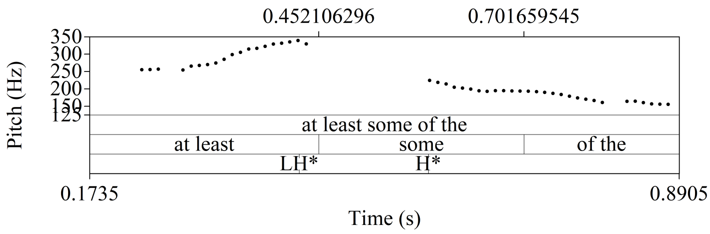

Figure 2: Pitch track for (LH*+)H* condition.

As an additional exploratory between-item factor, dialogues varied in whether the target sentence contained *some*, as above, or a numeral between *one* and *four*. While epistemic contexts remained unchanged with numerals, the evaluative contexts were adjusted to contain *not more* instead of *not all*. The comparison between *some* and numerals was used to see how any potential effect would generalize across different types of scalar items (see Alexandropoulou 2021 for relevant findings).

(10) <u>Sample Item, Experiment 1: numerals</u>

[6]The additional accent in the H* condition was used based on our impression from a previous natural production study. We will come back to this issue in the discussion.

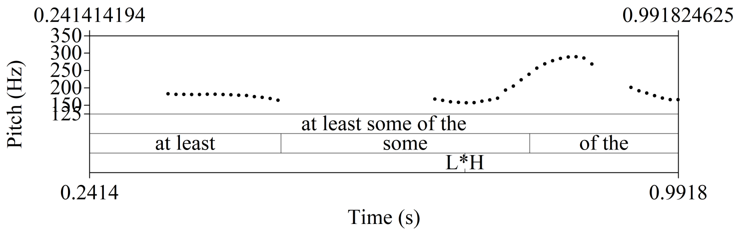

Figure 3: Pitch track for (∅+)L*H condition.

a. *Epistemic context*
A: How many of the customers do you think gave a tip?
B: At least THREE of the customers gave a tip.

b. *Concessive context*
A: I'm shocked that not more of the customers gave a tip.
B: At least THREE of the customers gave a tip.

The design was thus a 2x2x2 with within-item factors CONTEXT (epistemic vs concessive) and INTONATION (H* vs L+H*) and between-item factor SCALE-ITEM (*some* vs *numeral*). The factors were Latin-squared such that participants only saw one combination of context and intonation per item. There were 24 items in combination with 24 fillers, which can be viewed at the associated OSF repository at `https://osf.io/m9tgn`.

3.1.2. Procedure

The experiment started with a headphone screener test to make sure participants were wearing headphones to appropriately listen to audio, followed by a consent form and a demographic survey. Participants were then told to rate items according to naturalness on a scale from 1 to 6. Dialogues were presented only auditorily without displaying any items in written form. There were three practice trials that varied in naturalness before the main part of the experiment began. At the end, participants had the option to provide feedback.

3.1.3. Participants

47 participants were recruited from Prolific.ac and compensated with $2.00 each. 11 participants were excluded due to failing headphone check, leaving 36 for data analysis.

3.1.4. Predictions

On the hypothesis that the L*+H accent evokes an evaluative scale, its presence should bias toward a concessive interpretation of *at least*, whereas we assume the H* accent to be neutral. As a result, we predict an interaction between CONTEXT and INTONATION such that the difference between H* and L*+H (i.e. the rating resulting from L*+H from H*) should be smaller for concessive contexts than epistemic contexts. However, we remain agnostic about the exact shape this interaction may take given uncertainty about the independent baseline ratings for intonation and contexts.

3.1.5. Results

Data were analyzed in R using ordinal mixed effects model with random intercepts for subjects and items and sum-coded factors. The mean ratings by condition are shown in Figure 4. Looking first at *some*, we see higher ratings for H* than for L*+H in epistemic contexts, and a numerical trend toward the reverse in concessive contexts. Additionally, evaluative contexts were overall rated more natural. For numerals, there is a similar pattern of H* above L*+H for epistemic contexts, which decreases without reversing in concessive contexts. Moreover, epistemic contexts were overall higher rated than concessive ones, contrasting with *some*.

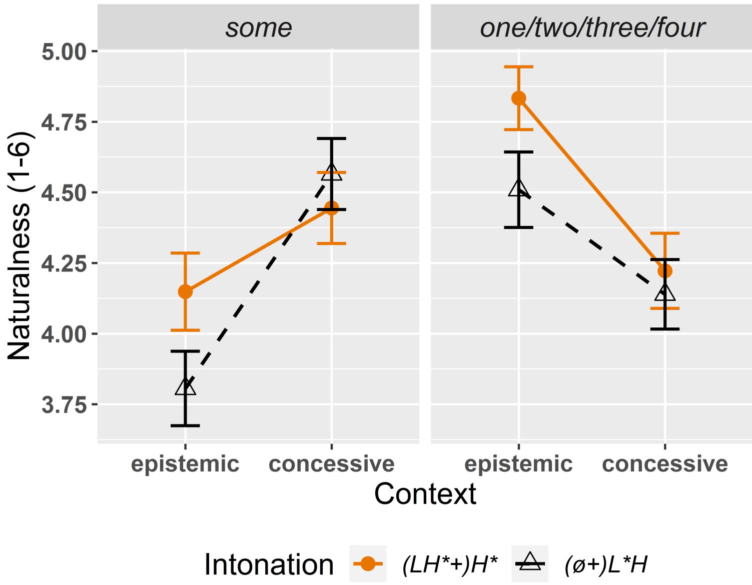

Figure 4: Mean ratings by condition, Experiment 1

Model outputs reveal significant main effects of INTONATION ($z = -2.29$, $p < .05$*), with higher ratings for H*, and SCALE-ITEM ($z = 2.55$, $p < .05$*), with numerals better than *some*, while CONTEXT was not significant ($z = 0.07$, $p = .95$). Additionally, we find a significant effect for the crucial interaction between CONTEXT and INTONATION ($z = 2.20$, $p < .05$*), as well as an interaction between CONTEXT and SCALE-ITEM ($z = -7.23$, $p < .001$***), both in line with the impression of the results pattern. The interaction between INTONATION and SCALE-ITEM as well as the three-way interaction was not significant ($z = -0.79$, $p = .43$; $z = -0.65$, $p = .52$).

3.1.6. Discussion

The results provided evidence for the hypothesis that L*+H evokes an evaluative scale: the particular pattern we found was that L*+H lead to lower ratings in epistemic contexts relative to H*, whereas there was a small numerical difference for intonation in concessive contexts. On the view advocated for here, these results are explained by L*+H biasing toward a concessive interpretation, which is deemed less natural in epistemic contexts, or takes cognitive effort to revise and hence leads to lower ratings.[7] This pattern was present for both *some*

[7]Notably, a more definitive interpretation of the results is not possible given the lack of an assessment of the baseline naturalness for the two intonation conditions outside the experimental design. That is, it might also be

and numerals, although numerically more pronounced for *some*. However, *some* and numerals differed in another way: while concessive contexts were rated better than epistemic ones for *some*, the reverse was true for numerals, with concessive contexts rated worse than epistemic ones. A possible explanation for this could be that the reply with *some* in epistemic contexts is less informative than with a numeral. The *how many* question may be taken as the speaker pragmatically presupposing the underlying existential statement, which would render B's reply only minimally informative. In contrast, the numeral provides a more specific answer than an existential presupposition would entail. This difference could thus account for why *some* and numerals differ in which of the contexts is rated higher.

A potential confound of the experiment, on the other hand, is that the two intonation conditions varied not only in the pitch accent on the target word but also in the presence/absence of an accent on *at least*. The results may thus be solely driven by the prosody on *at least* or an interaction of it with pitch accent on target. Moreover, from a theoretical perspective, there is an open question whether the potential effect of L*+H is due to it serving as a cue for disambiguating *at least* and hence mediated by the presence of an applicable ambiguity, or whether the pitch accent itself makes an independent meaning contribution. The next experiment aims to address both of these issues.

3.2. Experiment 2: accent comparison without *at least*

3.2.1. Materials & design

In order to test whether the L*+H pitch accent makes its own contribution, the experiment used the same design and materials as Experiment 1, but removed *at least* from the target sentences. The modification was done by manually cutting off the portion of the audio recordings corresponding to *at least*.[8] This change also removes the potential confound regarding the influence of the prosody on *at least*, given that there now is no *at least* anymore. A sample item is shown below for completion:

(11) Sample Item, Experiment 2
  a. *Epistemic context*
    A: How many of the children do you think ate their broccoli?
    B: SOME of the children ate their broccoli. [H*], [L*H]
  b. *Concessive context*
    A: I'm surprised that not all of the children ate their broccoli.
    B: SOME of the children ate their broccoli. [H*], [L*H]

We used the same 24 item sets with the same 24 fillers from Experiment 1 in the same Latin-square design.

the case that L*+H is generally deemed less natural than H*, and that the interaction is driven by L*+H leading to more concessive interpretations in concessive contexts and hence higher ratings. However, a significant interaction would crucially constitute evidence for our hypothesis in either case.

[8]Note that for the *some* items, all parts of the initial fricative identifiable in Praat were kept for consistency despite sometimes noticeable co-articulation with the preceding *at least*, which may have led to some recordings sounding slightly less natural.

3.2.2. Procedure

The procedure was the same as Experiment 1.

3.2.3. Participants

37 participants were recruited from Prolific.ac and compensated with $2.00 each. 1 participant was excluded due to failing the headphone check, leaving 36 for data analysis.

3.2.4. Predictions

If the L*+H accent makes a contribution that is independent of its effect on an applicable ambiguity, we should again find an interaction between *context* and *intonation*, although the exact shape of the results pattern may differ given the removal of *at least*. If the L*+H accent does not have any independent effect, INTONATION should not interact with the other factors.

3.2.5. Results

The results, given in Figure 5, were again analyzed with a sum-coded ordinal mixed effects model with random intercept for participants and items. To again first descriptively characterize the results, for *some* we see numerically slightly higher ratings for H* compared to L*+H in epistemic contexts, and this difference being reversed and becoming larger for concessive contexts. This pattern is almost identical for numerals, except that epistemic contexts are overall much more natural than concessive ones.

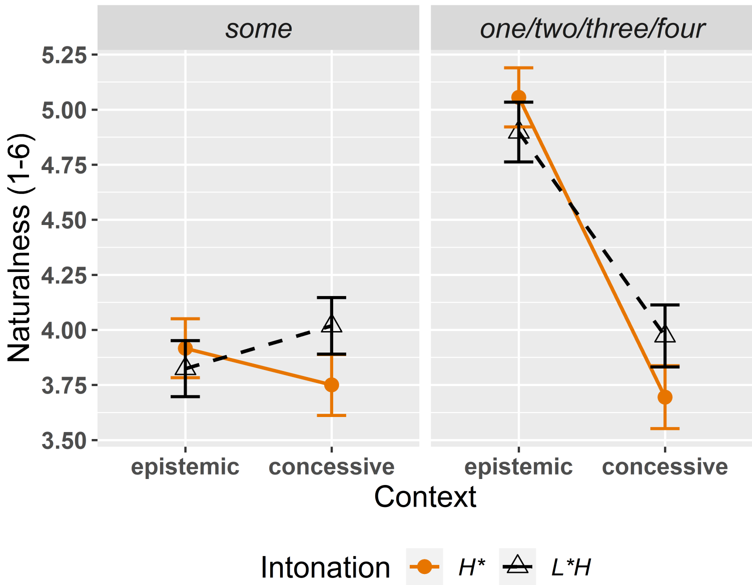

Figure 5: Mean ratings by condition, Experiment 1

In line with this characterization, the model revealed a significant effect of CONTEXT ($z = -8.05$, $p < .001$***), with higher ratings for epistemic contexts than concessive ones, a significant effect of SCALE-ITEM ($z = 4.80$, $p < .001$***), with numerals rated higher than *some*, as well as significant interactions of CONTEXT and INTONATION ($z = 2.56$, $p < .05$*), and CONTEXT and SCALE-ITEM ($z = -7.78$, $p < .001$***). All other effects were non-significant

(INTONATION: z = 0.60, p = .55; INTONATION*SCALE-ITEM: z = -0.47, p = .64; CONTEXT*INTONATION*SCALE-ITEM: z = 0.32, p = .75). The analysis thus shows almost exactly the same significant factors as Experiment 1, the only difference being that Experiment 1 showed a main effect of INTONATION where Experiment 2 shows a main effect of CONTEXT.

3.2.6. Discussion

The data provide evidence for a genuine contribution of the L*+H pitch accent. More specifically, the L*+H's contribution seems to resemble that of concessive *at least* given how similar the pattern of results is to that of Experiment 1: independent of scale-item, L*+H received numerically higher ratings than H* in concessive contexts, and — albeit with a smaller difference — numerically lower ratings in epistemic contexts. In relation to Experiment 1, that means that the larger difference is now in concessive contexts rather than epistemic ones, but is nonetheless consistent with the hypothesis of L*+H being evaluative. The change in results patterns may be due to a small overall decrease in ratings for H* in both contexts in the absence of *at least*. For epistemic contexts, the issue of the reply being uninformative may be exacerbated without (an epistemically interpreted) *at least*, as the reply is now fully equivalent to the existential presupposition of the question. For concessive contexts, on the other hand, H* may be more likely to be taken as corrective/exhaustive — also due to it now being the most prominent accent — which seems somewhat incoherent as a reply.

This issue, that the lack of informativity in epistemic contexts is worse for H* in this experiment, may also be reflected in the interaction of CONTEXT with SCALE-ITEM. In the absence of *at least*, the response with a bare numeral is now maximally informative, whereas *some* maximally uninformative on the view that the question triggers an existential presupposition.

To sum up, the results provide evidence that L*+H does not merely serve as a cue to resolve an appropriate ambiguity but has its own meaning contribution, which aligns with that of concessive *at least*, and resolved the potential confound of the influence of the prosody on *at least* given that target sentences here only differed in the pitch accent on the target word. The next section discusses the results of this experiment and Experiment 1 in more detail.

4. General discussion

The experimental results provide evidence for the L*+H pitch accent contributing an evaluative meaning not only in the context of an ambiguous *at least* but also in the absence of any mediation. The resulting question is how to capture this hypothesis in a formal semantic analysis. We discuss two paths forward here.

The first option is to adopt a proposal by Göbel (2019), treating the L*+H accent as a modified squiggle operator. While regular squiggle — formalized as in (12) — presupposes a set of propositional alternatives *C* that contains the prejacent and at least one other member varying along its focus dimension, alternatives are not ordered in any way and can hence be considered equal to each other, so to speak. The modified squiggle, $\sim^*$, then differs in exactly this way by ranking alternatives relative to each other, shown in (13).

(12) $[\![\sim]\!] = \lambda C : C \subseteq [\![\phi]\!]^f \ \& \ [\![\phi]\!]^o \subset C \,.\, C$

(13) $[\![\sim^*]\!] = (12) \ \& \ \forall p \forall q [p, q \in C \ \& \ p \neq q \rightarrow p < q \vee p > q]$

(= for all distinct propositions p, q in C, p is either ranked below or above q)

This modification is notably weak: it is left open how alternatives are ranked specifically, which would have to be determined by pragmatics.[9] The main reason for keeping the meaning underspecified is to capture other occurrences of L*+H, for instance in the context of *only* as in (14), intuitively marking an evaluative (or "scalar") interpretation (i.e. to mean that the Focus-associate is not a lot). While the contribution of the pitch accent would still be evaluative, the utterance crucially serves a different discourse function from concessive *at least* in that it seems to be about higher (false) alternatives being better rather than lower (false) alternatives being worse. For cases as in Experiment 2, we would then assume that alternatives are ordered by logical strength but interpreted evaluatively, such that we would get *some children ate their broccoli* being considered better than *no children ate their broccoli*, in line with the intuitive meaning of concessive *at least*. This analysis would predict that the constraint scale can be placed individually for separate Foci within a sentence. For example, if one focused constituent carries an H* accent and another an L*H, it would only be the latter Focus that must operate over an ordered scale.

(14) A: Did you get anything good at the farmer's market?
B: No, I **only** got [mandarines]$_F$. [AUDIO]

As a second option, the evaluation of the L*+H accent could be contributed globally as a contour taking scope over the whole utterance, rather than having the ability to be localized in as modified squiggle approach. That is, the ranking component of (13) would come from a [L*+H L- L%] contour.

One source of evidence to distinguish between these two options would be embedding environments: if L*+H contributes its evaluation via a type of squiggle operator, it should be embeddable and able to do so locally, rather than having to range over the whole sentence. However, constructing appropriate examples is not straightforward, such that we will leave an answer to this question for future research.

A relevant connection in this regard is that of the present account to the rise-fall-rise (RFR). Wagner (2012) presents arguments that the RFR cannot be embedded, and the uncertainty it conveys is always attributed to the speaker. Related to the question of embeddability and locality is the more general issue of analyzing intonational meaning holistically, as assumed by recent approaches (e.g. Goodhue et al. 2016; Rudin 2018), or as decomposable into meaningful parts, see (Pierrehumbert and Hirschberg 1990; Bartels 1999). The RFR constitutes a perfect comparison case in this regard, since it represents a minimal pair with respect to the terminal part of the contour for the intonation investigated here, only differing in there being a final rise instead of a final fall. Looking at the acceptability of the RFR in the experimental items in (15), it seems to be acceptable in concessive contexts, maybe even more so than with the final fall, and the fall feels more confrontational. Interestingly, the RFR seems less unnatural in epistemic contexts, maybe by virtue of sounding more like an educated guess that resembles the effect epistemic *at least* might have here, which would counteract the uninformativity issue. This pattern could be in line with the claim that the RFR is ambiguous between an epistemic-like and concessive-like meaning in Göbel and Wagner (2023) but requires further testing.

[9] An even weaker—but possibly cognitively more plausible—meaning would be to say that there is some alternative that is ranked above others. Thanks to Matt Husband for this suggestion.

(15) a. *Epistemic context*
A: How many of the children do you think ate their broccoli?
B: SOME of the children ate their broccoli. [RFR]

b. *Concessive context*
A: I'm surprised that not all of the children ate their broccoli.
B: SOME of the children ate their broccoli. [RFR]

One way to further investigate the question of locality and compositionality would be to look at cases of multiple accents, for instance to what extent the L*+H can be used in combination with a non-L*+H accent in the same utterance, and explore it interpretative effects if it can.

5. Conclusion

This paper started with a question about the relationship between the pitch accent repertoire in an intonational language like English and their corresponding meaning contribution. We presented two experiments to investigate this issue with respect to the L*+H accent. Experiment 1 used the epistemic-concessive ambiguity of *at least* to test the hypothesis that an L*+H accent should map onto a concessive interpretation, which was borne out. Experiment 2 elaborated on this finding by examining the L*+H in the same contexts but in the absence of *at least*. The results closely resembled that of Experiment 1, suggesting that the L*+H accent by itself contributes a meaning similar to that of concessive *at least*. We discussed two possible paths for formalizing this contribution, either in the shape of a modified squiggle-operator or as a global contour. While differentiating between these possibilities requires further research, the experimental results presented here provide evidence for a distinct contribution of the L*+H accent and hence the need for paying attention to pitch accent differences that go beyond their usage to convey contrast.

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Presupposition projection from the scope of *say*[1]

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Abstract. In this work, we investigate the projection behavior of presuppositions embedded under the predicate *say*. Drawing from new data elicited in French, German, Italian and English, we show that with *say* presuppositions from embedded declaratives and those from embedded interrogatives pattern in opposite ways. Specifically, presuppositions from declaratives must be satisfied at the attitude holder's level, in their 'presented beliefs', but not at the matrix level; from interrogatives, presuppositions project to the matrix level, but not the attitude holder's level. This result differs from the general pattern observed with responsive predicates. To capture this projection behavior, we propose a mechanism for declarative embedding that ensures for presuppositions to be satisfied in the same worlds at which the prejacent will be evaluated, here the attitude holder's presented beliefs. In addition, we assume that *say* cannot directly embed interrogatives, and instead, when it appears to embed a question Q, it is selecting for a silent DP 'the answer to Q'. Matrix projection follows on standard assumptions.

Keywords: say, presupposition, projection, French, German, Italian, English

1. Introduction

This paper is on the under-researched phenomenon of the projection behavior of presuppositions from the scope of *say*, a representative of the class of communication predicates.[2] Existing work on projection from under attitudes focuses on non-communication predicates, from which communication predicates, when mentioned, are explicitly set apart due to apparent differences in projection properties (Karttunen 1973, 1974; Geurts 1998; Uegaki 2021: a.o.). Pioneered by the work of Karttunen (1974) and Heim (1992), it is widely accepted that embedded presuppositions are filtered to the attitude holder's beliefs, at least. This appears to be true for both declarative embedding, as shown in (1), and interrogative embedding, as shown in (2). In (1) the uniqueness presupposition of a definite article gets anchored to the attitude holder's beliefs, and in (2), the uniqueness presupposition coming with the *which*-question filters to the beliefs of the attitude holder.[3]

(1) Zoe is certain that the cat is inside.
Presupposes: Zoe believes that there is a unique cat and it is compatible with Zoe's beliefs that it is inside.

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[2]The class of communication predicates includes *say*, *tell*, *show*, *indicate*, *inform*, *disclose* (Karttunen 1977).
[3]In this paper, we set aside the proviso problem, which is the observation that embedded presuppositions appear to project by default to the matrix level. When we present the crucial data, we use contexts that are meant to bring out projection to the attitude holder's beliefs only, i.e., those in which the context would explicitly contradict matrix projection in an appropriate way.

(2) Zoe is certain (about) which cat is inside.
Presupposes: Zoe believes that exactly one cat is inside.

Uegaki (2021) generalizes this observation, claiming that presuppositions (including the existence and uniqueness presuppositions triggered by a *wh*-word) from under responsive predicates project in the same way from declaratives and interrogatives: to the attitude holder's beliefs only, in the case of non-veridical predicates, or additionally to the matrix evaluation world, for veridical predicates.

In this paper, we make two main novel empirical claims. First, we show that presuppositions from declaratives embedded under *say* must be satisfied not in the attitude holder's belief worlds, but instead in the worlds compatible with what they say, which correspond to what we dub their 'presented beliefs', i.e., the reported common ground according to the attitude holder's goals (following a characterization of the semantics of *say* by Anand and Hacquard 2014). Second, we reveal a surprising generalization, where presuppositions project in opposite ways from embedded declaratives and interrogatives, posing a challenge to Uegaki's generalization: presuppositions from declaratives must be satisfied at the attitude holder's level, in their 'presented beliefs', but not at the matrix level; from interrogatives, presuppositions project to the matrix level, but not the attitude holder's level. To back these claims, we use data from different languages (French, German, Italian, English), which all exhibit the same behavior, tentatively suggesting a hypothesis that these properties are cross-linguistically stable.

We propose an analysis which captures this projection behavior. First, we propose a mechanism for declarative embedding that ensures for presuppositions to be satisfied in the same worlds at which the prejacent will be evaluated, here the attitude holder's presented beliefs. Second, we assume that *say* cannot directly embed interrogatives, and instead, when it appears to embed Q, it selects for a silent DP 'the answer to Q'. Matrix projection follows on standard assumptions.

The remainder of the paper is organized as follows. Section 2 discusses previous work on communication predicates. Section 3 and 4 present how presuppositions project from under *say* when it embeds declaratives and interrogatives. Section 5 shows how *say* differs from non-communication responsive predicates in its projection behavior. In Section 6, we propose an analysis of *say* which captures its projection behavior before concluding in Section 7.

2. Previous work on presupposition projection from under communication predicates

Presupposition projection from clauses embedded under communication predicates has been subject to debate in the literature. There is no agreement yet on (i) whether communication predicates allow presuppositions to project from their complement and (ii) if they do, what the resulting content of these presuppositions is.

Karttunen (1973) attributes to communication predicates the label of presupposition plugs. Presupposition plugs are known to block all the presuppositions of their complement. Based on examples (3) and (4) which involve the definite article and *again* as presupposition triggers, Karttunen (1973) claims that "one can report a certain illocutionary act has taken place without committing themselves to the presuppositions of whatever was said on that occasion." In other words, neither the presupposition triggered by the definite article nor the presupposition triggered by *again* is presupposed at the matrix level in (3) and (4).

(3) a. Harry has promised Bill to introduce him to the present king of France. (Karttunen 1973: 174)
  b. *Does not presuppose:* The king of France exists.

(4) a. Cecilia asked Fred to kiss her again.
  b. *Does not presuppose:* Fred had kissed Cecilia before.

The claim that communication predicates are presupposition plugs is challenged by Permesly (1973) who shows that presuppositions can project from under communication predicates when they embed an interrogative.[4] In particular, Permesly (1973) claims that when the predicate *tell* embeds a *wh*-question the existential presupposition coming with that question projects all the way to the matrix level, as shown in (5).

(5) a. John told us who Bill had an argument with. (Permesly 1973: 60)
  b. *Presupposes:* Bill had an argument with someone.

Permesly (1973) thus shows that presuppositions do not project the same way from under embedded declaratives and interrogatives. Following Karttunen's (1973) terminology, this suggests that when communication predicates like *tell* embed a declarative, they can be characterized as plugs, but when they embed an interrogative, they should be characterized as holes.

In recent work, Spector and Egré (2015) and Uegaki (2015) challenge Karttunen's (1973) and Permesly's (1973) respective claims that presuppositions don't project from embedded declaratives, but project all the way to the matrix level when they come from an embedded interrogative. Specifically, they argue that communication predicates like *tell* are ambiguous between a veridical and a non-veridical version (in contrast to Karttunen 1977 and Groenendijk and Stokhof 1984, a.o., who consider that they are veridical). When veridical *tell* is used, presuppositions project both from embedded declaratives and interrogatives. In contrast, when non-veridical *tell* is used, nothing projects no matter what kind of clause is embedded. To illustrate, let us start with veridical *tell*. When veridical *tell* embeds a declarative, as in (6), a veridical inference (i.e., that the complement 'Fred is the culprit.' is true) arises when the sentences are used out of the blue. That this inference is preserved under negation and in polar questions suggests that it is some kind of presupposition.

(6) a. Sue told Jack that Fred is the culprit. (Spector and Egré 2015: 1739)
  b. Sue didn't tell that Fred is the culprit.
  c. Did Sue tell Jack that Fred is the culprit?

To confirm that this veridical inference is in fact a factive presupposition, Spector and Egré (2015) show that the above sentences pass the *Wait a Minute Test* (von Fintel 2004).

(7) A: Sue told Jack that Fred is the culprit. (Spector and Egré 2015: 1739)
  B: Hey wait a minute! I didn't know that Fred is the culprit.

(8) A: Sue didn't tell Jack that Fred is the culprit.
  B: Hey wait a minute! I didn't know that Fred is the culprit.

[4] Permesly (1973) characterizes communication predicates like *tell*, *say*, *state* and *teach* as *wh-factives* but claims that it is the existential presupposition that comes with the embedded questions that projects, and not some kind of factive presupposition as one may expect given the name.

(9) A: Did Sue tell Jack that Fred is the culprit?
B: Hey wait a minute! I didn't know that Fred is the culprit.

Based on these examples, Spector and Egré (2015) and Uegaki (2015) conclude that veridical *tell* comes with a factive presupposition that projects all the way to the matrix level with embedded declaratives. As for interrogatives embedded under veridical *tell*, example (10) suggests that they come with the veridical inference that John told the true answer to the question 'Who is the culprit?'. Uegaki (2015) further claims that when veridical *tell* is used, the existential presupposition coming with the embedded question, i.e., there is someone who is the culprit in (10), projects to the matrix level as well.

(10) Jack told Mary who the culprit is. (Spector and Egré 2015: 1737)

Moving on to non-veridical *tell*, Spector and Egré (2015) and Uegaki (2015) claim that no veridical inference arises no matter what kind of clause is embedded, a declarative or an interrogative. Example (11) shows that in the case of embedded declaratives, what is told does not necessarily have to be true as indicated by the continuation *but he was lying*. As for embedded interrogatives, they do not come with the veridical inference that the attitude holder told the true answer to the embedded question. For instance, as shown in (12), it is felicitous to add the continuation that the attitude holder (i.e., the meteorologists) is wrong.

(11) John told Mary that Zoe passed the test, but he was lying.

(12) Every day, the meteorologists tell the population where it will rain the following day, but they are often wrong. (Spector and Egré 2015:1737)

Uegaki (2015) adds that just like veridical inferences do not arise with non-veridical *tell*, other kinds of presuppositions are not present at the matrix level either. This claim is based on example (13) where the existential presupposition coming with the embedded question, i.e., 'Some students passed the test.', is negated in the preceding context.

(13) Unfortunately, none of our students passed the test, but John is mistaken that Ann and Bill did. To make matters worse, John told Mary which students passed the test (although he was of course wrong). (Uegaki 2015: 132)

As noted by Uegaki (2015), the judgment for (13) is subtle. In addition, although the existential presupposition coming with the embedded question may not be part of the common ground, the sentence involving *tell* still presupposes that the attitude holder (i.e., John) believes that some students passed the test, suggesting that some projection is taking place.

Most of the examples discussed in this section involve the predicate *tell*. One question that arises is whether all communication predicates trigger the same presuppositions and share the same projection properties. Spector and Egré (2015) mention that it may not be the case – specifically, *say* seems to differ from *tell* in this respect. In contrast to the sentences involving (veridical) *tell* in (6), no veridical inference arises when the following sentences are uttered out of the blue. And in contexts in which Sue is well-informed, although (14a) may suggest that Fred is the culprit, (14b) clearly does not. This suggests that unlike veridical *tell*, *say* does not come with a factive presupposition.

(14) a. Sue said that Fred is the culprit. (Spector and Egré 2015: 1739)

b. Sue didn't say that Fred is the culprit.
c. Did Sue say that Fred is the culprit?

To summarize, previous literature does not settle on what the empirical facts are. Specifically, no agreement has been reached yet regarding (i) the presuppositions that may come with communication predicates and (ii) the projection behavior of these predicates. The current paper aims at contributing to (ii) by investigating the projection properties of the predicate *say* in four languages, French, German, Italian and English. Specifically, we looked at whether presuppositions triggered within the complement of *say* project and if so how (to the attitude holder level only, to the matrix level only, or both). We considered two kinds of complements, declaratives, to which we turn next, and interrogatives (Section 4).

3. Presupposition projection from embedded declaratives

In this section, we show that when *say* embeds a declarative, presuppositions triggered within the embedded clause need not project to the speaker's beliefs. Instead, they project into what we dub the attitude holder's 'presented beliefs', which depend on the attitude holder's intentions at the speech act reported. The presuppositions project (i) to the attitude holder's actual belief state, if they are being truthful; (ii) to a fake belief state of the attitude holder, if they are lying.

To start with, we look at the most common case, namely contexts in which the speaker believes the attitude holder to be truthful. In the first scenario in (15), the speaker – in contrast with the attitude holder – does not believe the presupposition coming with the embedded clause. The presupposition trigger *aussi* 'also' triggers the presupposition that someone other than Zoé has bought milk (in the following example, the prejacent is not believed by the speaker either; the judgment stays the same if the speaker believes it, unsurprisingly). The relevant presupposition trigger is marked in bold, as it will be throughout.

(15) *Max thinks Lou bought a bottle of milk, but I don't think she did. Then he sees another one, and thinks that Zoé bought it, even though I don't think that can be the case either.*
Max me dit que Zoé **aussi** a acheté du lait.
Max me says that Zoé also has bought of.the milk
'Max says to me that Zoé **also** bought some milk.'

That the sentence involving *say* is felicitous in (15) shows that the presupposition triggered by *aussi* can project to the attitude holder's beliefs only. The speaker does not need to share this belief that someone other than Zoé has bought milk. We will be making our empirical observations using French examples in the main text, but the corresponding English translations make the same point, as do counterparts in German and Italian, which we include in the appendix which can be found on osf.io/ywt83.

Let us now turn to a second scenario where the speaker but not the attitude holder believes the presupposition triggered by *aussi*, i.e., someone other than Max has bought milk in (16). That the sentence involving *say* is not felicitous in such a scenario shows that the presupposition coming with the complement of *say* cannot project to the speaker's beliefs only. In other words, the attitude holder must believe the presupposition for the sentence to be felicitously uttered.

(16) *I bought some milk this morning. As I open the fridge I see that Max also bought some. Max didn't see the milk I bought, and thinks he's the only one who bought milk.*

#Il va voir Zoé et il lui dit que lui **aussi** a acheté du lait.
he goes see Zoe and he her says that he also has bought of.the milk
'He goes to Zoe and he says to her that he **also** bought milk.'

Examples (15) and (16) thus show that in declarative-embedding cases where the attitude holder speaks their mind, the presupposition coming with the complement of *say* must project to their belief worlds. As previously mentioned, with *say* the attitude holder need not to tell the truth, which appears to disrupt projection to their actual beliefs (as in examples from Karttunen 1977; Spector and Egré 2015; Uegaki 2015: a.o.). Instead, we show that in such cases presuppositions triggered within an embedded declarative project to the attitude holder's fake beliefs, namely those that the attitude holder wants their addressee to believe about their beliefs. To see this, let us consider (17) which again involves the presupposition trigger *aussi*. In this example, neither the attitude holder nor the speaker believe the embedded presupposition (i.e., someone other than Zoé has bought milk), but crucially the attitude holder wants their addressee to believe that they believe it.

(17) *When I left my apartment this morning, there was no milk left in the fridge. Max, as always, has decided to lie, and tells me he bought milk. But he doesn't stop lying there:*
Max me dit que Zoé **aussi** a acheté du lait.
Max me says that Zoé also has bought of.the milk
'Max says to me that Zoé **also** bought some milk.'

The sentence involving *say* is felicitous in (17), which suggests that the presupposition coming with the embedded clause can project to the attitude holder's fake beliefs, and does not need to project to the speaker's beliefs, confirming what we have shown in (15) and (16), nor does it not need to project to the attitude holder's actual beliefs.

To show that projection is not random, we show that presuppositions must project to the attitude holder's fake beliefs, and not their actual beliefs, when they are lying. In the scenario in (18), the at-issue content of the prejacent of *say* is satisfied in the attitude holder's fake belief worlds, but the presupposition is satisfied in their actual belief worlds (in addition to the speaker's). This mismatch makes the sentence infelicitous, showing that indeed, presuppositions from declaratives embedded under *say* must always be satisfied in the same worlds that the prejacent is evaluated at, i.e. the 'presented beliefs' at the speech act reported.

(18) *Max bought a bottle of milk, but he lies and says he didn't, and instead blames Zoé.*
#Max me dit que Zoé **aussi** a acheté du lait.
Max me says that Zoé also has bought of.the milk
'Max says to me that Zoé **also** bought some milk.'

To sum up, we have shown in this section that when *say* embeds a declarative, the presupposition coming with its complement is anchored to the attitude holder's presented beliefs, i.e., either to the attitude holder's actual beliefs in honest speech reports, or to the attitude holder's fake beliefs in dishonest speech reports. This projection pattern is robust and observed in controlled contexts across the four languages we have investigated, namely, French, English, German and Italian, and across embedded declaratives involving other strong presupposition triggers like clefts (see appendix for remaining data). As a result, we have rejected a characterization of *say* as a presupposition plug (cf. Karttunen 1974). We have further shown that in contrast to what has been claimed for *tell* (Spector and Egré 2015; Uegaki 2015), some kind of projection always takes place with *say* even in its non-veridical use, i.e., when the attitude holder doesn't tell the truth. Before turning to embedded interrogatives, we note that we can find cases with some presupposition triggers in which there is apparent projection of the presupposition up to the speaker's beliefs only (and not to attitude holder's beliefs) in declaratives. In (19), the attitude holder – in contrast to the speaker Max – doesn't believe the presupposition that Max and Theo have a cat. Nevertheless, the sentence involving *say* is felicitous.

(19) *Zoe comes to my house not knowing that Max and Theo have a cat. She sees it as she comes up to the door.*
Zoe to Max: I saw a white cat outside! Do you have cats?
Max to Theo: Zoe says she saw **our** cat!

We follow Heim (1992) in claiming that these cases are simply taken to be *de re* readings of the presupposition triggers. A paraphrase of (19) would be: 'As for our cat, Zoe says she saw it.' We therefore exclude these from consideration, as these presupposition triggers are to be interpreted outside the scope of *say*.

4. Presupposition projection from embedded interrogatives

When *say* embeds an interrogative, we show that presuppositions project from them differently than from embedded declaratives. Specifically, they must be included in the speaker's beliefs, but not necessarily the attitude holder's presented beliefs. In this section, we discuss on the one hand polar questions embedding strong presupposition triggers like *aussi* 'also', and on the other hand embedded *wh*-questions and their associated existential presupposition. As far as we know, the literature on communication predicates has focused on embedded *wh*-questions. Extending our investigations to polar questions allows us to check whether different types of questions behave alike when it comes to presupposition projection from the scope of *say*.

Let us start with embedded polar questions. In the first scenario (20), the honest attitude holder believes the presupposition coming with the embedded clause (i.e., someone other than Zoé bought some milk), but not the speaker. The sentence involving *say* is not felicitous in such a scenario, which shows that the presupposition coming with the complement of *say* cannot project to the attitude holder's beliefs only. The speaker must believe the presupposition for the sentence to be felicitously uttered.

(20) *Max thinks Lou bought a bottle of milk, but I don't think she did. I think that only Zoé bought some. I will ask Max about it.*
#Max me dira si Zoé **aussi** a acheté du lait.
Max me say.FUT if Zoé also has bought of.the milk
#'Max will say to me whether Zoé **also** bought some milk.'

In contrast, when the speaker believes the presupposition triggered by *aussi*, but the honest attitude holder does not, the sentence involving *say* is felicitous.

(21) *I bought a bottle of milk this morning, but I didn't tell Max yet. As I open the fridge I see that someone else bought one. I suspect Zoé did. I will ask Max about it, because he stays at home all day and witnesses all comings and goings.*
Max me dira si Zoé **aussi** a acheté du lait.
Max me say.FUT if Zoé also has bought of.the milk

‘Max will say to me whether Zoé **also** bought some milk.’

This example shows that the presupposition coming with the complement of *say* can project to the speaker’s beliefs only. The attitude holder does not need to share the belief that someone other than Zoé bought milk. This is the exact opposite of what we observed with declaratives.[5]

We observe the same projection pattern when *say* embeds a *wh*-question. Specifically, the existential presupposition coming with the embedded *wh*-question (i.e., someone bought milk) cannot be anchored to the beliefs of the (honest) attitude holder only, as shown by the oddness of (22a). In (22b), we reject the possibility that the oddness comes from a potential veridical use of *say*. In (23), we show that the same presupposition can project the speaker’s beliefs only.

(22) *When I left my apartment this morning, there was no milk left in the fridge. Unlike Max, I think that no-one bought milk. He tries to convince me, and*
a. #il me dit **qui** en a acheté.
he me says who of.it has bought
‘he says to me **who** bought some.
b. il me dit que Zoé en a acheté.
he me says that Zoé some has bought
‘he says to me that Zoé bought some.’

(23) *I believe that someone bought a new milk carton. Max heard one of his flatmates talk about it, but he doesn’t believe them. I ask Max about the milk.*
Max ne me dit pas **qui** a acheté du lait, parce qu’il pense que personne
Max NE me says that who has bought of.the milk because=he thinks that no-one
n’en a acheté.
NE=it has bought.
‘Max doesn’t say to me **who** bought milk, because he thinks that no-one bought any.’

Note that we used negated *say* to construct the example in (23). The reason to do so was because the existential presupposition of a *wh*-question is entailed by an answer to that question. This means that it is not possible to construct a sentence ‘Max says who bought milk’, where Max

[5] We used the future in these examples to construct natural-sounding examples with embedded polar questions (in the past or present, there needs to be a reason for why the speaker is not directly reporting the answer to the question as an embedded declarative; the context becomes very heavy if it is included). However, it is important to check that doing so does not affect projection properties overall. Below, we show controls with declaratives embedded under future *say*, and show that the generalization found in the previous section is not affected. (i) shows that it is possible for the honest attitude holder to believe the presupposition (that someone else than Zoé bought milk), and not the speaker, while (ii) is odd, because in the context, the speaker but not the honest attitude holder believes the presupposition.

(i) *There are two new bottles of milk in the fridge, I think only one person bought them, but Max thinks that Lou and someone else did. Zoé says she bought some milk, but doesn’t say how many bottles. Then Lou asks Max about it.*
Max lui dira que Zoé **aussi** a acheté du lait.
Max to.her say.FUT that Zoé also has bought of.the milk
‘Max will say to her that Zoé **also** bought some milk.’

(ii) *I bought a bottle of milk this morning, but I didn’t tell Max yet. He instead thinks that Zoé bought it. When I ask him,*
#Max me dira que Zoé **aussi** a acheté du lait.
Max me say.FUT that Zoé also has bought of.the milk
#‘Max will say to me that Zoé **also** bought some milk.’

presents the belief that X bought milk (an answer to 'who bought milk') without presenting the belief that someone bought milk. When *say* is negated, it is unclear what the definition of presented beliefs is, because there is no speech act to anchor them to. We therefore check the attitude holder's actual beliefs.[6]

(24) *I believe that someone bought a new milk carton. Max heard one of his flatmates talk about it, but he doesn't believe them. I ask Max about the milk.*
Max ne me dit pas que Zoé **aussi** a acheté du lait, parce qu'il pense que
Max NE me says NEG that Zoé also has bought of.the milk because=he thinks that
personne n'en a acheté.
no-one NE=of.it has bought.
'Max doesn't say to me that Zoé **also** bought milk, because he thinks that no-one bought any.'

To sum up, we have shown in this section that when *say* embeds an interrogative, the presupposition coming with its complement projects to the speaker's beliefs, and not to the attitude holder's presented beliefs. This projection pattern is robust and has been observed in controlled contexts for several presupposition triggers and across several types of embedded interrogatives, namely strong presupposition triggers (*also* and clefts) in polar questions, and the existence presupposition associated with *who*-questions and *what*-questions, in French, English, German and Italian. Our result is novel. It is partially in line with Permesly's (1973) claim about *tell*, where presuppositions must project to the matrix level. It is however in contradiction with Spector and Egré (2015) and Uegaki (2015), who argued that no presupposition is present at the matrix level with non-veridical *tell*. One possibility for this is that *tell* is different from *say*. But we propose to challenge their empirical claims (thus maintaining Permesly's original claim). First, we disagree with the data point (12) from Uegaki (2015). As for the example in (13) from Spector and Egré (2015), we note that involves both universal quantification and a future modal, which might muddy the judgments, a point which calls for future investigation.[7] These disagreements highlight the fact that these judgments are subtle and should be handled with care. Checking across more types of contexts, and perhaps in an experimental setting could be beneficial to confirm and refine (or reject) our result.

We have thus shown that with *say* presuppositions from embedded declaratives and those from

[6]For a full characterization of the semantics of *say* and its projection properties, we need to see what happens when *say* is embedded under other operators like negation. For reasons of space, we do not provide the full picture in this paper. However, we still need to check that negation does not affect projection properties for declaratives: (i) shows that for declaratives under negated *say*, in the case where the honest attitude holder does not believe the presupposition, but the speaker does, the sentence is odd, as we showed it is under non-negated *say* in Section 3.

(i) *I believe that someone bought a new milk carton. Max heard one of his flatmates talk about it, but he doesn't believe them. I ask Max about the milk.*
#Max ne me dit pas que Zoé **aussi** a acheté du lait, parce qu'il pense que personne n'en
Max NE me says NEG that Zoé also has bought of.the milk because=he thinks that no-one NE=of.it
a acheté.
has bought.
#'Max doesn't say to me that Zoé **also** bought milk, because he thinks that no-one bought any.'

[7]In particular, under a particular modal semantics of *will*, one could read "the metereologists told us where it will rain" as "the metereologists told us where it is predicted to rain", which allows for the existential presupposition of *where* to project to the matrix level, even when the prediction is wrong.

embedded interrogatives do not pattern in the same way, and in fact, pattern in opposite ways. This result differs from the general pattern observed with responsive predicates, which we present in the next section.

5. Presupposition projection from responsive attitude predicates

The standard view on presupposition projection from the scope of attitude predicates is based on the seminal works by Karttunen (1974) and Heim (1992). Specifically, when a predicate embeds a presupposition trigger, the presupposition of the embedded clause gets filtered to the attitude holder beliefs, or additionally to the common ground, in the case of factive predicates. Building on this line of work, Uegaki (2021) proposes the following generalization about presupposition projection from under attitude responsive predicates.

(25) **Generalization about responsive predicates (Uegaki 2021):**
Presuppositions project from embedded declaratives in the same way that the existential presupposition does from embedded interrogatives, and presupposition triggers embedded therein.

This generalization is based on examples like (26) and (27). Under factive predicates such as *know*, the factive presupposition as well as any other presupposition of the embedded clause (e.g., the uniqueness presupposition triggered by the definite article in (26)) project both into the beliefs of the attitude holder and the speaker. This is the case whether the predicate embeds a declarative, as in (26a), or an interrogative, as in (26b) (examples adapted from Uegaki 2021).

(26) a. Max knows that the unicorn danced.
Presupposes: There is a unique unicorn & it danced & Max believes that there is a unique unicorn.
b. Max knows who caught the unicorn.
Presupposes: There is a unique unicorn & someone caught it & Max believes that there is a unique unicorn.

Under non-veridical predicates, embedded presuppositions project into the beliefs of the attitude holder, and not into the speaker's beliefs, as illustrated in (27). Again, presuppositions project the same way with embedded declaratives (27a) and embedded interrogatives (27b) (examples adapted from Uegaki 2021).

(27) a. Max is certain that the unicorn danced.
Presupposes: Max believes there is a unique unicorn & it is compatible with Max's beliefs that it danced.
b. Max is certain (about) who caught the unicorn.
Presupposes: Max believes that there is a unique unicorn.

In this paper, we have shown that *say* does not fit into this generalization, because presuppositions do not project the same way from embedded declaratives and embedded interrogatives. Specifically, when *say* embeds a declarative, the presuppositions are anchored to the presented beliefs of the attitude holder. When it embeds an interrogative, the presuppositions project to the speaker's beliefs. One may be inclined to conclude that *say* behaves similarly to *be certain* when it embeds declaratives and similarly to *know* when it embeds interrogatives. However, there are several differences between these predicates worth keeping in mind. First, just like *tell* and unlike *know*, *say* is not veridical when it embeds a question (see Tsohatzidis 1993, 1997, Uegaki 2015, on *tell* and Spector and Egré 2015), as shown below for French *dire* and English *say*.

(28) a. Zoé m'a dit qui elle a vu dans le brouillard. Mais il s'est avéré
Zoe me=has said who she has seen in the fog but it REFL=is turn.out
qu'elle s'est trompée.
that-she REFL=is mistaken
'Zoe said to me whom she saw in the fog. But it turned out that she was mistaken.'

b. Zoé sait qui elle a vu dans le brouillard. #Mais il s'avère
Zoe knows who she has seen in the fog but it REFL=turn.out
qu'elle se trompe.
that-she REFL is.mistaken
'Zoe knows who she saw in the fog. #But it turns out that she is mistaken.'

Second, when presuppositions project from the scope of *say*, they are not anchored to the attitude holder's actual beliefs, but to their presented beliefs, i.e., the reported common ground according to their goals. Therefore, an analysis of *say* based on the assumption that *say* behaves similarly to *be certain* when it embeds declaratives and similarly to *know* when it embeds interrogatives is not desirable.
The next section introduces our proposal for *say* which takes into account these differences with responsive attitude predicates and captures the peculiar projection behavior of *say*.

6. Analysis

Our analysis needs to capture the following: a) the at-issue content of a proposition embedded under *say*, be it a declarative or an answer to an interrogative, is evaluated at the attitude holder's presented beliefs; b) the presuppositions of an embedded declarative project into the attitude holder's presented beliefs; c) the presuppositions of an embedded interrogative project into the common ground, and not the attitude holder's presented beliefs.

We propose that the surprising projection behavior of presuppositions under *say* follows from *say*'s underlying c-selectional restrictions: it can select for declarative CPs, but not for interrogative CPs, at least not directly. We propose that apparent interrogative embedding under *say* is in fact DP embedding, where there is a silent definite noun phrase 'the answer to'. Furthermore, we argue that presuppositions project differently from CPs and DPs from *say* and across predicates, based on arguments from the literature and new empirical observations. We then propose a novel analysis of this difference in projection that assigns to the *that* complementizer the burden of redefining definedness conditions, which, we claim, captures the facts across attitude predicates, and challenges the Karttunen-Heim generalization of a uniform projection pattern to the attitude holder's beliefs. In contrast, since the attitude predicates themselves are not specified for any special projection behavior, the presuppositions of a DP complement project to the matrix level, and not the attitude holder's.

6.1. *Say*'s core semantics: evaluating the prejacent to the presented beliefs

Our first desideratum for the semantics of *say* is to capture the projection behavior of presuppositions embedded in declaratives into the attitude holder's 'presented beliefs', instead of the attitude holder's real beliefs, as is standardly assumed for attitude predicates.

When an agent *says* something, that something is generally a proposal by an apparently truthful speaker to add it to the beliefs of the hearer. This uttered proposition often ends up in the actual common ground (actual shared beliefs between speaker and addressee), but it need not: the speaker may be deceitful and utter a proposition they believe to be false but want the hearer to believe, or the hearer may not accept the proposition into their beliefs. What is common across these situations is that the speaker wants the hearer to add the uttered proposition to what the hearer believes is the common ground. We encode this property in the semantics of *say*, following Anand and Hacquard (2014) on assertive predicates, by requiring the prejacent proposition to hold in the worlds of the 'reported common ground' (CG_R) according to the goals of the attitude holder, that is 'in the worlds of the context set that match the goals of the discourse move event' (Anand and Hacquard 2014: p.77).

(29) $[\![\text{say}]\!] = \lambda p.\lambda e.say(e) \wedge \forall w' \in Goal(e)[CG_R(w') \subseteq p]$

We call the 'reported common ground according to the goals of the attitude holder' the attitude holder's 'presented beliefs', following the terminology from Section 3.

6.2. Projection from declaratives vs. interrogatives: Wrong results with Uegaki's procedure

We show that a standard approach to handling presupposition filtering, coupled with composition path proposed by Uegaki (2021) to capture presupposition projection for responsive predicates, does not produce the right result.

In the Karttunen-Heim tradition (Karttunen 1974; Heim 1992), attitude verbs provide their own definedness conditions, where the presuppositions of the embedded declarative are generally to be evaluated at the attitude holder's beliefs. We can propose something similar for *say*, where it is defined if the presuppositions of the proposition it selects are satisfied in the attitude holder's presented beliefs, as shown below.

(30) $[\![\text{say}]\!](p)(e)$ is defined if $\forall w' \in Goal(e)[CG_R(w') \subseteq \pi(p)]$

These definedness conditions capture the empirical distribution from Section 3: if the attitude holder is truthful, their actual beliefs are a subset of their presented beliefs, and therefore the presuppositions of the prejacent must hold in the attitude holder's actual belief worlds. If the attitude holder is lying, then the presuppositions project not into their actual beliefs, but into their fake beliefs, those they want their addressee to believe are their actual beliefs.

As discussed in Section 5, according to Uegaki's generalization, we should expect presuppositions from interrogatives embedded under *say* to behave like those from declaratives. And indeed, from a semantic point of view, there is nothing obvious that should block that type of behavior: *say wh-* could easily be a speech report of saying the answer to a *wh-* question that belongs to the speaker's presented beliefs. Here we show that if we follow Uegaki's procedure, based on Spector and Egré (2015), to derive the definedness conditions of interrogatives embedded under a responsive predicate, this is what we wrongly obtain.

(31) The lexical rule generating question-embedding predicates (Uegaki 2021):
$V_{int}(Q,x,w)$
a. true iff $\exists w'[V_{decl}(\textsc{Exh}_Q(\textsc{Ans}_{w'}(Q)))(x)(w)$ is defined $\wedge V_{decl}(\textsc{Ans}_{w'}(Q))(x)(w)]$

b. defined iff $\exists w'[V_{decl}(\text{EXH}_Q(\text{ANS}_{w'}(Q)))(x)(w)]$ is defined

Where:

(32) a. $\text{ANS}_w := \lambda Q : \exists p \in Q[p = \text{MAX}_{inf}(Q,w)].\text{MAX}_{inf}(Q,w)$ (Dayal 1996)
b. $\text{MAX}_{inf}(Q,w) := p$ iff $w \in p \wedge \forall q \in Q[w \in q \rightarrow p \subseteq q]$
c. $\text{EXH}_Q(p) := \lambda w.[\text{ANS}_w(Q) = p]$ (Spector and Egré 2015)

ANS carries the presupposition that there is a maximally informative true answer in the set of propositions it combines with, and picks out such a maximally informative true answer. EXH ensures that that answer is strongly exhaustive.

Since *say* appears to be a responsive predicate, i.e., it is able to embed declaratives and interrogatives, we can use the rule in (31) to derive interrogative semantics for *say* from the semantics we proposed for declarative-embedding *say* in the previous section. We apply the rule for definedness in (31b) for *say* (adapting it to match our event semantics for *say*).

(33) a. $say_{int}(Q)(e)$ defined iff $\exists w'[say_{decl}(\text{EXH}_Q(\text{ANS}_{w'}(Q)))(e)]$ is defined
b. $\exists w'[say_{decl}(\text{EXH}_Q(\text{ANS}_{w'}(Q)))(e)]$ is defined iff
$\exists w'.\forall w \in Goal(e)[CG_R(w) \subseteq \pi(\text{EXH}_Q(\text{ANS}_{w'}(Q)))]$ (from (30))

We get that *x say Q* is defined iff the presuppositions of the (strongly exhaustive) answer to *Q* are in *x*'s presented set. This derives what Uegaki's generalization suggests, i.e., that the presuppositions of the question should project in the same way as the presupposition of the declarative. But it is not what we actually observe in the data, where it appears that presuppositions from embedded interrogatives project to the matrix level, and not the attitude holder's.

6.3. Solution: *say* can't select for questions, only DPs embedding questions

Our proposal for matrix projection of interrogatives will rely on the stipulation that *say* cannot select for interrogatives directly. Instead, it can embed DPs (as can be seen with overt examples in (35) and (36)), which allows for apparent question embedding via a silent question-embedding noun, forming a definite DP of the type 'the answer to', as shown in (34).

(34) Max said <*the answer to*> who came.

This proposal is largely a stipulation.[8] It can find support in similar proposals in the literature that argue for a silent DP layer in some instances of declarative clausal complementation (Moulton 2009; Kastner 2015; Özyıldız 2017; Bochnak and Hanink 2022; Bondarenko 2020, 2022); this proposal would be an interrogative version of this type of theory. Furthermore, these cited works argue that the presence of a DP layer affects semantic properties of clausal embedding. For instance, when looking at a variety of declarative CPs, Kastner (2015) argues that the complements of factive attitudes have a definite DP-like behavior, while complements of non-factives don't necessarily. This leads him to propose that while sometimes similar on the surface, these factive and non-factive complements come in different sizes, where factive complements come with an overt or covert D head that merges with the CP complement, and

[8] In future work, we hope to derive this property in a principled way. Indeed, if *say*'s projection facts hold across languages, this should be a desideratum for the theory. Furthermore, if this selectional restriction is indeed present for *say* cross-linguistically, it begs the question: are other responsive predicates also underlyingly responsive? If not, can we capture the projection behavior differently?

carries a presupposition that the prejacent refers to a discourse referent in the common ground. Work on factivity alternations of predicates which have factive and non-factive uses argues that they are dependent on complement type (with varying proposals for the actual mechanism): English (Moulton 2009), Washo (Hanink and Bochnak 2017), Turkish (Özyıldız 2017), Barguzin Buryat (Bondarenko 2020).

In this context, one could say that *say* exhibits alternation, not in its factivity (i.e. whether the prejacent needs to be satisfied at the matrix evaluation world), but in its presupposition projection behavior (i.e. whether the prejacent's presuppositions are satisfied at the matrix evaluation world). The explanation will be of a similar tone as the ones given for factivity alternative, namely where differences in projection behavior do come not from the semantics of the attitude itself, but as a result of complement type.

In most of this literature, it is only implicitly assumed that presuppositions of the definite DP must project to the matrix level, despite this property being central to some of these proposals. Here, we provide actual evidence to back this assumption, by presenting data with overt DPs embedded under *say*. We can show that the presuppositions of these DPs project to the matrix level, in (35)–(36)— data is given for French, replicated for English in the translations.

(35) *Zoé thinks that Jean has a dog (he doesn't); she tells me this.*

a. #Elle m' a dit le nom du chien de Jean.
she 1SG AUX said the name of.the dog of Jean
#'She said the name of Jean's dog.' $\rightsquigarrow$ *Jean has a dog.*

b. Elle m' a dit que le nom du chien de Jean est Paul.
she 1SG AUX said that the name of.the dog of Jean is Paul
'She said that the name of Jean's dog is Paul.' $\not\rightsquigarrow$ *Jean has a dog.*

(36) *Zoé hears that Jean asks her if Max is married, and she answers. But she misheard, Jean didn't ask anything, he just stated that Max is married.*

a. #Elle a dit la réponse à la question de Jean.
she AUX said the answer to the question of jean
#'She said the answer to Jean's question.' $\rightsquigarrow$ *There is a question by Jean.*

b. Elle a dit que la réponse à la question de Jean est oui.
she AUX said that the answer to the question of Jean is yes
'She said that the answer to J.'s question is yes.' $\not\rightsquigarrow$ *There is a question by Jean.*

Furthermore, we show that this pattern can also be found under *believe* and *explain*.

(37) a. *John thinks it rained, but it didn't.*
#He believed the fact that it rained. $\rightsquigarrow$ *(There is a fact that) it rained.*

b. *Mary asked whether it rained. John thought she claimed that it rained.*
??John believed the claim that it rained. $\rightsquigarrow$ *There is a claim that it rained.*

c. *Sue thinks that France has two capitals.*
(i) Sue thinks that both capitals of France were destroyed.
(ii) Sue explained that both capitals of France were destroyed.
(iii) ??Sue explained the destruction of both capitals of France.

This data shows that the presuppositions of DP complements project to the matrix level, differently than those of CP complements, which as we saw project to the attitude holder's presented beliefs, in the case of *say*, and their actual beliefs for non-communication attitudes. While a contrast between declaratives and interrogatives would be surprising in light of the typology captured by Uegaki's generalization, a contrast between CPs and DPs is not, as we show here.

6.4. Compositional analysis

Next, we give a compositional analysis that derives the contrast in projection behavior between CP and DP embedding, which can be summarized below.

(38) a. $[\![\text{say CP}]\!](e)$ is defined iff $\forall w' \in Goal(e)[CG_R(w') \subseteq \pi([\![\text{CP}]\!])]$
 b. $[\![\text{say DP}]\!](e)$ is defined iff $\pi([\![\text{DP}]\!])$ is true

As reflected in (38), we base our analysis in an event-based framework where attitudes do not select a proposition, but can only combine with one if it type-shifts into a predicate of contentful individuals (Moltmann 1989; Kratzer 2006; Moulton 2009; Elliott 2016, 2020: a.o.). Specifically, we will adopt the framework proposed by Elliott (2016, 2020), where events and individuals are entities, of the same semantic type *e*, and attitudes, like other verbs, are predicates of events/entities. An event x, in this framework, can have propositional content $\textsc{Cont}(x)$.

In order to combine with an attitude predicate, a proposition must first type-shift to a predicate of (contentful) entities. Predicate modification can then apply. We propose that *say* itself does not provide new definedness conditions; instead, the operator responsible for the proposition-to-entity type-shift also introduces new definedness conditions, which make the presuppositions of declaratives project to the set of worlds associated with the contentful event, rather than the speaker's beliefs. Thus, if the content of the event is true in all the presented beliefs, then the presuppositions must also be. This captures what happens when *say* embeds declaratives.

As for interrogatives, we assume that questions cannot count as content as they are non-propositional, therefore no type-shifting operator is available to allow them to combine with attitudes. Instead, they must combine with content nouns that embed questions, such as *answer*, as argued in Section 6.3. These then combine through a DP layer as a complement to *say*. These elements do not affect the definedness conditions, which results in matrix projection.

6.4.1. *Say* as a predicate of contentful entities

We modify the semantics of *say* proposed by Anand and Hacquard (2014), in (29), into a predicate of events, to fit Elliott's framework.[9]

(39) $[\![\text{say}]\!] = \lambda e_e.say(e) \wedge \forall w' \in Goal(e)[CG_R(w') \subseteq \textsc{Cont}(e)]$

Note that this lexical entry is only defined when the content of *e* is propositional. However, it is conceivable that one can say something non-propositional, e.g. 'say a name'. So speakable content has a wider range than, for instance, thinkable content, which arguably can only be propositional. For the sake of simplicity, we restrict our attention to saying events with propositional content; refining it to reflect the general use of *say* is beyond our current scope.

[9]This semantics should be intensional. We ignore the world arguments on predicates for the sake of clarity, as they don't play a role in our derivations.

6.4.2. Declarative embedding

We assume a covert type-shifter F_{cont} (as in Hanink and Bochnak 2017; Elliott 2020; Bochnak and Hanink 2022), which selects for propositions (sets of worlds, of type *st*) to predicates of (contentful) entities, of type *et*.

(40) $[\![F_{cont}]\!] = \lambda p_{st}.\lambda e_e.\textsc{Cont}(e) = p$

Our lexical entry for *say* in (39) cannot directly compose with propositions. However, it can compose via Predicate Modification with a proposition that has previously combined with the type-shifter F_{cont}, which results in a predicate of contentful entities.

(41) a. $[\![F_{cont}]\!]([\![\text{that the box fell}]\!]) = \lambda e.\textsc{Cont}(e) = \{w : \text{the box fell in } w\}$
b. $[\![\text{say } F_{cont} \text{ that the box fell}]\!] = \lambda e.say(e) \wedge \forall w' \in Goal(e)[CG_R(w') \subseteq \textsc{Cont}(e)$
$\wedge \textsc{Cont}(e) = \{w : \text{the box fell in } w\}]$

The denotation of F_{cont} on its own does not say anything about definedness conditions. By default, we might assume that it is a hole, and that a type-shifted proposition is defined whenever the presuppositions of its prejacent are true in the world of evaluation. We propose instead that the presuppositions of the prejacent must only be met at those worlds supplied by the content entity, as in (42).

(42) $[\![F_{cont}]\!] = \lambda p_{st}.\lambda e_e.\textsc{Cont}(e) = p$ defined iff $\textsc{Cont}(e) \subseteq \pi(p)$

We further propose that *say* does not introduce its own definedness conditions. We obtain the desired result in (43). The presuppositions of the prejacent of *say* must be satisfied, as dictated by F_{cont}, in the worlds provided by the content of the event, which must itself be satisfied in the presented belief worlds, as dictated by the semantics of *say*.

(43) $[\![\text{say } F_{cont} \text{ p}]\!] = \lambda e.say(e) \wedge \textsc{Cont}(e) = p \wedge \forall w' \in Goal(e)[CG_R(w') \subseteq \textsc{Cont}(e)]$
defined iff $\textsc{Cont}(e) \subseteq \pi(p) \Rightarrow$ defined iff $\forall w' \in Goal(e)[CG_R(w') \subseteq \pi(p)]$

An advantage of this proposal is that it makes correct predictions for doxastic attitude verbs. If we take F_{cont} to be responsible for declarative embedding in general, and attitudes to be underspecified for definedness conditions, we predict that the presuppositions of the declarative are evaluated at the same set of worlds in which the prejacent itself is evaluated. This is what we observe, at least, for belief predicates: *believe* asserts that its prejacent is true at all belief worlds, and is defined when the presuppositions of the prejacent are true in those belief worlds.

(44) $[\![\text{believe } F_{cont} \text{ p}]\!] = \lambda e.believe(e) \wedge Bel(e) \subseteq \textsc{Cont}(e) \wedge \textsc{Cont}(e) = p$
defined iff $\textsc{Cont}(e) \subseteq \pi(p) \Rightarrow$ defined iff $Bel(e) \subseteq \pi(p)$

In the Karttunen-Heim conception, presuppositions from non-communication attitude verbs, including of belief and desire, project to the attitude holder's beliefs. In our system, the predictions are more nuanced and dependent on the specific semantics of the attitude. We leave testing the predictions of our system across attitude predicates for further investigation.

6.4.3. Interrogative embedding through DPs

We now show how we obtain matrix projection when *say* combines with interrogatives via a content noun. Following Elliott (2016, 2020), we take content DPs to be definite descriptions of content entities. In particular, *answer* is a content noun, that we define as a function taking a question and returning a property of entities whose content is the maximally true answer to Q (essentially integrating Dayal's answerhood operator into the semantics of 'answer').

(45) a. $[\![\text{the answer to Q}]\!]^w = \iota x[\textsc{Cont}(x) = \textsc{Max}_{inf}(Q,w)]$
b. defined iff $\exists!x.\textsc{Cont}(x) = \textsc{Max}_{inf}(Q,w)$
c. defined iff Q is defined

The word *answer* does not redefine definedness conditions, and thus the presuppositions of $[\![\text{the answer to Q}]\!]$ are the same as those of $[\![\text{Q}]\!]$. Now we see what happens when it further composes. The type of a definite content DP like (45a) allows it to combine with *say* via function application, with the result shown in (46).

(46) (first attempt) $[\![\text{say the answer to Q}]\!]^w = say(\iota x_e[\textsc{Cont}(x) = \textsc{Max}_{inf}(Q,w)]) \wedge \forall w' \in Goal(\iota x[\textsc{Cont}(x) = \textsc{Max}_{inf}(Q,w)])[CG_R(w') \subseteq \iota x[\textsc{Cont}(x) = \textsc{Max}_{inf}(Q,w)]]$

However, this composition is problematic because the attitude holder, which later enters the derivation as a predicate of events, cannot compose with this expression. We follow Elliott (2016) in assuming that the content DPs can only compose with a verb via a thematic argument head F_{int}, whose semantics (here for *say*) is as follows in (47a). It first composes with *say*, creating a thematic argument slot, which then can compose with the DP.

(47) a. $[\![F_{int}]\!] = \lambda f_{et}.\lambda x_e.\lambda e_e.[\textsc{Cont}(e) = \textsc{Cont}(x)] \wedge f(e)$
b. $[\![F_{int}\ \text{say}]\!] = \lambda x.\lambda e.[\textsc{Cont}(e) = \textsc{Cont}(x)] \wedge say(e) \wedge \forall w' \in Goal(e)[CG_R(w') \subseteq \textsc{Cont}(e)]$
c. $[\![[F_{int}\ \text{say}]\ \text{the answer to Q}]\!]^w =$
$\lambda e.[\textsc{Cont}(e) = \textsc{Cont}(\iota x[\textsc{Cont}(x) = \textsc{Max}_{inf}(Q,w)])]$
$\wedge\, say(e) \wedge \forall w' \in Goal(e)[CG_R(w') \subseteq \textsc{Cont}(e)]$

The presuppositions of 'the answer to Q' project all the way up. As we defined it, *say* does not redefine definedness conditions, nor does F_{int}, therefore 'say the answer to Q' is defined whenever Q is defined. In contrast, there is no requirement for the presuppositions to be satisfied in the attitude holder's presented beliefs. Finally, while the presuppositions of the embedded interrogative must project to the matrix level, the answer need not be true in the matrix evaluation world, as has been observed in the literature (Tsohatzidis 1993; Spector and Egré 2015). It simply predicts the answer must be true in the presented beliefs of the attitude holder.

One may be skeptical of the seemingly ad hoc difference between F_{int} and F_{cont} in how presuppositions are filtered. However, one can argue that it is not arbitrary: the projection properties of F_{cont} follow from a standard universal projection rule for presuppositions in the scope of a universal quantifier (Heim 1983). We can rewrite F_{cont} as a universal quantifier as in (48).

(48) $F_{cont} = \lambda p.\lambda e.\forall w \in \textsc{Cont}(e).p(w)$ defined iff $\forall w \in \textsc{Cont}(e).\pi(p)(w)$

However, we cannot apply the same projection rule for F_{int}, because the nuclear scope of the universal quantification, $\textsc{Cont}(x)$, is not itself an argument of F_{int}, which means that its presuppositions would be undefined if we extended the rule to this case. Thus, any presupposition filtering rule for F_{int} would be stipulative.[10]

[10]Another solution would be to embed this analysis in a framework of clausal embedding that does not need F_{int}, such as the one proposed by Kratzer (2006) and Moulton (2009), where *say* is a transitive predicate, selecting both for a contentful individual and an event (which in such a framework are of different types).

7. Conclusion

This paper provides a novel characterization of presupposition projection from the scope of *say*, which has received little attention in the literature. It reveals on the one hand that presuppositions from declaratives are filtered to the attitude holder's presented beliefs, i.e., the reported common ground according to the attitude holder's goals (following the characterization by Anand and Hacquard 2014). On the other hand, presuppositions from interrogatives project to the speaker's beliefs, and not necessarily to the attitude holder's beliefs. This contrast in projection behavior between declaratives and interrogatives is unexpected given a generalization proposed by Uegaki (2021), according to which presuppositions embedded under responsive predicates project into the same set of worlds regardless of complement type.

We propose to explain away this apparent exception to the generalization by arguing that interrogative complements can combine with *say* only through a definite description containing a question embedding content noun such as 'answer'. Now, the difference in presupposition projection is no longer unexpected from a typological point of view. We show data with overt definite DPs that reveals this presupposition projection behavior, which corrobates observations and claims made in the literature showing that the presuppositions associated with DP complements project to the matrix level. In particular, this has been argued to underlie factivity inferences for predicates exhibiting factivity alternations, as well as a more general observation that factive and non-factive predicates combine with different types of complements, where the former takes CP embedding DPs, headed by a silent definite D head.

We propose an analysis where *say*, like other attitudes, is a predicate of contentful entities. It combines with propositions via a type-shifter that turns propositions into predicates of contentful entities, and is defined whenever the presuppositions of the propositions are true in the worlds associated with the contentful entity. This makes presuppositions of embedded declaratives project to the worlds at which the prejacent is evaluated. For *say*, this is the presented beliefs. In contrast, when *say* combines with a DP, the presuppositions of the DP project to the matrix level, because *say* does not provide any non-default definedness conditions, and the word *answer* doesn't either. This analysis has wider-ranging consequences on the theory of presupposition filtering. We depart from the traditional Karttunen-Heim conception that presuppositions from under attitudes project to the attitude holder's beliefs, except for verbs of saying, which are noted by Karttunen to be plugs, without receiving much further attention. Instead, presuppositions must project to the set of worlds at which the embedded proposition is evaluated: the attitude holder's beliefs for doxastic predicates, the attitude holder's presented beliefs for verbs of saying, and, possibly, so on.

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Comparing contextual shifts in partial/total predication and plural non-maximality[1]

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Abstract. We investigate a potential analogy between the varying quantificational strength of partial/total predicates and plural predication. Using the predicates *wet* and *dry* as a case study, we ask whether partial/total adjectives show a property characteristic of plurals, namely homogeneity effects. As far as part quantification is concerned, these predicates do exhibit homogeneity. But for degree quantification, a new contrast emerges between partial and total predicates: only partial predicates show homogeneity.

Keywords: partial/total predicates, homogeneity, non-maximality, vagueness and imprecision, exhaustivity

1. Introduction

In many adjectival antonym pairs, one predicate tends to get a weaker interpretation than the other. We refer to the predicates whose preferred interpretation is weak/existential as PARTIAL and to those whose preferred interpretation is strong/universal as TOTAL (Yoon 1996, Krifka 1996, Gajewski 2005, a.o.). This paper presents a case study of this contrast focusing on the antonym pair *wet* and *dry*; the former is partial (weak out of the blue) while the latter is total (strong out of the blue):

(1)	a.	The table is wet.	PARTIAL predicate
		≈ 'Some part of the table is wet to some degree.'	WEAK construal
	b.	The table is dry.	TOTAL predicate
		≈ 'No part of the table is wet to any degree.'	STRONG construal

As highlighted by the paraphrases in (1), there are two dimensions along which *wet* is weaker than *dry*. The first is what we call the MEREOLOGICAL dimension. The observation is that in (1) *wet* means that *some part* of the table is wet, while *dry* means that *all parts* are dry (see e.g. Yoon 1996, Krifka 1996). The second dimension is what we call the DEPTH dimension. The observation is that in (1a), the wet parts of the table only have to be wet to *some* extent (they could be anywhere from moist to covered in a thick layer of liquid), while in (1b), *dry* requires the dry parts to be just about fully dry (see e.g. Kennedy and McNally 2005, Kennedy 2007).

It has been observed that the weak or strong semantics of at least some partial predicates is not purely lexical; it can be overridden by context (see e.g. Krifka 1996, Kennedy and McNally 2005, Kennedy 2007). Such contextual shifts in meaning have quite naturally been compared with NON-MAXIMALITY, a form of contextual weakness in plural predication (see e.g. Krifka 1996, Yoon 1996, Burnett 2017, Feinmann 2020, Amiraz 2020). Indeed, definite plurals stan-

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dardly have universal quantificational force, but in certain contexts, they can be interpreted much more weakly. We will elaborate on these contexts in due time.

(2) The children sang.
  a. out of the blue: 'All or almost all of the children sang.'
  b. in certain contexts: 'Some of the children sang.'

However, most previous work investigating this analogy (e.g., Krifka 1996, Gajewski 2005, Burnett 2017) does not look at the mereological and depth dimensions separately, and does not investigate whether partial/total predicates show other hallmarks of plural predication (except for Feinmann 2020, 2022 and Amiraz 2020, which we discuss later). In particular, plural predication is known to show HOMOGENEITY effects, whereby positive sentences display universal quantification in their truth conditions, negative sentences display negated existential quantification, and both positive and negative sentences are UNDEFINED rather than FALSE in non-homogeneous cases (e.g., Fodor 1970, Löbner 2000, Schwarzschild 1994, Križ 2015):

(3) a. $[\![\text{The children sang}]\!] = \begin{cases} \text{1, if all of the children sang;} \\ \text{0, if none of the children sang;} \\ \text{\#, otherwise (for our purposes: some but not all sang)} \end{cases}$

  b. $[\![\text{The children didn't sing}]\!] = \begin{cases} \text{1, if none of the children sang;} \\ \text{0, if all of the children sang;} \\ \text{\#, otherwise} \end{cases}$

Therefore, our research question is whether both dimensions of the partial/total contrast involve the same kind of context-dependency as plural predication. We will show that, in the mereological dimension, the behavior of partial/total predicates is indeed analogous with plurals. However, in the depth dimension, the analogy holds only for partial predicates (*wet*, but not *dry*). Specifically, certain contexts bring out homogeneity effects (read: undefinedness for non-homogeneous cases) for *wet*, but *dry* resists such undefinedness. The fact that, on the depth dimension, total but not partial predicates refuse a truth-value gap constitutes a new empirical claim about the partial/total distinction.

This paper is organized as follows. In section 2, we motivate the existence of the mereological and depth dimensions, and then show that the partial/total contrast is context-dependent. We also show why it is initially tempting to understand this along the same lines as the context-dependency observed with plurals. In section 3, we show that on the mereological dimension, total and partial predicates pattern with plural predication, and sketch a unified account of both phenomena within the alternative-based framework of Križ and Spector (2021). However, in section 4, we show that this account cannot be extended to the depth dimension; it would work for partial predicates, but not total ones, because the latter resist truth-value gaps. In section 5, we provide some additional motivation for this newfound contrast between partial and total predicates, namely that they interact differently with the phrase *in a certain sense*. Section 6 concludes; an appendix elaborates on why this contrast between *wet* and *dry* is also a challenge for another recent theory of homogeneity, namely the exhaustivity account by Bar-Lev (2021).

2. Some observations on dimensions and context-dependency

In this section, we first motivate empirically the distinction between the mereological and depth dimensions among partial/total predicates; they cannot be reduced to a single holistic scale. Then, we show that in both dimensions the varying strength of partial/total predicates is context-dependent, rather than lexical. Finally, we make an analogy between the behaviour of these predicates and plurals; the analogy suggests that the varying strength of such predication (singular and plural) has a common cause.

We have already described partial and total predicates like *wet* and *dry* as differing in strength along two dimensions, the mereological and depth dimensions.[2] The distinction between these two dimensions is well motivated empirically. First, the dimensions can be targeted separately by proportional quantifiers like *half* (see Kennedy and McNally 2005). Indeed, for *wet/dry*, such quantifiers can target either the amount of surface covered by liquid, as in (4a), or the degree of wetness of each subatomic part, as in (4b).

(4) The table is half wet. ✓MEREOLOGICAL, ✓DEPTH
 a. MEREOLOGICAL CONSTRUAL: 'Half the table is wet; the rest is dry.'
 b. DEPTH CONSTRUAL: 'All of the table has a (uniform) degree of wetness halfway along the wetness scale.'

The dimensions can also be isolated in various ways. For example, pseudopartitives cannot quantify along the depth dimension (5a). Moreover, some partial/total pairs like *open/closed* lack the mereological dimension entirely (5b).

(5) a. Half of the table is wet. ✓MEREOLOGICAL, *DEPTH
 b. (i) The window is half open. *MEREOLOGICAL, ✓DEPTH
 (ii) #Half of the window is open. *MEREOLOGICAL, *DEPTH

We therefore assume that these dimensions are not reducible to a single scale.

In both dimensions, the weak–strong contrast between partial and total predicates is not purely lexical. In some contexts *wet* shifts to a strong interpretation, and *dry* shift to a weak one. We see this in (6), where *dry* and *not wet* mean 'not fully wet' rather than 'not wet at all.'

(6) SCENARIO: *A beached whale needs to be kept as wet as possible to survive, but*
 a. MEREOLOGICAL: *... some of its body parts are dry.*
 b. DEPTH: *... its entire skin is no longer maximally wet.*
 The whale is not wet. / The whale is dry. TRUE in (6a) and (6b)

This contextual shift holds regardless of whether the scenario is set up to target the mereological dimension (6a) or the depth dimension (6b).

The shift in the strength of *wet* and *dry* occurs due to differences in the conversational goal, modelled through a QUESTION UNDER DISCUSSION (QUD). The predicate *wet* is strong, and *dry* weak, if the conversational goal targets the distinction between 'maximally wet' and 'not

[2] See e.g. Kennedy and McNally 2005 on dimensions. The degree semantics literature has drawn attention to another sense in which predicates can be 'multidimensional' (e.g., Sassoon 2013). Indeed, a predicate may be sensitive to an open-ended set of many different scales that is determined by non-linguistic knowledge. For instance, the semantics of *healthy* and *sick* arguably involves distinct scales for many different aspects of physical and mental health. We will not be concerned with such predicates in this paper.

maximally wet'—rather than the distinction between 'maximally dry' and 'not maximally dry.' In (6), the conversational goal is to keep the whale maximally wet; all parts should be wet, and the wet parts should be wet to the highest degree. Thus, what matters is the distinction between full wetness and non-full wetness.

This raises the question, of course, of why *wet* and *dry* have different construals out of the blue. After all, out of the blue, the QUD is not clear; how do speakers know which strength to assign to these adjectives, and why do speakers seem to agree that *wet* is weak and *dry* is strong? Presumably, even when the sentences are presented without context, speakers accommodate a QUD for which the difference between 'fully dry' and 'not fully dry' is what matters, because in most everyday contexts, one wants things to be dry. Consider again our original example (1), repeated in (7). This is an out-of-the-blue sentence about a table; one very naturally assumes that the goal would be for the table to be fully dry. Since this accommodated QUD leads to the relevant distinction being whether the table is fully dry or not fully dry, any degree of wetness counts as 'wet'; so *dry* is strong and *wet* is weak in this case.

(7) a. The table is wet. $\approx$ 'Some part of the table is wet to some degree.'
b. The table is dry. $\approx$ 'No part of the table is wet to any degree.'

As such, we take the weak and strong meanings of 'partial' and 'total' predicates to be the result of particular QUDs. This means that the terms 'partial' and 'total' are misleading. Still, we will keep using them as labels for the adjectival antonyms based on the meanings each adjective has out of the blue.

The QUD-dependency of these predicates has a parallel elsewhere in language, namely in the quantificational force of plural predication (e.g., Krifka 1996, Malamud 2012, Križ 2015). In positive sentences, plurals typically receive a universal interpretation out of the blue (8a). Unsurprisingly, one also observes universal quantification in contexts where what matters is whether the predicate is true of all relevant individuals or just some of them (8b).

(8) a. [*out of the blue*] The children sang.
$\approx$ 'All of the children sang.'
b. SCENARIO: *All the children under discussion will be tested on their singing.*
A: Are the children practicing?
B: Yes, the children are singing.
$\approx$ 'All of the children are singing.'

But certain contexts can lead to weaker meanings for plurals, including existential ones; this has been called 'non-maximality.'[3]

(9) NON-MAXIMALITY
A: Did you sleep well last night?
B: Alas, the children sang all night.
$\approx$ 'At least some of the children sang.'

Given the context in (9), B's answer is felicitous if only three out of ten children sang, for example; the truth conditions are existential. Intuitively, this is because in (9), it does not

[3]The term 'non-maximality' is sometimes used to refer to 'near-universal' construals that involve a small handful of exceptions. In this paper, we focus exclusively on the instances of non-maximality that are outright existential.

matter for B's sleep whether all or only some of the children sang.

The fact that the QUD mediates whether plural predication is interpreted as universal (8b) or existential (9) constitutes an empirical parallel between plurals and partial/total predicates. Another such parallel is that, when partial adjectives are predicated of pluralities, they tend to receive a non-maximal interpretation out of the blue in addition to being weak at the atomic level (10a), in contrast to total predicates (10b) (e.g., Krifka 1996, Yoon 1996).

(10) a. The tables are wet. $\approx$ 'At least some of the tables are at least partly wet.'
b. The tables are dry. $\approx$ 'All of the tables are entirely dry.'

As such, one might want a single explanation for when plurals and partial/total predicates are weak or strong. To see how seriously the parallel should be taken, we now turn to another property of plural predication, namely homogeneity—the lack of truth value (in many discourse contexts) in situations where a predicate holds of some but not all members of a plurality. We will show that, from the perspective of homogeneity, partial/total predicates behave like plurals in the mereological dimension, but diverge from plurals in the depth dimension.

3. The mereological dimension: partial/total predicates pattern with plurals

In this section, we show that partial/total predicates display a homogeneity effect (truth-value gap) in the mereological dimension. We then show how Križ and Spector's (2021) theory of homogeneity and non-maximality, made for plurals, can be extended to account for it. The empirical contrasts we will find between total predicates and plurals (sections 4 and 5) do not hinge on a particular theory, however, and we will discuss an alternative theory in appendix A.

3.1. Homogeneity effects in the mereological dimension

Following recent work (Križ 2015, Bar-Lev 2021, Feinmann 2020, Križ and Spector 2021), we take non-maximality to have a common source with homogeneity. A common argument for collapsing non-maximality and homogeneity is that they both disappear with *all*:

(11) All the children sang.
$\Rightarrow$ no homogeneity: the sentence is simply false in a non-homogeneous situation
$\Rightarrow$ no non-maximality: the sentence is only true/felicitous if every child sang

If the varying strength of partial/total predicates has the same underlying cause as the varying strength and truth-value gaps observed with plurals, then partial/total predicates should also show truth-value gaps in the right environment. Whatever generates undefinedness in plural predication would also, in the right circumstances, generate it for partial/total predicates.[4]

We address this prediction for the mereological dimension in this section,[5] turning to the depth dimension in section 4. The mereological dimension is more akin to plurals than the depth

[4]This prediction could be avoided on Feinmann's (2020) proposal that partial/total predicates underlyingly give rise to truth-value gaps, which are not intuited due to a second form of context-dependency. But as shown below and in Feinmann 2022, truth-value gaps with partial/total predicates *are* in fact intuited in the right contexts.
[5]See Löbner 2000, Spector 2013, Križ 2015, and Amiraz 2020 on other predicates that do not come in partial/total pairs but have a mereological dimension and show homogeneity.

dimension, as it makes reference to material parts rather than to degrees. Thus, naively, it is the one where we most expect to find correspondences between partial/total and plural predication.

To see if the prediction holds, let's begin by identifying a type of scenario that reliably gives rise to homogeneity effects in plural predication. One possibility is to set up a QUD where it matters exactly which parts of the plurality satisfy the predicate, as in (12):

(12) SCENARIO: *A and B need to varnish ten tables. For each table, A must spray it with water, and then B can start varnishing it. At present, half of the tables are wet.*
B: How are the tables looking? A: #They're wet / not wet yet.

The crucial property of the scenario in (12) is that the implicit QUD is *which tables* can be varnished; thus, for each individual table x, the proposition that x is wet is relevant.

Turning now to subatomic parts, we likewise need a scenario where, for several subatomic parts x of the individual that *wet* applies to, the proposition that x is wet is relevant (and likewise for *dry*). Two contexts of this kind, modelled on (12), are given in (13). Scenario (13b) is somewhat more 'plural-like' as it makes a finite number of discrete subparts of the table relevant.

(13) a. SCENARIO 1: *A and B need to varnish a huge table. A must spray it with water; once some part of it is wet, B can varnish that part. At present, half the table is wet.*
b. SCENARIO 2: *A and B need to varnish a huge table that consists of four sections. They have decided that A will spray each section with water and, as soon as A is done with a section, B will varnish that section. At present, two of the sections are completely wet; the other two are completely dry.*

B: How is the table looking?
A: #It's wet / not wet (yet).
A′: #It's dry / not dry (anymore).

As expected on the prediction described above, both *wet* and *dry* show homogeneity effects in both scenarios.

3.2. An account of homogeneity in the mereological dimension

Given the observation of homogeneity with partial/total predicates, we now introduce Križ and Spector's (2021) account of plural homogeneity (12) and extend it to the subatomic case (13).

For Križ and Spector (2021), definite plural sentences introduce alternatives that quantify existentially over different sets of subpluralities. For concreteness, we take their system to generate a set of alternatives as the semantic value of a sentence (at least if the sentence involves a plural) (15). Each alternative means that in a certain upward-closed set[6] of subpluralities of the tables, at least one individual (whether an atom or a sum) satisfies the starred predicate ***wet** (14), i.e., at least one individual in the set consists of atomic parts all of which are wet.

(14) $^*\mathbf{wet}_w(x) = 1$ iff $\forall y[y \leq x \wedge y \text{ is atomic} \rightarrow \mathbf{wet}_w(y)]$

(15) $[\![\text{The tables are wet}]\!]^w = \{\lambda w'.\exists x[U(x) \wedge {}^*\mathbf{wet}_{w'}(x)]$
$: U$ is a nonempty upward-closed subset of $\{y : {}^*\mathbf{table}_w(y)\}\}$

[6]An upward-closed subset of a set R is a set $U \subseteq R$ such that for any $x, y \in R$, if $x \in U$ and $x \leq y$, then $y \in U$.

The truth conditions in a given discourse context arise from the conjunction of the subset of these alternatives that are STRONGLY RELEVANT. Alternatives are strongly relevant iff they identify the same set of worlds as a given subset of the partition cells of the QUD:

(16) **Strong relevance:** Given a partition Q, an alternative p is STRONGLY RELEVANT if there is a nonempty subset $R \subset Q$ of partition cells such that $p = \bigcup R$.

The falsity conditions of a sentence with multiple strongly relevant alternatives are derived analogously, by conjoining the falsity conditions of the strongly relevant alternatives:

(17) Given a sentence ϕ containing a plural and a QUD Q:
  a. ϕ is TRUE in w w.r.t. Q iff $\forall p \in [\![\phi]\!]^w[p$ strongly relevant to $Q \rightarrow p(w) = 1]$
  b. ϕ is FALSE in w w.r.t. Q iff $\forall p \in [\![\phi]\!]^w[p$ strongly relevant to $Q \rightarrow p(w) = 0]$

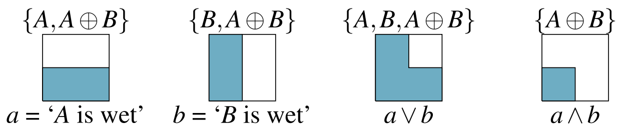
When some but not all strongly relevant alternatives are true, the sentence lacks a truth-value.

Let's first see how this works in an out-of-the-blue context for plural predication with *wet*. Assume that $[\![\text{the tables}]\!]^w = A \oplus B$, so that $\{y : {}^*\mathbf{table}_w(y)\} = \{A, B, A \oplus B\}$.

(18) [*out of the blue*] The tables are wet.

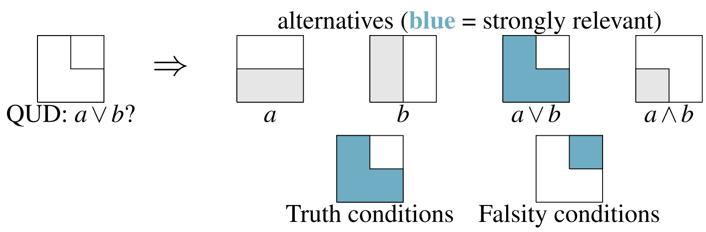
For each subset there is an alternative of (18), which says that *some* element of the subset satisfies ***wet**. This is shown in (19), with the subsets above the squares and the corresponding alternatives below. Given that *wet* is distributive, 'A or $A \oplus B$ is wet' is equivalent to 'A is wet.'

(19)



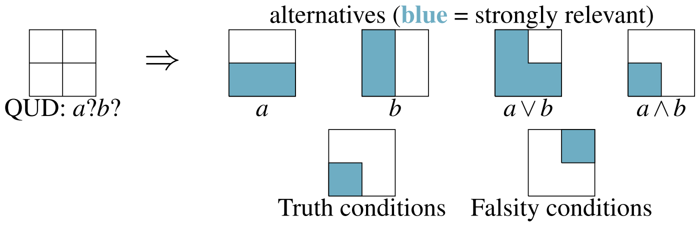
Which of these alternatives are strongly relevant (and therefore end up being conjoined) in a given context? Assuming that in an out-of-the-blue context, we tend to be interested in whether all the tables under discussion are dry, a natural QUD is 'Is any table wet?'. Given this QUD, the only strongly relevant alternative is the existential:

(20)



Since there is only one strongly relevant alternative, it ends up as the meaning of the sentence. Thus, (18) has an existential construal and no homogeneity effect with this particular QUD. On the other hand, in a context like (12), where the implicit QUD is 'For each table x, is x wet?,' there are now multiple strongly relevant alternatives about different subsets of the tables:

(21)



The truth/falsity conditions of the sentence in this context are obtained by conjoining the truth/falsity conditions of all the alternatives. This leads to a universal construal in positive sentences, and to a homogeneity effect: if only some of the tables are wet, (18) is neither true nor false, since only some of its strongly relevant alternatives are true.

Let us now return to singular predication with *wet/dry* and the homogeneity effect in (13), to see how it can be captured on Križ and Spector's approach. First, we need a working lexical entry for partial/total predicates; for now, we focus on *wet* and put aside the depth dimension. In (22), we encode the alternative-triggering nature of *wet* (necessary for Križ and Spector's approach) in its lexical entry.

(22) a. $[\![\text{wet}]\!]^w = \lambda y.\{\lambda w'.\exists x[U(x) \wedge \textbf{wet}^{\forall}_{w'}(x)] : U \text{ is an upward-closed subset of } \{x : x \leq y\}\}$

b. $\textbf{wet}^{\forall}_{w}(x) = 1$ iff every relevant part of x is wet in w

Given this lexical entry, when *wet* composes with a singular argument, the resulting phrase's alternatives arise compositionally from functional application:

(23) $[\![\text{The table is wet}]\!]^w =$
$\{\lambda w'.\exists x[U(x) \wedge \textbf{wet}^{\forall}_{w'}(x)] : U \text{ is an upward-closed subset of } \{x : x \leq [\![\text{the table}]\!]^w\}\}$

With this alternative set, we can obtain contextual shifts between weak and strong interpretations in the mereological dimension. The weak construal of *wet* out of the blue is due to an existential QUD (there is no lexical asymmetry between *wet* and *dry*):

(24) [*out of the blue*] The table is wet.
⇒ QUD: 'Does any part of the table need to be dried?'/'Is any part of the table wet?'

Given this QUD, only the weak alternative in (25) (where the domain of ∃ contains all parts of the table, rather than all parts of a particular part of the table) is strongly relevant.

(25) $\lambda w'.\exists x[U(x) \wedge \textbf{wet}^{\forall}_{w'}(x)]$, where $U = \{y : y \leq [\![\text{the table}]\!]^w\}$

The other alternatives are too informative to be strongly relevant, because they do not exactly correspond to any cell, or set of cells, in the partition of worlds induced by the QUD. Thus, given that there is only one strongly relevant alternative and it is existential, we obtain existential truth conditions with no truth-value gap. (24) is correctly predicted to be true rather than undefined if the table is partly wet and partly dry.

Next, let's consider scenario (13), about which we suggested that the QUD is something like 'Which parts of the table are wet?'. Given this QUD, for any set U of parts of the table, the proposition that some part in U is wet is strongly relevant. In other words, all of the alternatives in (23) are strongly relevant. The truth/falsity conditions are therefore derived by conjoining the truth/falsity conditions of all these alternatives, with the following result:

(26) a. *The table is wet* is TRUE in w iff $\textbf{wet}^{\forall}_{w}([\![\text{the table}]\!]^{w})$
b. *The table is wet* is FALSE in w iff $\neg\exists x[x \leq [\![\text{the table}]\!]^{w} \wedge \textbf{wet}^{\forall}_{w}(x)]$

Križ and Spector's framework also makes it possible to derive strong truth conditions without homogeneity, as in the stranded-whale scenario (6). There, the QUD does not distinguish between the whale being partly wet and not wet at all, so the universal alternative (27) is the only strongly relevant one. Therefore, it alone determines the truth and falsity conditions.

(27) $\lambda w'.\exists x[U(x) \wedge \textbf{wet}^{\forall}_{w'}(x)]$, where $U = \{[\![\text{the whale}]\!]^{w}\}$

Since U is a singleton containing the part of the whale corresponding to the entire whale, and given the universal meaning of the constant $\textbf{wet}^{\forall}_{w}$, this means that the whale is entirely wet.

In sum, Križ and Spector's framework can be extended to account for the context-dependency of *wet*/*dry* in the mereological dimension, correctly predicting homogeneity effects when they are observed.

4. The depth dimension: total and partial predicates diverge

We have seen that the context-dependency of *wet*/*dry* in the mereological dimension patterns with non-maximality in plural predication. We now turn to the variable strength of these predicates on the depth dimension. Both scenarios in (28) control for part-quantification, but *wet*/*dry* are still interpreted as having variable strength as a result of the QUD. Indeed, in (28a), the salient QUD is 'Is the whale maximally wet?,' and *not wet* and *dry* are interpreted as meaning 'not maximally wet'; but in (28b), the salient QUD is 'Is the shirt wet to any (noticeable) degree?,' and these predicates mean 'not wet to any degree.'

(28) a. SCENARIO: *A beached whale needs to be kept as wet as possible to survive, but its entire skin is no longer maximally wet, just slightly moist.*
The whale is not wet./The whale is dry. TRUE
b. SCENARIO: *A T-shirt is drying and is still slightly moist throughout, so it should not be worn yet.*
#The T-shirt is not wet./The T-shirt is dry. NOT TRUE

This lends plausibility to the idea that the depth dimension involves the same mechanism determining relative strength as in the mereological dimension and plural non-maximality.

In this section, we address a prediction of this idea: given the right QUD, the depth dimension of partial/total predicates should give rise to homogeneity effects. We begin by discussing *wet* on the depth dimension and showing it displays homogeneity. Then, we show how Križ and Spector's approach can explain these data. Finally, we turn to *dry* to contrast it with *wet*. In particular, *dry* does not have a homogeneity effect on the depth dimension.[7]

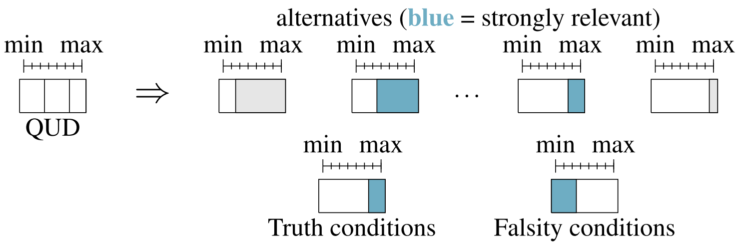
[7] Kennedy (2007) makes a related claim: in the unidimensional partial/total pair *open*/*closed*, *open* is context-dependent while *closed* is not. In contrast, our claim is that in the bidimensional pair *wet* and *dry*, both predicates are context-dependent; what they differ in is that only the partial *wet* displays homogeneity in both dimensions. Kennedy's claim is compatible with ours, since we are discussing predicates with different dimensions.

4.1. *wet* shows homogeneity on the depth dimension

Križ and Spector's theory generates a homogeneity effect whenever more than one alternative is strongly relevant. If it is correct to extend this theory to the depth dimension, homogeneity effects are predicted to be observable when the QUD makes multiple thresholds on a scale relevant. That is, if the QUD partitions the wetness scale into more than two intervals, *wet* should be neither true nor false if its argument has a degree of wetness in neither the lowest nor the highest interval. In (29), we provide a scenario of exactly this kind; the intervals and the predicted homogeneity effect are illustrated in (30).

(29) SCENARIO: *A special fan uses a wet filter to cool the air. If the filter is wet at 80–100% capacity, the fan works well. If it's at 30–80% wetness, the fan will still cool the room somewhat but noticeably less so. If it's under 30%, the fan switches off. B is not in the room cooled by the fan and only has epistemic access to the state of the fan.*
A: How cool is the room?
B: The filter is wet. (≈ it's 80–100% wet)
B′: The filter is not wet. (≈ it's 0–30% wet)

(30) Prediction of the homogeneity approach for *The filter is wet* in scenario (29)



As it turns out, (29) behaves exactly as predicted by extending Križ and Spector's approach to the depth dimension: the degree scale is partitioned into the three intervals [0%, 30%), [30%, 80%) and [80%, 100%], and neither of the answers in (29) is true if the filter is wet to a degree in the intermediate interval. Thus, with the right scenario, we observe a homogeneity effect in the depth dimension.[8]

A natural question arising at this point is whether this effect is specific to *wet* or more general. The latter is suggested by the work of Feinmann (2022) on homogeneity effects induced by the partial predicate *open*. This predicate lacks a mereological dimension, so any homogeneity effect occurs in the depth dimension. Feinmann notes that in scenario (31), neither a positive nor a negative sentence with *open* is straightforwardly true.

[8]Compared to the mereological dimension, it is harder to elicit a clear homogeneity effect in the depth dimension. Consider (i), a variant of our table-varnishing scenario (13a). The amount of varnish must match the amount of water, so the exact degree of wetness should matter for B's purposes; (i) makes every degree of wetness relevant.

(i) SCENARIO: *A and B need to varnish a table. A must spray it with water and B with varnish in equal amounts. A has added half of the water it will need in total.*
B: How is the table looking?
A: a: #It's dry / not wet.
b. It's wet / not dry.

One expects all the sentences in (i) to be infelicitous, contrary to fact. Perhaps scenario (i) gives rise to an existential QUD ('Can I work on the table?'); but why this happens only in the depth dimension is unclear.

(31) SCENARIO: *A horse is trying to get through a door opened at an angle of 15°. We wonder whether the horse will make it through the door without touching the frame.*
#The door is open. / #The door is not open. (adapted from Feinmann 2022)

We suggest that the reason for this effect might be that the scenario implicitly makes three intervals on the openness scale salient. At the extremes are the interval where the door is so closed that the horse cannot pass, and the interval where it is so open that it can pass without touching the frame. In between is an interval where the door is open enough that the horse is able to pass through by nudging it open. 15° falls in this intermediate interval, and for this reason leads to undefinedness, much like with *wet* in (29).

4.2. Extending Križ and Spector's framework to degree predication

We now turn to the formal details of extending Križ and Spector's (2021) theory to the depth dimension. A degree scale for wetness is defined in (32):

(32) **Wetness scale** $S_{wet} = (D_{wet}, \leq_{wet}, F_{wet})$ where:
a. D_{wet} is the set of degrees of wetness;
b. $\leq_{wet}$ is a linear ordering on D_{wet}, which we assume to have a maximum ('completely wet') and a minimum ('not wet at all');
c. F_{wet} is a measure function mapping a world w and individual x to a degree in D_{wet}.

Recall that we are modelling the mereological and depth dimensions as two aspects of a single lexical meaning of *wet*/*dry*, rather than distinct readings. The alternatives introduced by *wet*/*dry* must therefore vary along both dimensions. Simplifying somewhat, each alternative of *wet* should say that the argument must have a relevant part that is wet at least to a certain degree d, while each alternative of *dry* says the argument must have a relevant part that is wet at most to a certain degree d.[9] We formalize this by taking each alternative to depend on two parameters: an upward-closed set U of relevant parts of its arguments, and a parameter that determines how the wetness scale is partitioned. We model the latter parameter as a PARTITION FUNCTION—a mapping from scalar orderings to partitions into intervals, as defined in (33a). (33b) defines the equivalence relation of being in the same partition class.

(33) a. A PARTITION FUNCTION P maps any scale $(D, \leq, F)$ to a partition of D into at least two sets that are convex[10] with regard to $\leq$.
b. Given a partition function P and a scale S, we write $d \sim_{P(S)} d'$ iff d and d' are in the same cell of $P(S)$.

Each of the alternatives for *wet* in (34a) is based on an upward-closed set U of parts of the individual argument and a partition function P, and says that there is a part in the set U whose degree of wetness is in the same partition class as the scale maximum according to P.[11] Similarly, each of the alternatives for *dry* in (34b) requires its argument to have a part in the set U whose degree of wetness is in the same partition class as the scale minimum given P.

[9]The definitions to be given in the main text will also permit intervals that do not contain the threshold d.
[10]A set S is convex relative to an ordering if, whenever $x, z \in S$, so is any y ordered in between x and z.
[11]This approach makes analogous the alternatives introduced for the depth and mereological dimensions; the alternatives for the mereological dimensions involve convex sets too, because every upward-closed set of parts is convex with regard to the parthood relation.

(34) a. $[\![\text{wet}]\!]^w = \lambda x.\{\lambda w.[\exists y \in U.F_{wet}(w,y) \sim_{P(S_{wet})} \max(\leq_{wet})]$
$: U$ is an upward-closed subset of $\{y : y \leq x\} \wedge P$ is a partition function$\}$

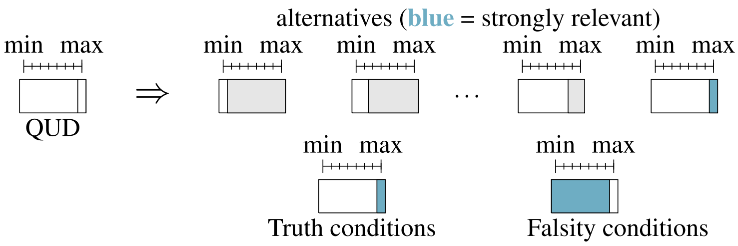
b. $[\![\text{dry}]\!]^w = \lambda x.\{\lambda w.[\exists y \in U.F_{wet}(w,y) \sim_{P(S_{wet})} \min(\leq_{wet})]$
$: U$ is an upward-closed subset of $\{y : y \leq x\} \wedge P$ is a partition function$\}$

(35) a. $[\![\text{The whale is wet}]\!]^w = \{\lambda w'.[\exists y \in U.F_{wet}(w',y) \sim_{P(S_{wet})} \max(\leq_{wet})]$
$: U$ is an upward-closed subset of $\{y : y \leq [\![\text{the whale}]\!]^w\}$
$\wedge P$ is a partition function$\}$

b. $[\![\text{The whale is dry}]\!]^w = \{\lambda w'.[\exists y \in U.F_{wet}(w',y) \sim_{P(S_{wet})} \min(\leq_{wet})]$
$: U$ is an upward-closed subset of $\{y : y \leq [\![\text{the whale}]\!]^w\}$
$\wedge P$ is a partition function$\}$

Consider first the predictions of this system for the contrast between the homogeneity-less scenarios in (28a) and (28b). Since these scenarios stipulate that all relevant parts of the individual in question are wet to the same degree, we may simplify things by ignoring variation between alternatives along the mereological dimension, and pretend that each partition of the wetness scale corresponds to a unique alternative. The alternatives of *The whale is wet*, given this simplification, are schematized in (36). Each alternative requires the whale's degree of wetness to be in some interval containing the scale maximum. But given the QUD 'Is the whale maximally wet?,' only the strongest alternative, which requires the whale to be wet to the maximum degree, is strongly relevant. As such, it alone determines the truth and falsity conditions.

(36) Truth and falsity conditions given the QUD 'Is the whale maximally wet?'



In contrast, if the QUD is 'Is the T-shirt wet to some degree?,' the only strongly relevant alternative is the one that puts all degrees except for the scale minimum in the same partition class.

The crucial property of the fan scenario in (29) that sets it apart from these contexts, then, is that two different thresholds on the wetness scale—30% and 80%—are relevant for the salient QUD. As a consequence, there are two strongly relevant alternatives:

(37) Strongly relevant alternatives for *The filter is wet*:
a. $\lambda w'.[F_{wet}(w', [\![\text{the filter}]\!]^w) \geq 30\%]$
b. $\lambda w'.[F_{wet}(w', [\![\text{the filter}]\!]^w) \geq 80\%]$

The predicted truth conditions of the sentence correspond to the conjunction of these alternatives, which is equivalent to the stronger alternative in (37b). The falsity conditions correspond to the conjunction of their negations, which is equivalent to the negation of the weaker alternative in (37a). In sum, the system successfully generates the truth-value gap shown in (30).

4.3. *dry* does not show homogeneity on the depth dimension

What we have seen so far is that on the depth dimension, the partial predicate *wet* shows a homogeneity effect, as expected on the extension of Križ and Spector's approach to homogeneity to the depth dimension. We now turn to the central empirical contribution of this paper, which is to observe that the total adjective *dry* does *not* display a homogeneity effect—even in the exact same scenario. Indeed, our fan scenario gives rise to a non-homogeneous interpretation of *dry*. In (38), the scenario and B/B′ are repeated from (29).

(38) SCENARIO: *A special fan uses a wet filter to cool the air. If the filter is wet at 80–100% capacity, the fan works well. If it's at 30–80% wetness, the fan will still cool the room somewhat but noticeably less so. If it's under 30%, the fan switches off. B is not in the room cooled by the fan and only has epistemic access to the state of the fan.*
A: How cool is the room?
B: The filter is wet. (≈ it's 80–100% wet)
B′: The filter is not wet. (≈ it's 0–30% wet)
B″: The filter is dry. (≈ it's 0–30% wet)
B‴: The filter is not dry. (≈ it's 30–100% wet)

The salient interpretation of *The filter is not dry* in this scenario is that the filter's degree of wetness is 'not in the lowest interval,' rather than in the highest interval. If the filter is, say, 50% wet, the sentence is straightforwardly true (although underinformative). This is unexpected given that there are two strongly relevant alternatives:

(39) Strongly relevant alternatives for *The filter is dry*:
a. $\lambda w'.[F_{wet}(w', [\![\text{the filter}]\!]^{w}) < 30\%]$
b. $\lambda w'.[F_{wet}(w', [\![\text{the filter}]\!]^{w}) < 80\%]$

In sum, an asymmetry between *wet* and *dry* emerges once we control for any effects of the mereological dimension and generate a context in which the QUD is sensitive to multiple degree thresholds. Whereas the behavior of *wet* closely follows the predictions of theories relating non-maximality to homogeneity, this is not the case for *dry*.

As with *wet*, the question arises whether this effect is specific to the lexical item *dry* or reflects a broader generalization. Again, the discussion of *open*/*closed* by Feinmann (2022) provides a point of comparison. Our judgment is that in Feinmann's scenario, *closed* targets the lowest of the three partition classes without a homogeneity gap. If so, the total predicate *closed* patterns with *dry* in being insensitive to the intermediate partition class.[12]

(40) SCENARIO: *A horse is trying to get through a door opened at an angle of 15°. We wonder whether the horse will make it through the door without touching the frame.*
The door is not closed. / #The door is closed. (adapted from Feinmann 2022)

This suggests that the asymmetry is not a lexical idiosyncrasy of the predicates *wet* and *dry*, but reflects a general contrast between partial and total predicates.

[12] There are some scenarios in which even *closed* exhibits a truth-value gap—for instance, in some contexts, a door open at an angle of just 2° might count as neither *closed* nor *not closed*. However, these cases always involve degrees that are very close to the scale minimum (i.e., full closure).

5. Elaborating on the new contrast between total and partial predicates

The fact that we find an asymmetry between *wet* and *dry* even in this very controlled setting casts doubt on the idea that the perceived partial/total asymmetries all reduce to non-semantic facts about QUDs. Reducing the partial/total asymmetry to the QUD seems correct for the mereological dimension, but not for the depth dimension. On the latter, both *wet* and *dry* are context-dependent (recall the beached-whale scenario (6), where *dry* shifts to meaning 'not maximally wet' on the depth dimension), but their context-dependency is apparently not the same, since only *wet* has a homogeneity effect. On Križ and Spector's approach, this means that *wet* introduces alternatives that vary both in the choice of the relevant parts and the way the scale is partitioned, but the alternatives of *dry* vary only along the mereological dimension.

In this section, we first give additional empirical motivation for a general difference between *wet* and *dry* as part of a general observation that there are at least two kinds of context-dependency in language, then suggest a way to make sense of this distinction.

5.1. 'In a certain sense': motivation for two types of context-dependency

As noted by Lewis (1970), context-dependency can often be targeted by shifters like *in a certain sense*. This is shown in (41a) for standards of comparison and in (41b) for polysemy.

(41) a. SCENARIO: *John is tall compared to the general population, but not compared to the other people on his sports team.*
John is tall, but in a certain sense he isn't.
b. SCENARIO: *Anne was born and raised in France, but is no longer a French citizen.*
Anne is French, but in a certain sense she isn't.

In both cases, there is a particular construal of *tall* or *French* that makes the first conjunct maximally relevant to the QUD, but *in a certain sense* allows us to shift to a different construal for the second conjunct. This shift saves the sentences in (41) from being contradictions.

Not all context-dependent phenomena can shift via *in a certain sense*, however. This includes non-maximality. While the sentence in (42) could have a coherent reading involving two distinct senses of *singing*, it cannot mean that some but not all of the children are singing (see Križ 2015 and Feinmann 2020 for related observations).

(42) SCENARIO: *Some of the children are clearly singing. The others are not doing anything comparable to singing.*
#The children are singing, but in a certain sense they aren't.

If the context-dependency of *wet* and *dry* patterns with plural non-maximality, such predicates should not be shiftable via *in a certain sense*. But in fact, on the depth dimension, they differ: *wet* patterns with plural non-maximality (42), while *dry* patterns with *tall* and *French* (41):

(43) a. SCENARIO: *A T-shirt counts as wet (throughout), but is not maximally wet.*
#The T-shirt is wet, but in a certain sense it isn't.
b. SCENARIO: *A T-shirt counts as dry (throughout) for present purposes but is slightly moist.*
The T-shirt is dry, but in a certain sense it isn't.

In sum, the depth dimension of *wet* has two non-trivial properties in common with plural predication and the mereological dimension: it is susceptible to homogeneity effects in certain contexts, and it is insensitive to shifters like *in a certain sense*. But the depth dimension of *dry* does not pattern with *wet* or plurals on either of these diagnostics.

5.2. Two different types of context dependency

Apparently, there are (at least) two ways that the values of contextual parameters can be determined (cf. Križ and Spector 2021: section 3.5). The first, call it ALTERNATIVE-BASED VALUATION, is involved in plural predication; this is valuation through the conjunction of sentential alternatives varying in the value of a given contextual parameter. All such alternatives that are 'strongly relevant' to the QUD are conjoined, resulting in the context-dependent truth conditions (Križ and Spector 2021). The second, call it PRAGMATIC VALUATION, involves accommodating a particular value for a given parameter without the presence of alternatives. Indeed, it is standard to view certain context-dependent values (such as values of domain-restriction variables, or standards of comparison for predicates like *tall*) as being fed directly to the interpretation module rather than being computed semantically through a set of alternatives.

In light of this, we suggest that *wet* and *dry* contrast on the depth dimension because the former involves alternative-based valuation, while the latter involves pragmatic valuation. The lexical entry of *wet* introduces alternatives that vary in the choice of a partition function (44a), while *dry* is sensitive to a contextually provided partition function provided as a parameter P of the semantic interpretation function (44b).

(44) a. $[\![\text{wet}]\!]^w = \lambda x.\{\lambda w.[\exists y \in U.F_{wet}(w,y) \sim_{P(S_{wet})} \max(\leq_{wet})]$
$: U$ is an upward-closed subset of $\{y : y \leq x\} \wedge P$ is a partition function$\}$
b. $[\![\text{dry}]\!]^{w,P} = \lambda x.\{\lambda w.[\exists y \in U.F_{wet}(w,y) \sim_{P(S_{wet})} \min(\leq_{wet})]$
$: U$ is an upward-closed subset of $\{y : y \leq x\}\}$

Of course, (44b) still introduces alternatives, but these vary along the mereological dimension only. The alternatives in (44b) do not vary in the partition functions, while those in (44a) do.

If the partition-function parameter of *dry* is selected pragmatically rather than being derived from alternatives, why does the QUD still influence the interpretation of *dry*, as in the beached-whale example (6b)? This effect might come about indirectly. When interpreting an utterance of *The whale is dry*, the listener will assume that the speaker is following the Gricean cooperative principle, in particular the maxim of Relevance (Grice 1975). They will therefore accommodate a value for the partition-function parameter P in (44) under which the sentence communicates a proposition relevant to the QUD. If the QUD is 'Is the whale maximally wet?,' a partition of the wetness scale that puts maximal and non-maximal degrees of wetness into the same partition class would give rise to a construal that is irrelevant to this question. Therefore, P is chosen in such a way that the partition of the wetness scale distinguishes between maximal and non-maximal degrees.

Of course, encoding the distinction between *wet* and *dry* in the lexicon, as in (44), is a stipulation that does not predict that partial/total predicates as a class behave like *wet* and *dry*. If we are right in thinking that they do, a less lexical account is needed; we leave this for future work.

6. Conclusion

In this paper, we have considered whether the varying strength of partial/total predicates (based on the case study of *wet* and *dry*), in both the mereological and depth dimensions, should be derived through the same mechanism as the varying strength of plural predication. With plurals, the standard in recent work has been to take homogeneity and non-maximality to have a common cause; analyzing weak construals for partial/total predicates as due to the same mechanism as plural non-maximality therefore predicts that homogeneity effects should be observed with partial/total predicates too, just like with plurals. We showed that, in looking for homogeneity with such predicates, a novel contrast between partial and total adjectives surfaces: on the depth dimension, while the partial *wet* displays homogeneity, the total *dry* does not. We tentatively suggested to capture this contrast by positing an alternatives-based context-dependency for the mereological dimension and the depth dimension of the partial predicate *wet* (à la Križ and Spector 2021), in contrast to the depth dimension of the total predicate *dry*, where context-dependency is captured through parameter valuation.

A. Considering an exhaustification-based alternative to Križ and Spector (2021)

We end this paper by discussing a less stipulative approach to the *wet/dry* contrast. The basic idea is to define *dry* as the negation of *wet*, and to take advantage of Bar-Lev's (2021) theory of homogeneity and non-maximality, where negated expressions, by design, do not show non-maximality. This would capture the contrast between *wet* and *dry*. Does this approach work?

Let's start with a brief overview of Bar-Lev's theory. He assigns an existential basic meaning to definite plurals and attributes the universal default construal in (45) to the strengthening operator Exh (e.g., Bar-Lev and Fox 2020). For (45), the alternatives Exh operates over are generated by narrowing the domain of children (45b). In particular, for every child x, the proposition that x sang is an alternative.

(45) $[_\beta$ Exh $[_\alpha$ the children sang$]]$
  a. Basic meaning of α: $\approx$ 'Some of the children in the domain D sang.'
  b. Alternatives of α: $\approx$ 'Some of the children in the domain D' sang.' (for every $D' \subseteq D$)
  $\approx$ 'All the children in the domain D sang.'

While Exh standardly negates alternatives, Bar-Lev (2021) argues that this does not happen in (45) because none of the alternatives in (45b) is 'innocently excludable' (Bar-Lev and Fox 2020), i.e., there is no overlap between the sets of alternatives that can be excluded while remaining consistent with (45a). Under his assumptions, alternatives that are not innocently excluded are 'included,' i.e., asserted to be true jointly with the prejacent (if this does not lead to inconsistency). The default interpretation is therefore the conjunction of all the alternatives, which amounts to the universal construal in (46):

(46) Meaning of β in (45): $\approx$ 'All the children in the domain D sang.'

Non-maximality obtains if some of the alternatives are not asserted because they are not relevant to the contextual QUD.

Crucially, this QUD-dependent strengthening does not take place in negated plural sentences like (47). The alternatives in (47b) are entailed by the basic meaning in (47a), so that Exh is either absent or has no effect.

(47) $[_\beta$ Exh $[_\alpha$ not [the children sang]]]
  a. Basic meaning of α: $\approx$ 'None of the children in the domain D sang.'
  b. Alternatives of α: $\approx$ 'None of the children in the domain D' sang.' (for every $D' \subseteq D$)

On this approach, the standard form of non-maximality is therefore limited to non-negated plural sentences; any cases of non-maximality in negative sentences must have a different cause.

Paillé (2022) proposes to derive truth-value gaps in plural predication by assuming that Exh affects truth conditions but not falsity conditions (following work by Bassi et al. 2021). If so, since Exh has no effect in negated plural sentences, only non-negated plural sentences would be predicted to show truth-value gaps (see Augurzky et al. 2022 for relevant data). Against this background, it seems appealing to hypothesize that *wet*-predications are like non-negated plural sentences and *dry*-predications are like negated plural sentences, and that this is at the root of the homogeneity asymmetry between *wet* and *dry*. In effect, we could claim that *dry* is syntactically composed of *wet* and negation ('not wet'; see e.g. Büring 2007 and Heim 2008 on such decompositions).

This can explain that *dry* has no homogeneity effect in the depth dimension. But does it successfully derive that *wet* does have one? In a nutshell, no, because the alternatives for *wet* on this analysis will be totally ordered by entailment, and Exh will therefore exclude them rather than including them. To see this, we need to make an assumption about the basic meaning and the alternative set of *wet*. We assume that each alternative says that the degree of wetness is at least in a certain partition class of the contextually salient partition of the scale S_{wet}. For our fan example in (29), where the scale is partitioned into the three intervals in (48a), this gives rise to the two non-trivial alternatives in (48c) for the LF in (48).

(48) [in scenario (29)]: Exh [the filter is wet]
  a. Salient partition $P(S_{wet})$ of the scale: $[0\%, 30\%), [30\%, 80\%), [80\%, 100\%]$
  b. Basic meaning: 'The filter is at least 30% wet.'
  c. Alternatives:
    (i) 'The filter is at least 30% wet.'
    (ii) 'The filter is at least 80% wet.'

This approach therefore makes the LF of *wet*- and *dry*-predications analogous to non-negated and negated plural sentences, respectively—with the expectation of observing homogeneity (and non-maximality) in the former but not the latter. However, it fails to properly strengthen *wet*: the alternative in (48c-ii) can be negated consistently with the prejacent in (48b), and is therefore innocently excludable. Exh, as defined by Bar-Lev and Fox (2020), will assert it to be false rather than true. The predicted behavior of the Exh operator in (48) is the same as in standard scalar implicatures; in scenario (29), *The filter is wet* would mean that the fan's degree of wetness is in the intermediate partition class.[13]

[13] This might be solvable by claiming that the wetness scale is dense, every degree of wetness gives rise to an alternative, and all such alternatives cannot be innocently excluded together because doing so would create incon-

In sum, if both plural and degree predication arise due to Exh, we would expect a principled empirical difference between them due to the different logical relations among the alternatives; they are linearly ordered for degree predication, but not plural predication.

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sistency. But scenarios like (28a), where the interpretation of *wet* is strengthened without a homogeneity effect, suggests that the basic meaning of *wet* can at least sometimes be based on a context-dependent partition of the scale into finitely many classes; it can't be that the wetness scale is dense regardless of context.

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Alternatives are blind to some but not all kinds of context: the view from Hurford Disjunctions[1]

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Abstract. Hurford Disjunctions (HDs) are infelicitous disjunctions in which one disjunct entails the other (Hurford 1974). The infelicity of basic HDs has been successfully modeled by several competing approaches (Schlenker 2009; Meyer 2013; Katzir and Singh 2014; Anvari 2018). As first noticed by Singh (2008) however, HDs involving entailing scalar items like *all* and *some* are subject to an asymmetry: when the weaker scalar item linearly precedes the stronger one, the sentence seems to be rescued from infelicity. This fact is not readily accounted for by standard approaches, which treat the disjuncts in a symmetric fashion. Fox and Spector (2018) and Tomioka (2021) proposed different solutions to that problem and extensions thereof, but at the cost of positing relatively heavy and complex machineries. Here we propose a novel analysis of Singh's asymmetry, based on the familiar process of alternative pruning (Fox and Katzir 2011; Crnič et al. 2015 a.o.). In particular, we claim that exhaustification targeting the weak disjunct operates on a set of formal alternatives that is sensitive to previously uttered material. This leads us to propose a new *dynamic* constraint on alternative pruning, which ensures that the only remaining alternatives to a prejacent *p* are those which could be realistically entertained instead of *p*, *given the eventualities previously and overtly raised by the speaker*. Unlike other approaches, our account derives Singh's asymmetry *via* a direct computation, and not a global principle constraining either the insertion of the exhaustivity operator (Fox and Spector 2018), or the particular shape of the alternative set (Tomioka 2021).

Keywords: Hurford disjunctions, scalar implicatures, contrastive focus, formal alternatives, alternative pruning, relevance, redundancy.

1. Introduction

Hurford Disjunctions (henceforth HD) are disjunctions of the form $p \vee q$ where p entails q or q entails p. Those disjunctions are generally thought to be infelicitous (Hurford 1974). This is known as Hurford's Constraint (henceforth HC) exemplified in (1) below.

(1) # Michelle lives in **Paris** or **France**

Various constraints have been devised to capture those basic HDs: NON-TRIVIALITY (Schlenker 2009), MISMATCHING IMPLICATURES (Meyer 2013, 2015), NON-REDUNDANCY (Katzir and Singh 2014), LOGICAL INTEGRITY (Anvari 2018). Those constraints impose logical restrictions on the two disjuncts w.r.t. each other and/or the context. Yet, Gazdar (1979) noticed that some HDs involving two related scalar items (scalar HDs) appear to be felicitous. This *obviation* of HC is exemplified in (2), with scalemates *or* and *and*. As pointed out by Singh (2008) however, such scalar HDs are subject to an asymmetry. A scalar HD in which the weaker item precedes the stronger one – such as (2) above, or (3a) below – is felicitous, but a

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scalar HD in which the stronger item precedes the weaker one – such as (3b) – is not. We call HDs such as (3a) weak-to-strong, and HDs such as (3b), strong-to-weak.

(2) Jude ate an apricot **or** a banana, or (else) an apricot **and** a banana.

(3) a. Eleanor ate **some** or **all** of the cookies.
b. # Eleanor ate **all** or **some** of the cookies.

The various competing principles modeling HC in the basic case cannot account for this asymmetry, because they remain insensitive to the order of presentation of the disjuncts. Besides, given that the asymmetry seems restricted to disjunctions involving scalar items, it must result from an interplay between scalar implicatures and a specific implementation of HC. In the rest of this paper, we will go over the theories behind scalar implicatures (the grammatical approach in particular), then summarize previous attempts to solve Singh's asymmetry. This will set the stage for our own account and lead us to introduce critical datapoints that will be used to test its empirical adequacy. We will then propose our own take on the issue, which is based on the independently motivated idea of alternative pruning. We will show that our account can explain a variety of (in)felicity patterns attested in more complex instances of scalar HDs, as well as in other kinds of "contrastive" environments. We will conclude by briefly discussing the interaction between our theory and earlier approaches to alternative pruning.

2. Background

2.1. Scalar implicatures in Hurford Disjunctions

Let us first take a step back to review the core theories behind scalar terms and the inferences that seem to be specifically derived from them. Scalar implicatures (SI) are inferences that enrich the literal meaning of a given scalar item with the negation of more informative, relevant alternative(s). The exact nature of SIs has been subject to debate. The so-called Neo-Gricean framework (Horn 1972; Horn 1989; Fauconnier 1975a; Fauconnier 1975b; Gazdar 1979; Levinson 1983; Sauerland 2004 a.o.) posits that scalar implicatures result from pragmatic (Gricean) reasoning, i.e. occur after syntactic processing, at the level of the whole sentence. The grammatical approach to scalar implicatures (Chierchia 2006; Fox and Hackl 2006; Fox 2007; Spector et al. 2008; Chierchia et al. 2012, a.o.) on the other hand, assumes that scalar inferences are entailments which result from the action of a covert operator EXH (for EXHaustification), which is merged at the syntactic level and whose semantics is akin to that of *only* (Rooth 1992; Krifka 1993). More specifically, EXH is a function that takes two arguments: a proposition p (the *prejacent*) and a set of alternatives to that proposition $\mathscr{A}_p$.[2] EXH then returns the conjunction of the prejacent and the grand negation of logically non-weaker alternatives which are Innocently Excludable (IE, Fox 2007). Innocent Excludability is a condition which guarantees that the alternatives that are being negated (1) do not together contradict the prejacent, i.e. are Consistently Excludable (CE)[3] and (2) are selected in a non-arbitrary

[2]It has been traditionally assumed that alternatives where defined using lexically encoded *scales* ordered by entailment (Horn 1972; Gazdar 1979). Focus (Rooth 1992), or the question-under-discussion (Groenendijk and Stokhof 1984) were also argued to be responsible for the generation of alternatives. More recent approaches (Fox and Katzir 2011, building on Katzir 2007) propose a syntactic procedure to compute alternatives, that does not rely on scales.

[3]Cases of contradiction between the prejacent and its SIs happens in so-called *symmetric* configurations (first pointed out by Kroch 1972, and extensively discussed in Fox and Katzir 2011) where the disjunction of a subset

way.[4] Definitions of EXH, IE alternatives, and CE alternatives are given in (4) below. This relatively complex definition will however coincide with the following definition in (5) in many of the examples we will study throughout this paper.

(4) **Exhaustification with Innocent Exclusion**
a. $\text{EXH}(p, \mathscr{A}_p) = p \wedge \bigwedge\{\neg q \mid q \in \mathscr{A}_p \wedge \neg(p \Rightarrow q) \wedge q \in IE(p, \mathscr{A}_p)\}$
b. $\text{IE}(p, \mathscr{A}_p) = \cap\{S \mid CE(S, p, \mathscr{A}_p) \wedge \neg\exists S' \supset S.\, CE(S', p, \mathscr{A}_p)\}$
c. $\text{CE}(S, p, \mathscr{A}_p) \iff S \subseteq \mathscr{A}_p \wedge \bigwedge\{\neg q \mid q \in S\} \wedge p \not\vdash \bot$

(5) **Basic Exhaustification**
$\text{EXH}(p, \mathscr{A}_p) = p \wedge \bigwedge\{\neg q \mid q \in \mathscr{A}_p \wedge \neg(p \Rightarrow q)\}$

Under that view, an occurrence of *some* ($\exists$) as in *Eleanor ate some of the cookies* will be strengthened with the negation of *all* ($\forall$), to yield a *some but not all*-meaning ($\exists \wedge \neg\forall$). Likewise, an occurrence of *or* ($\vee$) as in *Jude ate an apricot or a banana*, will be strengthened with the negation of *and* ($\wedge$), to yield an *exclusive or*-meaning. The key difference between the Neo-Gricean approaches and the grammatical approaches is that the latter, unlike the former, allow for “embedded” SIs, i.e. implicatures targeting a particular subconstituent of the sentence. If inferences that may *seem* local can sometimes be accounted for using carefully defined Neo-Gricean reasoning and alternatives (see e.g. Sauerland 2004), it does not seem to be the case with Gazdar-style Hurford Disjunctions such as (2) or (3a), which *require* embedded exhaustification (targeting the weaker disjunct) in order to be rescued from a violation of HC and to get the right intuitive meaning. This is schematized below.

(2) Jude ate an apricot **or** a banana, or (else) an apricot **and** a banana.
$\text{EXH}(A \vee B, \{A, B, A \wedge B\}) \vee (A \wedge B) = (A \vee B \wedge \neg(A \wedge B)) \vee (A \wedge B)$ HC ✓
$\rightsquigarrow$ Jude ate an apricot **or** a banana but **not both**, or else **both**.

(3) a. Eleanor ate **some** or **all** of the cookies.
$\text{EXH}(\exists, \{\exists, \forall\}) \vee \forall = (\exists \wedge \neg\forall) \vee \forall$ HC ✓
$\rightsquigarrow$ Eleanor ate **some but not all** of the cookies, or **all** of them.

Assuming that HC is real, these datapoints strongly suggest that the grammatical view of scalar implicatures is the best theory to tackle HDs. Yet, without further assumptions, this view predicts that EXH should be equally active in either of the disjuncts. In other words, both weak-to-strong and strong-to-weak HDs should be rescued from a violation of HC, and the contrast between (3a) and (3b) remains to be accounted for. This calls for further constraints on HC, EXH, or the arguments EXH operates on.

of non-weaker alternatives is equivalent to the prejacent – for instance, if the prejacent is $A \vee B$ and its alternatives contain both A and B.

[4] Arbitrariness is also somewhat related to symmetry: given a symmetric set of alternatives to a prejacent, a way to preserve consistency and break the symmetry would be to negate some but not all of these alternatives. For instance, if A and B are alternatives to $A \vee B$, one could either infer $\neg B$ or $\neg A$, without inconsistency. But the choice of which alternative to negate would be arbitrary. The notion of Innocent Exclusion allows to prevent such dilemmas: A and B may be *Consistently Excludable* given $A \vee B$, but crucially are not *Innocently Excludable*.

	Embedded SIs?	Weak-to-strong HD (3a)	Strong-to-weak HD (3b)
Neo-Gricean framework	No	HC ✗	HC ✗
Grammatical approach	Yes	HC ✓	HC ✓

Table 1: A summary of the predictions of the two approaches to SIs regarding basic scalar HDs

2.2. Previous accounts of the asymmetry

Three accounts have been put forward in the past literature to explain the asymmetries in scalar HDs. In this section, we provide a brief summary of those approaches, explain how they solve the main asymmetry, and point out some of their limits. This will allow us to introduce some critical datapoints that we will later use to evaluate the accuracy of our own account.

2.2.1. Singh's solution

The first solution, adopted by Singh (2008), was to impose additional constraints on the process checking the satisfaction of HC (let us call this process HC-checking for short). More specifically, Singh argued that HC-checking should apply incrementally at each point of application of the $\vee$ (*or*) operator, and should verify whether the *necessarily unenriched* right-hand-side disjunct, along with the *potentially enriched* left-hand-side disjunct, do not violate HC. This captures the basic contrast in (3), in the following way. In (3a), the two arguments passed to HC-checking are $\textsc{Exh}(\exists, \mathscr{A}_\exists) = \exists \wedge \neg\forall$ (enriched left-hand-side) and $\forall$ (unenriched right-hand side). Since $\exists \wedge \neg\forall$ and $\forall$ are mutually exclusive, HC is verified. In (3b) on the other hand, the arguments passed to HC-checking are $\forall$ (left-hand side) and $\exists$ (necessarily unenriched right-hand side). Since $\forall \Rightarrow \exists$, HC is violated. Under that line of analysis, the asymmetry between weak-to-strong and strong-to-weak HDs resides in a timing difference in the application of HC-checking *vs* EXH, which seems realistic from a language processing perspective. Singh's theory is also appealing due to its relative simplicity. This account however, is not very explanatory, and runs into problems when a basic HD gets embedded within universal operators,[5] as shown in (6) below (inspired by an example from Fox and Spector 2018).

(6) a. Robert must take **some** or **all** of the medicines.
$\rightsquigarrow$ Robert **must** take **some** of the medicines, and he **may or may not** take **all**.

b. Robert must take **all** or **some** of the medicines.
$\rightsquigarrow$ Robert **must** take **some** of the medicines, and he **may or may not** take **all**.

When both disjuncts of a scalar HD are embedded under a necessity modal, such as *must*, both the weak-to-strong and the strong-to-weak orders seem felicitous, meaning, HC gets *obviated*. This is unexpected under Singh's account, since by default the incremental HC-checking process is not sensitive to the global environment surrounding the disjuncts. Two other cases of apparent obviation of HC that Singh is unable to account for (and that are also discussed by Fox and Spector 2018) involve embedded exhaustification: the case of so-called Distant Entailing Disjuncts (DED), and that of universally-quantified disjuncts. The former, exemplified in (7), is characterized by disjoined scalar items (here, *some* and *all*) that are made "distant" on their scale by a salient alternative (here, *most*).

[5] A crucial point seems to be that the matrix universal operator is itself subject to exhaustification. We will come back to the precise mechanics of EXH in those examples later in the paper.

(7) *Context: if Lucy does **most** of the homework, she will pass the class.*
a. Lucy did **some** or **all** of the homework.
$\rightsquigarrow$ Lucy did **some but not most** or **all** of the homework.
b. Lucy did **all** or **some** of the homework.
$\rightsquigarrow$ Lucy did **all** or **some but not most** of the homework.

The felicity of (7b) is unexpected under Singh's view, because the two arguments passed to HC-checking in that case would be predicted to be the same as in (3b), namely $\forall$ (left-hand side) and $\exists$ (necessarily unenriched right-hand side). Likewise, Singh is unable to predict an obviation of HC when the two disjuncts are universally quantified, as in (8).

(8) *Context: John has been assigned a homework involving two Problems. The speaker is unsure of the conditions under which John will pass this assignment.*
a. John **must** solve Problem 1 **or** Problem 2, or he **must** solve **both**.
$\rightsquigarrow$ John must solve either problem, without the need to solve any specific one.
b. John **must** solve Problem 1 **and** Problem 2, or he **must** solve **either**.
$\rightsquigarrow$ John must solve either problem, without the need to solve any specific one.

More specifically, Singh predicts (8a) to be felicitous, because the exhaustified left-hand-side disjunct, $\text{E}\textsc{xh}(\Box(p_1 \vee p_2)) = \Box(p_1 \vee p_2) \wedge \neg\Box p_1 \wedge \neg\Box p_2$, is contradictory with the right-hand-side disjunct $\Box(p_1 \wedge p_2)$. But (8b) is incorrectly predicted to be infelicitous, because $\Box(p_1 \wedge p_2)$ (left-hand-side) and $\Box(p_1 \vee p_2)$ (unenriched right-hand-side), remain entailing. The attested contrast between (7b) and (3b), and the *absence* of such contrasts in (7) and (8), strongly suggest that the solution to the puzzle of scalar HDs does not solely reside in a refinement of HC as Singh originally suggested, but rather, in a more targeted restriction placed either on EXH or on its arguments ($\mathscr{A}_p$ in particular).

2.2.2. Fox and Spector's solution

The second solution, explored by Fox and Spector (2018) (henceforth FS18), and elaborating on Chierchia et al. (2012), was to impose additional constraints on the operator EXH. To this aim, FS18 posit the existence of an ECONOMY principle restricting EXH-insertion, based on the idea that EXH should *not* be inserted at a given point of a logical expression if it ends up being Incrementally Weakening (henceforth IW).

(9) **ECONOMY constraint based on Incremental Weakening (IW)**

$$\text{E}\textsc{xh} \text{ applied to } p \text{ is IW in context } \Delta \iff \forall\Gamma.\ (\Delta\ p\ \Gamma) \Rightarrow (\Delta\ \text{E}\textsc{xh}(p, \mathscr{A}_p)\ \Gamma) \iff \Delta\ ({}^{*}\text{E}\textsc{xh})(p, \mathscr{A}_p)$$

This constraint states that if applying EXH to a prejacent p, given a left-hand side context Δ, yields a globally weaker or equivalent meaning *for any right-hand side context* Γ, then EXH should not be inserted in the first place. The notion of logical context is clarified in (10) below.

(10) **Logical Contexts**[6]
Given a potentially partial expression U associated to a Logical Form LF_U, and an

expression E corresponding to the interpretation of a subtree of LF_U, we define the context C of E as the function which, applied to E, yields U, and applied to any other element x, yields the interpretation of LF_U where E has been substituted for x.

$$C = \lambda x.\ [\![LF_U[x/E]]\!](x)$$

Where [x/E] designates the syntactic substitution of E by x. C is a left-hand side context (resp. right-hand context) of E given LF_U iff the subtree of LF_U corresponding to E is linearized last (resp. first).

The constraint in (9) can account for the contrast between (3a) and (3b). In (3a), EXH applied to the first disjunct is not IW, because given an arbitrary continuation Γ, $\text{EXH}(\exists, \mathscr{A}_\exists)\ \Gamma = (\exists \wedge \neg\forall)\ \Gamma \not\Leftarrow \exists\ \Gamma$. EXH can thus be inserted within the first disjunct, making the resulting expression HC-compliant. In (3b), EXH applied within the second disjunct is IW, because $\forall \vee \text{EXH}(\exists, \mathscr{A}_\exists) = \forall \vee (\exists \wedge \neg\forall) = \forall \vee \exists$.[7] EXH therefore cannot be inserted and the structure remains HC-violating.

FS18's theory is very powerful and can account for more complex cases of HDs such as embedding under an exhaustified universal (cf. (6)), or Distant Entailing Disjuncts (cf. (7)). It also captures other apparent specificities of EXH, such as its general unavailibity in Downward Entailing environments. But this is achieved at the cost of positing a quite complex ECONOMY principle governing EXH-insertion. As FS18 already acknowledge, this principle requires to perform some abstract comparison on *all possible continuations* of the disjunction, with and without EXH, to eventually decide if EXH is weakening – or not.[8] We will also see in the next section that FS18 might not make the right prediction regarding "Close Bottom-Tier" disjuncts.

2.2.3. Tomioka's solution

Tomioka (2021) proposed a third way to tackle Singh's asymmetry, by devising a constraint on the structure of the alternative set of a *contrasted* expression. This account is based on the novel observation, attributed to Giorgio Magri, that a specific implementation of HC might be active in contrastive environments in general, which include disjunctions, but also conjunctive *but*-statements, as exemplified in (11), and dialogues expressing disagreement, as exemplified in (12). Both examples are taken from Tomioka (2021). From now on, focus-marked elements will be signaled using the $_F$ subscript.

(11) a. Adam$_F$ did **some**$_F$ of the homework, but Bill$_F$ did **all**$_F$ of it.
b. # Adam$_F$ did **all**$_F$ of the homework but Bill$_F$ did **some**$_F$ of it.

(12) a. A: **Some**$_{(F)}$ of Professor Smith's students are smart.
B: I disagree! **All**$_F$ of them are smart.

6 We hope that this definition is true to FS18. We will appeal to it again when presenting our own approach.

7 Note that these equalities still hold if we consider any continuation Γ to the disjunction.

8 A less costly heuristic to achieve a comparable result may be the following, as FS18 mention. Instead of using an arbitrary continuation Γ to compare the informativity of the (un)exhaustified sentences, the listener may just (1) wait for the specific continuation to be uttered by the speaker, (2) judge if this continuation makes EXH IW, and if so, (3) re-compute the meaning of the whole sentence without EXH. If this process appears less abstract, it still implies that the semantic evaluation of a sentence is not a one-pass process.

b. A: **All**$_{(F)}$ of Professor Smith's students are smart.
B: I disagree! #**Some**$_F$ of them are smart.

But-statements crucially differ from HDs in that their conjuncts are generally *not* entailing in the first place, i.e. before the application of any EXH operator. This implies that *but*-statements cannot be HC-violating in the standard sense. Additionally, cases of cross-sentential disagreement such as (12) appear problematic for FS18. This is because the apparent absence of exhaustification in (12b) cannot be directly attributed to the ECONOMY principle in (9), which is based on the idea that information builds up incrementally. These observations motivate an reanalysis of HC in terms of contrastive focus, *via* the constraint in (13).

(13) **The Contrast Antecedent Condition (CAC)**
For any phrase α and α' s.t. α is dominated by α', when α is contrastively focused, there must be β which precedes α and is dominated by β' which generates $\mathscr{A}_{\beta'}$ s.t.:
  (i) it is a subset of the focus semantic value of β';[9]
  (ii) its members are mutually exclusive;
  (iii) it includes both the ordinary value of β' and that of α'.

The CAC appeals to the notion of *focus semantic value*, as well as that of *ordinary value*, as first defined by Rooth (1992) and later by (Katzir 2007; Fox and Katzir 2011).

(14) **Focus semantics**
The *ordinary value* ($[\![.]\!]_o$) of an element refers to its regular semantics, while *the focus semantic value* ($[\![.]\!]_f$) is defined as the set of propositions identical to the ordinary value, except that the focused element is substituted for a salient alternative of the same type, and at most as complex.

Here is how the CAC accounts for the basic contrast in (3). In (3a), applying EXH to $\exists$ in the first disjunct allows to define $\mathscr{A}_{\text{EXH}(\exists,\mathscr{A}_\exists)}$ as $\{\exists \wedge \neg\forall, \forall, \neg\exists\}$ (where $\neg\exists$ is lexicalized as *none*). This set only contains at-most-as-complex, mutually exclusive alternatives to EXH($\exists$, $\mathscr{A}_\exists$), satisfying (i-ii), and also includes the ordinary value of both disjuncts ($\exists \wedge \neg\forall$ and $\forall$), satisfying (iii). In (3b) on the other hand, finding a CAC-compliant set of alternatives for $\forall$ is impossible, since this putative set should contain $\forall$ (ordinary value of the first disjunct), but also either $\exists$ (ordinary value of the unenriched second disjunct) or $\exists \wedge \neg\forall$ (ordinary value of the enriched second disjunct). The first option would violate (ii), and the second one would violate (i), since $\exists \wedge \neg\forall$ is strictly more complex than $\forall$.[10] This reasoning, which crucially relies on the interaction between the CAC and EXH-insertion to derive the relevant asymmetry, is summarized below.

[9] The final version of the CAC extends the notion of focus semantic value to that of actual or *potential* focus semantic value, to cover cases in which the relevant contrast antecedent is not focused (cf. (12)). The potential focus semantic value of an expression is the focus semantic value it would have had if focus had been put elsewhere.

[10] Note that computing EXH($\forall$, $\mathscr{A}_\forall$) does not help if complexity is understood in logical/semantic terms, since EXH($\forall$, $\mathscr{A}_\forall$) = $\forall$. But if complexity is seen as purely structural, then adding a vacuous EXH could introduce more complex alternatives in $\mathscr{A}_{\text{EXH}(\forall,\mathscr{A}_\forall)}$ (such as $\exists \wedge \neg\forall$) as opposed to $\mathscr{A}_\forall$. The additional "filter" that is needed to account for (15) happens to solve this issue.

(3) a. Eleanor ate **some**$_F$ or **all**$_F$ of the cookies.
$\mathscr{A}_{\textsc{Exh}(\exists,\mathscr{A}_\exists)} = \{\exists \wedge \neg\forall, \forall, \neg\exists\}$ (i) ✓ (ii) ✓ (iii) ✓

b. # Eleanor ate **all**$_F$ or **some**$_F$ of the cookies.
$\mathscr{A}_\forall = \mathscr{A}_{\textsc{Exh}(\forall,\mathscr{A}_\forall)} = \{\forall, \exists, \neg\exists\}$ (i) ✓ (ii) ✗ (iii) ✓
or $\mathscr{A}_\forall = \mathscr{A}_{\textsc{Exh}(\forall,\mathscr{A}_\forall)} = \{\forall, \exists \wedge \neg\forall, \neg\exists\}$ (i) ✗ (ii) ✓ (iii) ✓

This approach, which capitalizes on the relationship between focused expressions (and hence not necessarily full sentences), offers a unified treatment of all sorts of "contrastive" statements, in which the propositions at stake are not in an entailment relation *per se* (case of *but*-statements), or not combined in a purely logical way (cross-sentential disagreement). Tomioka's CAC, contrary to FS18's ECONOMY principle, also correctly predicts the *presence* of an asymmetry when two "close"-entailing (as opposed to distant-entailing) scalar items, none of them being at the top of the scale, are disjoined. We call such disjuncts Close Bottom-Tier Disjuncts (CBTD). This is illustrated in (15) below, along with schematic proofs for Incremental Weakening and candidate alternative sets for the CAC.

(15) a. Julia did **some**$_F$ or **most**$_F$ of the homework.
IW: $(\exists \wedge \neg\forall) \vee \textsc{Exh}(M) = (\exists \wedge \neg\forall) \vee (M \wedge \neg\forall) \not\Leftarrow (\exists \wedge \neg\forall) \vee M$ HC✓
$\rightsquigarrow$ Julia did **some but not most** or **most but not all** of the homework.
CAC: $\mathscr{A}_{\textsc{Exh}(\exists,\mathscr{A}_\exists)} = \{\exists \wedge \neg M, M, \neg\exists\}$ (i) ✓ (ii) ✓ (iii) ✓
$\rightsquigarrow$ Julia did **some but not most** or **most** of the homework.

b. Julia did **most**$_F$ or **some**$_F$ of the homework.
IW: $(M \wedge \neg\forall) \vee \textsc{Exh}(\exists, \mathscr{A}_\exists) = (M \wedge \neg\forall) \vee (\exists \wedge \neg M) \not\Leftarrow (M \wedge \neg\forall) \vee \exists$ HC✓
$\rightsquigarrow$ Julia did **most but not all** or **some but not most** of the homework.
CAC: $\mathscr{A}_{\textsc{Exh}(M,\mathscr{A}_M)} = \{M \wedge \neg\forall, \forall, \neg\exists\}$[11] (i) ✓ (ii) ✓ (iii) ✗
$\rightsquigarrow$ # Julia did **most but not all** or **some** $^?$**(but not most/all)** of the homework.

In brief, Tomioka's account can achieve good empirical adequacy, but again, at the cost of positing very strong (and somewhat unusual) structural constraints on the set of alternatives generated by the first scalar item. Mutual exclusivity (13-(ii)) in particular, can be seen as an emulation of HC in the realm of alternatives. Like FS18's account, Tomioka's approach ends up being relatively costly from a cognitive point of view, as alternative sets to both the non-exhaustified contrast antecedent, and its exhaustified counterpart may have to be computed to check CAC-compliance (itself being a complex process). Moreover, if the CAC did better than FS18 regarding the contrast in (15), it cannot readily account for cases of *obviation* by DEDs (judgments somewhat debated), or within universally quantified contexts (cf. (6)).

[11]Note however that the prediction of the CAC in (15) does not come totally for free; as Tomioka mentions, it requires an additional "filtering" principle imposing that the alternatives negated by exhaustification (e.g. $\forall$ in $\exists \wedge \neg\forall$) constitute the only additional alternatives to the exhaustified expression itself (so, $\forall \in \mathscr{A}_{\textsc{Exh}(\exists,\{\exists,\forall\})}$, but $M \wedge \neg\forall \notin \mathscr{A}_{\textsc{Exh}(\exists,\{\exists,\forall\})}$). This prevents $\mathscr{A}_{\textsc{Exh}(M,\mathscr{A}_M)}$ in (15b) from generating the CAC-compliant set $\{M \wedge \neg\forall, \exists \wedge \neg M, \forall, \neg\exists\}$. This principle however, may be problematic w.r.t. the specific *inferences* derived in (15a). Indeed, it forces $\mathscr{A}_{\textsc{Exh}(\exists,\mathscr{A}_\exists)}$ to contain *most*, instead of *most but not all*, which in turn suggests (*contra* FS18's prediction, that we think is correct) that the second disjunct (*Julia did most of the homework*) should not be exhaustified to mean *Julia did most but not all of the homework*.

	Basic (3)	DED (7)	CBTD (15)	∀-quantified disjuncts	∀-quantified disjunction (6)	Other contrastive (11-12)
Singh (2008)	✓	✗	✓	✗	✗	✗
Fox and Spector (2018)	✓	✓	✗	✓	✓	✗
Tomioka (2021)	✓	✗	✓	✓	✗	✓

Table 2: Empirical accuracy of the predictions of three approaches to scalar HDs

The rest of this paper is structured as follows. In section 3, we propose an alternative account of Singh's asymmetry, dubbed Dynamic Alternative Pruning (DAP), which exploits some aspects of both FS18's and Tomioka's approaches. We demonstrate that DAP accounts for (3). In section 4, we show that DAP also predicts an *obviation* of HC in specific environments, and the *presence* of a superficially HC-like pattern in contrastive (but non-disjunctive) environments. In section 5, we conclude by pointing out some differences between our account and previous approaches to alternative pruning, suggesting that the two views could be seen as complementary.

3. Capturing Singh's asymmetry *via* Dynamic Alternative Pruning

3.1. Motivation and assumptions

We propose a new way of deriving asymmetries in scalar HDs, based on the independently motivated notion of alternative pruning (Fox and Katzir 2011; Katzir 2014; Crnič et al. 2015; Denić 2023). More specifically, we propose that the set of alternatives to a prejacent somehow depends on previously and overtly raised alternatives – which is why we call the kind of alternative pruning at work in HDs *dynamic*. Instead of formulating the asymmetry as a problem of EXH-insertion as FS18 do, our account is closer to Tomioka's in that it assumes the asymmetry somehow originates in the structure of alternatives. Like FS18's account and unlike Tomioka's, our account retains a standard implementation of HC, and assumes that the contrasts observed in *but*-statement or cross-sentential disagreement examples are due to an interaction between DAP and the particular semantics of *but* or sentential operators such as *I disagree*.

3.2. Dynamic alternative pruning (DAP)

The key difference between our account and the previous accounts is that we assume $\mathscr{A}_p$ is sensitive to specific, previously uttered elements, i.e. it is determined dynamically. More concretely, let us consider a proposition *R* containing a focused scalar item. We define the set of alternatives to *R* as follows:

(16) **Dynamic Alternative Pruning (DAP)**

a. $\mathscr{A}_R = \begin{cases} [\![R]\!]_f \setminus [\![L]\!]_o & \text{if } \exists L \in C(R).\ \textsc{Contrast}(L,R) \\ [\![R]\!]_f & \text{otherwise} \end{cases}$

b. $\textsc{Contrast}(L,R) \iff [\![L]\!]_o \in [\![R]\!]_f \wedge [\![R]\!]_o \neq [\![L]\!]_o$[12]

c. $L \in C(R) \iff \exists \Delta, \Gamma.\ \Delta[L] \bowtie \Gamma[R]$

Where Δ and Γ are logical contexts, and $\bowtie$ is an arbitrary "contrastive" connector (*or*, *but*, *while*, *I disagree*...).

DAP imposes that whenever an expression R is contrasted with another expression L, the ordinary value of L should be pruned from the set of focus alternatives to R. Following Tomioka, we will call L the contrast antecedent of R. Using $[\![R]\!]_f$ as the default set of alternatives to R is probably an idealization; but it is worth noting that our account does not fundamentally prevent other "filters" from applying to this set, to *in fine* yield a smaller set of *relevant* alternatives. In what follows, we will use shorthands such as $\exists$ and $\forall$ to denote L and R, but one should keep in mind that we will be referring to entire disjuncts, unless otherwise stated. A last thing to mention is perhaps the presence of the contexts Δ and Γ in the above definition. If disjunctive statements generally feature null contexts (so that the whole disjuncts are contrasted, and subject to pruning), *but*-statements like (11a) and (11b) exhibit predicate-level parallelism (*do all$_F$/some$_F$ the homework*) which requires us to restrict the domain of pruning to relevant subconstituents of the individual conjuncts. This ensures that *do all$_F$ of the homework* (and not the whole conjunct *Adam did all$_F$ of the homework*) is pruned from the alternatives of *do some$_F$ of the homework* (and not from those of *Bill did some$_F$ of it*) when exhaustifying the second conjunct of (11b).

Let us now briefly explain how DAP allows to capture the simplest case of scalar HD, namely (3). In (3a), EXH applied to the first disjunct ($L = \exists$) operates on the default set of alternatives ($\mathscr{A}_L$=$\mathscr{A}_\exists$=$\{\exists,\forall\}$) because L has no contrast antecedent. Exhaustification thus yields the meaning $\exists \wedge \neg\forall$. This makes the two disjuncts of (3a) mutually exclusive and the structure is successfully rescued from HC-violation. In (3b), EXH applied to the second disjunct R operates on the reduced set of alternatives $\mathscr{A}_R$=$\{\exists,\forall\} \setminus \{\forall\} = \{\exists\}$, because R has $L = \forall$ as a contrast antecedent. Exhaustification of the second disjunct becomes idle, and the structure remains HC-violating. This result is schematized below, and can be easily generalized to other simple scalar HDs, such as $(p \vee q) \vee (p \wedge q)$ (cf. (17)).

(3) a. Eleanor ate **some**$_F$ or **all**$_F$ of the cookies.
$\text{EXH}(\exists, \mathscr{A}_\exists) \vee \forall = \text{EXH}(\exists, \{\exists,\forall\}) \vee \forall = (\exists \wedge \neg\forall) \vee \forall$ HC ✓

b. # Eleanor ate **all**$_F$ or **some**$_F$ of the cookies.
$\forall \vee \text{EXH}(\exists, \mathscr{A}_\exists) = \forall \vee \text{EXH}(\exists, \{\exists,\forall\} \setminus \{\forall\}) \vee \forall = \exists \vee \forall$ HC ✗

(17) a. Jude ate an apricot **or**$_F$ a banana, or **both**$_F$.
$\text{EXH}(A \vee B, \{A \vee B, A \wedge B, A, B\}) \vee (A \wedge B) = (A \vee B \wedge \neg(A \wedge B)) \vee (A \wedge B)$ HC ✓

b. # Jude ate an apricot **and**$_F$ a banana, or **either**$_F$.
$(A \wedge B) \vee \text{EXH}(A \vee B, \{A \vee B, A \wedge B, A, B\} \setminus \{A \wedge B\}) = (A \wedge B) \vee (A \vee B)$ HC ✗

3.3. Rationale behind DAP

This section attempts to spell out the conceptual motivation behind DAP. The starting point is that EXH, whether it is seen as the syntactic implementation of Grice's maxims, or just a

[12] This condition is inspired by Rooth's definition of contrast (Rooth 1992) except that instead of stating $[\![R]\!]_o \in [\![L]\!]_f$ as suggested in the original paper, we impose the opposite condition $[\![L]\!]_o \in [\![R]\!]_f$. This does not fundamentally change the nature and implications of the definition, if both L and R contain the same "parallel" focused elements. Indeed, both conditions state that the ordinary value of one of the two elements is the same as the ordinary value of the other modulo its focused elements. But as pointed out by Tomioka (2021), cases of cross-sentential disagreement can involve an unfocused contrast antecedent L. This never happens in the other direction. Because of this asymmetry, $[\![L]\!]_f$ may sometimes be less rich than $[\![R]\!]_f$ even though L and R clearly contrast; and that is why we prefer to state that the ordinary value of L is identical to that of R modulo the focused elements of R.

covert counterpart of *only*, involves reasoning about alternative propositions that the speaker *could have used but did not*. What could be legitimate reasons for the speaker's not using a specific alternative proposition? It could be either because (1) this proposition is not believed to be true by the speaker, (2) it is judged to be too costly to produce, or (3) it is deemed too precise w.r.t. the current question-under-discussion. In Gricean terms, (1), (2) and (3) roughly correspond to, respectively, the maxims of QUALITY, MANNER, and RELEVANCE (Grice 1975, 1989). Usually, whenever options (2) and (3) can be reasonably ruled out, the listener ends up believing that the alternative under consideration verifies condition (1), i.e., it is not believed to be true.[13] This is what eventually leads the listener to draw scalar implicatures. But if the candidate alternative has already been overtly entertained within a contrastive statement, there is one additional and obvious reason why the speaker would not use it again; namely, that an expression cannot contrast with itself. In (3b) for instance, a speaker entertains the possibility that *Eleanor ate all$_F$ of the cookies*, and then entertains the weaker possibility that *she ate some$_F$ of them*. A listener encountering this disjunctive statement may want to enrich the meaning of *some* within the second disjunct, by reasoning about the plausibility of the alternative utterance *Eleanor all$_F$ of the cookies or Eleanor ate all$_F$ of the cookies*. This whole disjunctive statement happens to be highly redundant and in fact *non-contrastive*. It then seems intuitive to exclude the *all*-alternative from the set of relevant alternatives to *some*, *in that kind of contrastive context*. This leads us to claim that if EXH is active locally (at the level of the individual disjunct in (3b)), the *relevant* alternatives it operates on depend on a larger context. More specifically, we argue that in order to be *relevant*, an alternative should be *utterable in context*, which within a contrastive environment implies that the alternative should contrast with its antecedent.

(18) **Relevance as Utterability (in contrastive environments)**[14]
A relevant alternative A to an expression E within a contrastive environment C is s.t. $C[A]$ (C where E is substituted for A) is utterable, i.e. satisfies any contrast requirement that E satisfies, which means in particular: $\exists \Delta, \Gamma, L, R.\ C[A] = \Delta[L] \bowtie \Gamma[R] \wedge \text{CONTRAST}(L,R)$

Since non-relevant alternatives should be pruned from the set of alternatives passed to EXH, the above principle can be seen as the conceptual motivation behind DAP. Also note that an expression of the form $\Delta[q] \bowtie \Gamma[p_F]$ with $p \not\Leftrightarrow q$ and either $p \Rightarrow q$, $q \Rightarrow p$, or $p \overset{ctxt}{\Longleftrightarrow} q$, will not be automatically considered as non-contrastive; in fact, it will be considered contrastive as soon as $[\![q]\!]_o \in [\![p]\!]_f$. As a result, uttering *Eleanor ate all$_F$ or some$_F$ of the cookies* should not lead to the pruning of an alternative such as *most* when exhaustifying *some* within the second disjunct, even if *most* contextually entails *all*. A correlate of this definition is that only the overtly (and previously) mentioned alternative to a given scalar item within a contrastive statement can be pruned, which is exactly what DAP achieves. In the next section, we show how our account captures a variety of more complex scalar HDs discussed in the past literature.

[13]One additional assumption, namely, *opinionatedness*, is in principle required to conclude that the alternative is believed to be *false* by the speaker. This is not a central point in the current discussion, but this distinction is discussed more in depth in e.g. Sauerland (2004).

[14]Note that, if we implemented this constraint specifically for contrastive environments, this does not mean that a generalized form of this condition is not at work in other constructions. In particular, we might be tempted to say that alternatives leading to a *redundant* utterance should be disregarded.

4. Accounting for more complex scalar HDs

4.1. Obviation of HC caused by a "Distant Entailing Disjunct" (DEDs)

As previously discussed, Singh's asymmetry vanishes when the scalar items present in the weak and strong disjuncts are separated on their scale by a salient alternative. This is illustrated in (7), repeated below.

(7) *Context: if Lucy does **most** of the homework, she will pass the class.*
  a. Lucy did **some**$_F$ or **all**$_F$ of the homework.
    ⇝ Lucy did **some but not most** or **all** of the homework.
  b. Lucy did **all**$_F$ or **some**$_F$ of the homework.
    ⇝ Lucy did **all** or **some but not most** of the homework.

In (7a), the weaker existential item occurs in the first disjunct *L*, which does not have any contrast antecedent. We thus have $\mathscr{A}_L = [\![L]\!]_f = \{\exists, \mathrm{M}, \forall\}$, since *most* (M), has been made particularly salient by the context. *L* is therefore subject to standard exhaustification ($\textsc{Exh}(L, \mathscr{A}_L) = \exists \wedge \neg M$). This makes the two disjuncts mutually exclusive and in turn, HC-compliant. In (7b) on the other hand, the weaker existential occurs within the second disjunct, *R*, which has a clear contrast antecedent, $L = \forall$. As a result, we have $\mathscr{A}_R = \{\exists, \mathrm{M}, \forall\} \setminus \{\forall\} = \{\exists, \mathrm{M}\}$, and thus, $\textsc{Exh}(R, \mathscr{A}_R) = \exists \wedge \neg \mathrm{M} \Rightarrow \exists \wedge \neg \forall$. This makes the disjuncts mutually exclusive, and therefore, HC-compliant, as expected. Note however that it is crucial to only prune the *literal* contrast antecedent of *some* (*all*), and not any additional item entailed by *all* (*most* in particular).

4.2. Presence of an asymmetry with Close Bottom-Tier disjuncts

Recall that CBTDs such as those in (15), repeated below, are disjuncts that are adjacent in their scale, but both dominated by a stronger alternative.

(15) *Context: someone is wondering how much of the homework Julia did. It is common ground that if Julia did most (but not all) of the homework, she will probably get a satisfactory grade.*[15]
  a. Julia did **some**$_F$ or **most**$_F$ of the homework.
    ⇝ Julia did **some but not most** or **most but not all** of the homework. (IW/DAP)
    ⇝ Julia did **some but not most** or **most** of the homework. (CAC)
  b. Julia did **most**$_F$ or **some**$_F$ of the homework.
    ⇝ Julia did **most but not all** or **some but not most** of the homework. (IW)
    ⇝ #Julia did **most but not all** or **some** $^{?}$**(but not most/all)** of the homework. (CAC)
    ⇝ #Julia did **most but not all** or **some but not all** of the homework. (DAP)

In that setting, both our account and FS18 correctly predict (15a) to be felicitous, and derive the same standardly exhaustified meaning. In our case, this is because pruning *some* from the alternatives to *most* while exhaustifiying the second disjunct does not affect the only alternative that is not weaker than *most*, i.e. *all*. CAC on the other hand, predicts felicity, but a different, less exhaustified meaning, that we do not think is the right one in that context. In the case of

[15]In this context, *most* is still salient but does not constitute the threshold for completion, because we want *all* to remain a relevant (i.e. informative) alternative.

(15b), our account aligns with the CAC to (correctly we think) predict infelicity. Our account however, may make more clear-cut predictions than the CAC about the infelicitous *reading* of (15b). Indeed, under the CAC it is a bit unclear whether the second disjunct *needs* to be exhaustified, because either way the structure would be CAC-violating. Under DAP, EXH applied to the second disjunct operates on a set of alternatives $\mathscr{A}_\exists = \{\exists, M, \forall\} \setminus \{M\} = \{\exists, \forall\}$. As a result, the exhaustified meaning EXH$(\exists, \mathscr{A}_\exists)$ is slightly weaker than usually predicted given the context: *some but not all* $(\exists \wedge \neg\forall)$ instead of *some but not most* $(\exists \wedge \neg M)$. Since the exhaustified first disjunct $(M \wedge \neg\forall)$ and the exhaustified second disjunct $(\exists \wedge \neg\forall)$ remain in an entailment relation, DAP predicts (15b) to be infelicitous. Under FS18's approach on the other hand, EXH operates on the standard set of alternatives within the second disjunct, leading to a global meaning $(M \wedge \neg\forall) \vee (\exists \wedge \neg M)$ which is stronger than its counterpart without right-disjunct exhaustification $(M \wedge \neg\forall) \vee \exists$. Since $(M \wedge \neg\forall)$ and $(\exists \wedge \neg M)$ are non-entailing, FS18 wrongly predict (15b) to be felicitous.[16]

4.3. Obviation of HC caused by universal operators

4.3.1. Embedded universals

As previously discussed, Hurford Disjuncts embedded under a universal operator (cf. (8), repeated below) do not exhibit the asymmetry characteristic of scalar HDs.

(8) *Context: John has been assigned a homework involving two Problems. The speaker is unsure of the conditions under which John will pass this assignment.*

a. John **must**$_F$ solve Problem 1 **or**$_F$ Problem 2, or he **must**$_F$ solve **both**$_F$.
$\Box(p_1 \vee p_2) \vee \Box(p_1 \wedge p_2)$
$\rightsquigarrow$ John must solve either problem, without the need to solve any specific one.

b. John **must**$_F$ solve Problem 1 **and**$_F$ Problem 2, or he **must**$_F$ solve **either**$_F$.
$\Box(p_1 \wedge p_2) \vee \Box(p_1 \vee p_2)$
$\rightsquigarrow$ John must solve either problem, without the need to solve any specific one.

Let us spell out how DAP predicts an obviation of the asymmetry in that configuration. In (8a), the first disjunct $L = \Box(p_1 \vee p_2)$ is being enriched by computing EXH$(\Box(p_1 \vee p_2), \mathscr{A}_{\Box(p_1 \vee p_2)})$.[17] We have $\mathscr{A}_{\Box(p_1 \vee p_2)} = \{\Box p_1, \Box p_2, \Box(p_1 \wedge p_2)\}$. L is enriched with $\neg\Box p_1 \wedge \neg\Box p_2 \wedge \neg\Box(p_1 \wedge p_2) = \neg\Box p_1 \wedge \neg\Box p_2$, which breaks the entailment between the disjuncts, and

[16]The exact judgment regarding (15b) might be hard to access. We are however tempted to claim that (15b) is as bad as the baseline (3b). It is interesting to note however, that a slight modification of DAP could emulate the prediction FS18 make for (15b). Indeed, we might assume that, instead of pruning the "bare" contrast antecedent of a given scalar item from the set of its alternatives, DAP should prune the *exhaustified* counterpart of this contrast antecedent. This way, EXH(M) = $M \wedge \neg\forall$ (and not simply M), would be tentatively pruned from $\mathscr{A}_\exists$ in (15b). But since $M \wedge \neg\forall$ is more complex than $\exists$, pruning it would not affect $\mathscr{A}_\exists$, and EXH$(\exists, \mathscr{A}_\exists)$ would yield $\exists \wedge \neg M$, just like FS18 would predict. This change in the definition of DAP is yet non-trivial to justify, as the exhaustified component of the contrast antecedent is not itself spelled out. Assuming that our conceptual justification for DAP is on the right track, we would have to modify the *Relevance as Utterability* principle by making it sensitive to the *exhaustified* context of a putative alternative – which is not straightforward.

[17]One could ask why EXH should not be inserted lower in the structure, meaning, below the necessity modal $\Box$ and above the disjunction operator – leading to $\Box((p_1 \wedge \neg p_2) \vee (p_2 \wedge \neg p_1))$. The fundamental reply to this concern remains unclear, as FS18 acknowledge. It is however true that the inferences triggered by a "high" EXH seem more accurate when the structure is considered in isolation, as noted by Chierchia et al. (2012).

renders the structure HC-compliant. In (8b), we have $\mathscr{A}_R = \{\Box p_1, \Box p_2, \Box(p_1 \wedge p_2)\} \setminus \{\Box(p_1 \wedge p_2)\} = \{\Box p_1, \Box p_2\}$, since $L = \Box(p_1 \wedge p_2)$ constitutes a contrast antecedent to R. Yet, alternative pruning does not affect exhaustification in that case, since the alternative to R that has been pruned, $\Box(p_1 \wedge p_2)$ is stronger than the two other alternatives $\Box p_1$ and $\Box p_2$ (in other words, its negation is entailed by the conjoined negations of the two other alternatives). As a result, exhaustification proceeds just like in (8a), and leads to the enrichment $\neg\Box p_1 \wedge \neg\Box p_2$, contradictory with L, as desired.

4.3.2. Matrix universals

The case of scalar HDs embedded under a universal operator (cf. (6) repeated below) is probably the most challenging for the various accounts of Singh's asymmetry; and it is one datapoint that DAP cannot straightforwardly account for.

(6) a. Robert must take **some**$_F$ or **all**$_F$ of the medicines.
$\textsc{Exh}(\Box(\textsc{Exh}(\exists) \vee \forall))$
$\rightsquigarrow$ Robert must take **some** of the medicines, and he **may or may not** take **all**.

b. Robert must take **all**$_F$ or **some**$_F$ of the medicines.
$\textsc{Exh}(\Box(\forall \vee \textsc{Exh}(\exists)))$
$\rightsquigarrow$ Robert must take **some** of the medicines, and he **may or may not** take **all**.

The problem is very simple: DAP is by default not sensitive to the context outscoping the exhaustified item and its contrast antecedent. As a result, pruning is predicted to occur in (6b) just as in the baseline (3b), and no obviation of HC can be predicted. DAP shares this kind on insensitivity to the surrounding context with Singh's and Tomioka's accounts. Let us nevertheless propose a tentative solution to this issue, within our particular framework, supplemented by two additional assumptions. The first one, that we dub *just-in-time DAP*, posits that the precise set of relevant alternatives to an expression is derived *via* DAP from the context that is active at the exact time a particular occurrence of $\textsc{Exh}$ is computed. The second assumption is that Hurford's Constraint is itself somewhat context-sensitive. We implement this property by adapting the NON-REDUNDANCY account of HDs developed by Marty and Romoli (2022):

(19) **Hurford's Constraint as NON-REDUNDANCY**
A sentence S cannot be used if there is a sentence S' s.t. S' is a simplification of S, and S' (along with its potential SIs) is contextually equivalent to S (along with its potential SIs). S' is a simplification of S if it can be derived from S *via* successive replacements of a constituent by one of its subconstituents.

This definition, crucially, does not directly appeal to disjunctions; instead, it considers sentences (which may strictly contain an HD) and potential simplifications thereof. Let us first compute the SIs of (6a) and (6b) assuming just-in-time DAP.

(20) a. $\mathscr{A}_{\Box(\textsc{Exh}(\exists)\vee\forall)} = \mathscr{A}_{\Box(\forall\vee\textsc{Exh}(\exists))} = \{\Box(\textsc{Exh}(\exists) \vee \forall), \Box\exists, \Box\forall, \Box(\textsc{Exh}(\exists))\}$

b. (6a) $= \textsc{Exh}(\Box(\textsc{Exh}(\exists) \vee \forall), \mathscr{A}_{\Box(\textsc{Exh}(\exists)\vee\forall)})$
$= \Box(\textsc{Exh}(\exists) \vee \forall) \wedge \neg\Box\forall \wedge \neg\Box(\textsc{Exh}(\exists))$
$= \Box(\textsc{Exh}(\exists, \{\exists, \forall\}) \vee \forall) \wedge \neg\Box\forall \wedge \neg\Box(\textsc{Exh}(\exists, \{\exists, \forall\}))$

$$= \Box(\exists \wedge \neg\forall \vee \forall) \wedge \neg\Box\forall \wedge \neg\Box(\exists \wedge \neg\forall)$$
$$= \Box\exists \wedge \neg\Box\forall \wedge \Diamond\forall$$

c. (6b)
$$= \textsc{Exh}(\Box(\forall \vee \textsc{Exh}(\exists)), \mathscr{A}_{\Box(\textsc{Exh}(\exists)\vee\forall)})$$
$$= \Box(\forall \vee \textsc{Exh}(\exists)) \wedge \neg\Box\forall \wedge \neg\Box(\textsc{Exh}(\exists))$$
$$= \Box(\forall \vee \textsc{Exh}(\exists, \{\exists\})) \wedge \neg\Box\forall \wedge \neg\Box(\textsc{Exh}(\exists, \{\exists, \forall\}))$$
$$= \Box(\forall \vee \exists) \wedge \neg\Box\forall \wedge \neg\Box(\exists \wedge \neg\forall)$$
$$= \Box\exists \wedge \neg\Box\forall \wedge \Diamond\forall$$

Following our assumption that alternatives are subject to DAP just when the relevant occurrence of EXH is resolved, we compute two potentially different set of alternatives for the two occurrences of the embedded EXH operator of (6a), obtained after resolving the matrix EXH. In that particular case, the two sets of alternatives are identical because no pruning occurs within the literal expression. In the case of (6b) however, the alternatives to $\exists$ computed for the literal utterance ($\Box(\forall \vee \textsc{Exh}(\exists))$) and for one of its SIs ($\neg\Box(\textsc{Exh}(\exists))$) end up being different. This is because DAP prunes the $\forall$-alternative to $\exists$ in the main utterance ($\exists$ having the contrast antecedent $\forall$), but not in its SI. Having a fully exhaustified $\exists$ within this SI will be crucial to rescue (6b) from a violation of HC. We then see that just-in-time DAP allows to derive the same exhaustified meaning for (6a) and (6b), thanks to the fact that the effect DAP has on the literal expression does not extend to the exhaustified SIs resulting from the resolution of the matrix EXH. Crucially, there is no simplification of (6a) or (6b) that can derive the very same SIs:[18]

(21)
a. $\textsc{Exh}(\Box(\textsc{Exh}(\exists)))$ $\rightsquigarrow \Box(\exists \wedge \neg\forall) \wedge \ldots$ $\not\Leftrightarrow$ (6a) or (6b)
b. $\textsc{Exh}(\Box(\forall))$ $\rightsquigarrow \Box\forall \wedge \ldots$ $\not\Leftrightarrow$ (6a) or (6b)
c. $\textsc{Exh}(\Box(\exists))$ $\rightsquigarrow \Box\exists \wedge \neg\Box\forall$ $\not\Leftrightarrow$ (6a) or (6b)

Therefore, neither (6a) nor (6b), when exhaustified *via* just-in-time DAP, violates the NON-REDUNDANCY implementation of HC.

4.4. Non-disjunctive environments

Because our account builds on structural considerations and in particular the notion of contrastive focus, it should extend to contrastive but non-disjunctive environments, such as those mentioned by Tomioka (2021). But if our account derives asymmetries in how contrastive statements get exhaustified, it does not make any direct prediction regarding the felicity of those statements. To fill this gap, we choose to retain a standard version of Hurford's Constraint in the domain of disjunctive statements,[19] and to supplement our definition of contrast with the condition in (22).

(22) **Contrasting expressions**
Statement making use of binary connectives like *but*, *while*, *whereas*, *I disagree* etc. contrasting two expressions *L* and *R*, should verify the following two conditions:

[18] Simplifications lacking a matrix EXH are not listed, because they clearly lack the relevant inferences.

[19] The NON-REDUNDANCY version being slightly preferable in order to account for HDs embedded under a universal, cf. Section 4.3.2.

(i) there exists a focus assignment pattern mapping L to $\tilde{L}$, s.t. each focused element of $\tilde{L}$ can be paired with a focused element in R;[20]
(ii) there is a subset of the pairs of contrasted element from $\tilde{L}$ and R $\{(\tilde{l}_1, r_1), (\tilde{l}_k, r_k)\ldots\}$, s.t. mapping each pair to the same arbitrary value makes the two expressions contradictory, i.e. $\tilde{L}[x_1/\tilde{l}_1]\ldots[x_k/\tilde{l}_k] \wedge R[x_1/r_1]\ldots[x_k/r_k] \vdash \bot$.

This constraint roughly says that L and R should be contradictory, disregarding some pairs of contrasted elements. For instance, (23a) below satisfies (22) because substituting both *Adam*$_F$ and *Bill*$_F$ for, say, *Charlie*, makes the two conjuncts contradictory, given that *some* is exhaustified as *some but not all*. In a sense, (22) could be seen as "HC modulo focused elements". Yet, a motivation for a separate treatment of disjunctive *vs* contrastive statements regarding their felicity conditions comes from the contrasts between *or* and *but* in (23b-25b).

(23) a. Adam$_F$ did **some**$_F$ of the homework, {or, but} Bill$_F$ did **all**$_F$ of it.
b. Adam$_F$ did **all**$_F$ of the homework {or, #but} Bill$_F$ did **some**$_F$ of it.

(24) a. Adam did **some**$_F$ of the homework$_F$, {or, but} he did **all**$_F$ of the readings$_F$.
b. Adam did **all**$_F$ of the homework$_F$ {or, #but} he did **some**$_F$ of the readings$_F$.[21]

(25) a. Adam$_F$ did **some**$_F$ of the homework$_F$, {or, but} Bill$_F$ did **all**$_F$ of the readings$_F$.
b. Adam$_F$ did **all**$_F$ of the homework$_F$ {or, #but} Bill$_F$ did **some**$_F$ of the readings$_F$.

Suppose that there were a general constraint encompassing both disjunctive and contrastive statement, either akin to HC, or to the contrast condition spelled out in (22). If the general constraint had the form of HC, it should target chunks of variable size (verb phrase, quantifier phrase, single quantifier...) in the *but* cases, and chunks of a fixed size (entire disjuncts) in the *or* case – potentially due to a difference in focus marking between the two kinds of structure. If the general constraint had the form of (22), it would again call for a difference in focus marking in *or*- *vs* *but*-cases. Yet, we do not think that disjunctive and contrastive statements exhibit fundamental differences in focus. Therefore a general constraint seems hard to justify, at least within the paradigms we explored. Let us now see how a combination of HC and the constraint in (22) can account for (23), the generalization to (24) and (25) being quite straightforward. The *or* cases in (23) are trivial: in none of the sentences are the two disjuncts entailing, so HC predicts *or* to be felicitous across the board. As for the *but* cases, we have already seen why (23a) complies with (22). Regarding (23b), we see that substituting *Adam*$_F$ and *Bill*$_F$ for *Charlie* does not help in making the two conjuncts contradictory because *all* will always entail *some* (which was vacuously exhaustified due to DAP). (23b) with *but* thus remains infelicitous.

5. Conclusion

We developed an account of the asymmetric felicity pattern of scalar HDs by proposing a new one-pass method to compute formal alternatives, Dynamic Alternative Pruning (DAP). DAP

[20]The need for a focus-modified version of L in the above definition is due to the existence of contrastive statements where only R (and not L) gets the relevant focus marking.
[21]The contrast between *or* and *but* may seem subtler in that sentence, in particular, the variant with *but* may not sound too infelicitous. Yet, we think that the contrast with (24a) remains. The relative weakness of the *or vs but* contrast in (24b) might be due to the availability of a "concessive" reading of *but* ($\sim$*but still*), caused by the two contrasted sentences having the same subject.

builds on the idea that alternative expressions which happen to be infelicitous in the context of the utterance should not be considered as *relevant*, and therefore should be discarded. This suggests that even if EXH can operate locally, the set of relevant alternatives it operates on is actually sensitive to more global features of the sentence. In that sense, and as a play on words on (Magri 2009), alternatives are both *blind to the context* (understand: common ground) and *not blind to the context* (understand: surrounding LF). This view may also supplement previous approaches to alternative pruning that were primarily based on some measure of informativeness (Chemla and Romoli 2015; Denić 2023). According to Denić (2023) for instance, alternatives that are made very probable *given* the current utterance should be seen as less informative, and therefore less attractive. But entertaining a $\forall$-alternative within the first disjunct of an HD should not in principle increase the probability of this alternative given the second disjunct (e.g. $\exists$). In other words, under informativeness-based accounts of pruning, mentioning a $\forall$-alternative in the first disjunct should not *reduce* the attractiveness of a $\forall$-alternative in the second disjunct. In that sense, DAP contributes some structural conditions to earlier accounts of alternative pruning. Beside the conceptual contribution of DAP, we saw that this account can capture most of the contrasts (or absence thereof) mentioned in Fox and Spector (2018), but also extends to the kind of contrastive environment mentioned in (Tomioka 2021), modulo one additional constraint. Further evidence, potentially experimental, would be welcome to assess the empirical adequacy of DAP in complex cases.

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Negativity without negation[1]

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Abstract. This paper addresses the anaphoric polarity sensitivity of negativity-tags, challenging the idea that they are only licensed by sentential negation (e.g., Klima 1964; Kramer and Rawlins 2009; Farkas and Bruce 2010; Brasoveanu et al. 2013, 2014; Roelofsen and Farkas 2015), arguing instead that they are sensitive to counterfactual propositional content in discourse. This is supported by data showing that negativity-tags are licensed without overt negation and their acceptability is influenced by contextual factors. The emerging notion of discourse-polarity has theoretical implications: The discourse-effect of negation is tied to its anti-veridical semantics, and characterizing negative antecedents requires a discourse-level representation that integrates information from both semantic representations and pragmatic inferences.

Keywords: negation, anaphora, discourse interpretation.

1. Introduction

Klima (1964) identified a set of negativity-tags: complex anaphoric expressions that require their antecedent to be in some sense negative, like English *neither*-tags, which may have negative antecedents (1a), but not affirmative ones (2a). The same contrast has been observed for (1/2b) agreeing uses of the negative polarity particle (PolP) *no* (Pope 1972), and (c) factive[2] uses of elliptical *'why not'*-questions (Hofmann 2018, 2022; Anand et al. 2021).

(1) **Negative antecendent:**
Sue didn't dance at the party.
a. Neither did Mary.
b. No, she really didn't.
c. but she didn't explain why not.

(2) **Positive antecendent:**
Sue danced at the party.
a. # Neither did Mary.
b. # No, she really did.
c. # but she didn't explain why not.

The expressions in (a–c) are interpreted relative to propositional content in discourse: *neither*-tags (a) have an additive presupposition (Heim 1992), while *no* (b) depends on a previous utterance (treated as propositional anaphora in e.g. Farkas and Bruce 2010; Krifka 2013). *why not* in (c) involves clausal ellipsis (Kramer and Rawlins 2009; Hofmann 2018), often linked to contextual entailment of the elided proposition (e.g. Merchant 2001; Kroll 2019). Since the standard view of propositions as sets of possible worlds doesn't distinguish the polarity of the introducing clause, the question arises of how to explain the sensitivity to polarity.

A related question—what makes a propositional antecedent behave as negative in discourse—arises because the class of licensing contexts is syntactically and semantically diverse. Negative markers (*not*), and expressions of varying negative strength can license negativity-tags, in various syntactic positions (Klima 1964; Brasoveanu et al. 2013, 2014): They include negative

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[2]Factive uses of *why not* appear in information-seeking questions or veridical contexts. They differ from the free modal reading, illustrated below, found in (zero-answer) rhetorical questions (Hofmann 2018; Anand et al. 2021).
(i) A: *Let's go to the movies!* B: *Why not?* (There is no reason that we wouldn't/shouldn't go to the movies.)

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quantifiers (like *never, no one*), certain downward-entailing quantifiers (*rarely, few people*), and negative proximatives (*hardly, hardly anybody*). In adverbial positions (3a), or argument positions (3b–c), these can license subsequent negativity-tags (4).

(3) a. Pat {never/rarely/hardly} dances.
b. {No one/few people/hardly anybody} dance(s).
c. Pat dislikes {no one/few people/ hardly anybody}.

(4) a. Neither do I.
b. No, they really don't.
c. but I'm not sure why not.

The various quantifiers in (3) have received a unifying analysis as contributing sentential negation and a positive (upward-monotone) quantifier to the representation of their clause. (e.g. Klima 1964; Haegeman and Zanuttini 1991; Penka 2007, though see De Swart 2000). This decompositional analysis is mainly motivated by split-scope readings (e.g. Penka 2007), but also their ability to license negativity-tags (Klima 1964; Brasoveanu et al. 2013, 2014). Accordingly, negativity-tags are often taken to be sensitive to sentential negation. For instance, the feature-based account of PolPs (Farkas and Bruce 2010; Roelofsen and Farkas 2015) assumes that negative antecedents are introduced by clauses involving sentential negation, based on Jackendoff's (1969) semantic characterization. Similarly, ellipsis-based accounts of PolPs (Kramer and Rawlins 2009; Holmberg 2013) rely on syntactic reflexes of negation.

This paper argues that an analysis of discourse-negativity and negativity-tags requires a level of representation that goes beyond explicit clausal content, incorporating information from the literal semantic content and pragmatic inferences. Section 2 presents data showing that negativity-tags can be licensed implicitly, without overt negation. It develops the generalization that negativity-tags are sensitive to negation because they are licensed in a discourse that makes available counterfactual propositional content. Section 3 provides an overview of previous approaches to anaphoric polarity sensitivity, evaluating them in light of the generalization developed in Section 2. While none of these accounts can fully explain it, a synthesis of their key insights leads to the conclusion that the negative antecedent requirement of negativity-tags arises from two factors: (i) an anaphoric expression in an anti-veridical embedding, and (ii) a requirement to interpret the utterance containing the anaphor in conjunction with the utterance containing its antecedent. Section 4 illustrates how these factors manifest in the three negativity tags in (1–2). Section 5 presents an analysis of discourse-negativity—the anaphoric potential of counterfactual content. It is implemented in Intensional CDRT, a dynamic intensional framework with propositional discourse referents (drefs). Section 6 derives the polarity-sensitivity of the anaphoric negativity-tag *why not* as a combination of multiple discourse-links. For reasons of space, I only provide a formal analysis for *why not* in this paper, but I lay the groundwork for extending the analysis to the other negativity-tags discussed. Section 7 concludes the paper.

2. Negativity without negation

This section shows that antecedents under neg-raising or anti-veridical attitudes can license negativity-tags without overt negation. The proposed generalization is that discourse-negative utterances introduce propositional content, which is (possibly implicitly) interpreted as counterfactual (i.e., false according to speaker commitments). We begin by looking to Kroll (2019, 2020), who identifies neg-raising as a context giving rise to polarity-reversing sluices, where the antecedent is an embedded clause without negation, but ellipsis receives a negative paraphrase:

(5) Kroll 2019: (2)
I don't think that California will comply but I don't know why ~~California won't comply~~.

Based on cases like (5), Kroll argues for a pragmatic constraint on ellipsis licensing: If the neg-raising inference is derived pragmatically (e.g. based on Gajewski 2007), the negative interpretation for the ellipsis is based on this pragmatic inference as well. Similarly, embedded clauses under neg-raising (6) also provide antecedents for the negativity-tags in (7).

(6) **Neg-raising antecendent:**
I don't think that Sue danced at the party…

(7) a. …but she didn't say why not
b. No, she really didn't.
c. …and neither did Mary.

The same argument applies here: If neg-raising is derived pragmatically, then so is the licensing of the tags in (7). While there is evidence that neg-raising with *think/believe* could be derived syntactically, (7a–c) may also follow neg-raising in island contexts, like the NP-island in (8), which is uncontroversially derived pragmatically (Collins and Postal 2018).

(8) I don't get the impression that Sue danced at the party…

While *neither*-tags and factive *why not* unambiguously require a negative antecedent, *no* (7b) after (6) or (8) could be characterized as a reversing use (based on Farkas and Bruce 2010). However, the German PolP *doch*, designated for rejecting negative antecedents, is also available in these types of contexts. (9) shows that neg-raising with *glaube* ('believe', A1) and island neg-raising with *Eindruck* ('impression', A2) can be followed by the PolP negativity-tag *doch* (B).

(9) Neg-raising antecedents for *doch*: (German)
A1: Ich glaube nicht, dass die Baustelle vor nächstem Jahr fertig wird.
I believe not that the construction site before next year finished gets
'I don't believe that the construction will be finished before next year.'
A2: Ich habe nicht den Eindruck, dass die Baustelle vor nächstem Jahr fertig wird.
I have not the impression that the construction site before next year finished gets
'I don't get the impression that the construction will be finished before next year.'
B: Doch, das wird sie bestimmt.
DOCH that will it certainly
'Yes, it certainly will.'

In (9), the negativity-tag *doch* is interpreted in relation to the embedded clause without negation. Licensing by neg-raising thus present a strong case that the relevant notion of polarity should be characterized on the level of discourse, not clausal representations. The main empirical contribution of this paper is the discourse-based generalization stated in (10).

(10) **Discourse-Negativity:**
An utterance patterns as negative for the purposes of negativity-tags, if it explicitly introduces propositional content into the discourse, which is interpreted as counterfactual (based on literal content or pragmatic inference.)

(10) states that the propositional content anaphorically picked up by negativity-tags needs to be introduced into the discourse explicitly, whereas the information about the speaker's epistemic

stance towards that content, i.e. whether it is interpreted as (counter-/non-)factual, may be implicitly inferred in discourse. The requirement of explicit introduction captures that entailment is insufficient to license negativity tags. This is illustrated for the tags in (12), which are not available following (11), even though the sentence entails the negative paraphrase *Susan didn't pass the exam*, modulo satisfaction of presuppositions (Hofmann 2019b).

(11) Sue failed the exam.
($\leftrightarrow$ Susan didn't pass the exam.)

(12) a. # …but I'm not sure why not
b. # No, she really didn't.
c. # …and neither did Mary.

While the propositional content itself has to be introduced explicitly, the generalization in (10) further predicts that overt non-negative clauses embedded in semantically anti-veridical (AV) attitude contexts (13) can introduce negativity, and are acceptable with the tags in (7).

(13) a. You were wrong…
b. It is a lie…
c. It was just a rumor…
d. It is false…
…that Sue danced at the party.

While judgments for (7) following (13) vary, experimental data from a forced-choice continuation task in Hofmann (2022) provides evidence that *why not* can be used following AV-attitudes, as well as neg-raising antecedents with *think/believe* or NP-islands.

Further supporting evidence for the claim that the implicit counterfactual interpretation of propositional content in dicourse licenses negativity-tags comes from the availability of negativity tags following sarcastic utterances (14), or when accommodating a negative answer to a polar question (15), illustrated there for *why not* and *neither*-tags.

(14) A (sarcastic): I will totally be able to afford buying a house by 35 in this economy.
a. B: Yeah, me neither.
b. B: I can see why not.

(15) Do you think this was a good idea?
a. Why or why not?
b. Well, neither do I.

3. Approaches to anaphoric polarity-sensitivity

This section surveys approaches to polarity-sensitive propositional anaphora, evaluates their applicability to implicitly negative antecedents, and highlights the insights that are integrated into the proposed analysis. I mainly focus on the literature on PolPs, as they have been explored in the greatest formal depth, discussing the feature-based analysis (Farkas and Bruce 2010; Roelofsen and Farkas 2015), the saliency account (Krifka 2013; Claus et al. 2017), and briefly touch on ellipsis-based accounts of PolPs (Kramer and Rawlins 2009; Holmberg 2013). Another formally explicit approach to the interaction of anaphora to propositional content with polarity involves local contextual entailment (Kroll 2019, 2020; Hofmann 2022), discussed here in some detail for Kroll's (2019) analysis of licensing clausal ellipsis.

3.1. Feature-based account of PolPs

The feature-based account of PolPs (Farkas and Bruce 2010; Roelofsen and Farkas 2015; Farkas and Roelofsen 2019) builds on Pope's (1972) typological study of PolP answering systems, which identified two dimensions of information signalled by PolPs across languages: (i) the response being positive or negative, and (ii) the response agreeing or disagreeing with the antecedent. The account explains Pope's generalization by proposing that PolPs across languages may morphologically realize *absolute* or *relative* polarity features, or a combination of both:

(16) Presuppositions of polarity features (simplified, after Roelofsen and Farkas 2015)
 a. Absolute features:
  (i) [+]: The response has positive polarity.
  (ii) [−]: The response has negative polarity.
 b. Relative features:
  (i) [AGREE]: The response and the antecedent have the same polarity and they are semantically equivalent.
  (ii) [REVERSE]: The response and the antecedent have opposite polarity and they are contradictory opposites.

The typology of answering systems is governed by morphological feature realization potentials, which specify which features PolPs may realize. For English *yes* and *no*, these are as in (17).

(17) Feature realization potential of English PolPs (Roelofsen and Farkas 2015)
 a. [AGREE] and [+] can be realized by *yes*
 b. [REVERSE] and [−] can be realized by *no*

The account assumes that PolPs can express one or both of the associated features and can be interpreted in combination with another feature not explicitly realized by the particle based on markedness considerations. Thus, agreeing uses of *no* are predicted to be negative, and matching the polarity of the antecedent, which in turn predicts their negativity-tag behavior.

This analysis offers core insights into the pragmatics and typology of answering systems by parametrizing PolPs based on the polarity of the response and their relationship with the antecedent utterance. However, cases of negativity without explicit negation raise questions about the representational assumptions and proposed semantics of polarity features. Roelofsen and Farkas (2015) associate negative polarity features with propositional discourse referents (drefs) introduced by semantically negative clauses, where contradictory negation is the highest-scoping operator in the semantic representation of the clause (based on Jackendoff 1969). However, this generalization doesn't cover the cases discussed in Section 2, where counterfactual propositions expressed affirmatively act as negative antecedents in discourse. To account for these cases while retaining the insights from the feature-based account, we redefine the notion of (discourse) polarity in terms of counterfactual content rather than sentential negation, while adopting the idea that PolPs and anaphoric negativity-tags impose a dual constraint: They convey information about the (absolute) polarity of the anaphoric utterance and (relative) polarity, i.e., the relationship between the utterances containing the anaphor and its antecedent.

3.2. PolPs as propositional anaphora

The saliency account of PolPs (Krifka 2013; Claus et al. 2017) explains the interpretation of PolPs by analogizing them to pronominal propostional anaphora. It assumes that negative utterances introduce two propositional drefs: one for the matrix clause and another for the negated content (see also Stone 1999; Murray 2014; Snider 2017). This is motivated by the independent observation that pronominal propositional anaphora can pick up either of these drefs:

(18) [Ede didn't [~~Ede~~ steal the cookie]$^{\phi_2}$]$^{\phi_1}$ … Adapted from Krifka 2013: (24)
 a. …and he can actually prove it$_{\phi_1}$. it$_{\phi_1}$: that Ede didn't steal the cookie
 b. …even though people believed it$_{\phi_2}$ it$_{\phi_2}$: that Ede stole the cookie

The account posits that *yes* and *no* are propositional anaphora, where *yes* asserts its antecedent, while *no* asserts the negation of its antecedent. The patterns for English PolPs are analyzed by assuming that they may be anaphoric to either the matrix content ϕ_1 or the negated content ϕ_2.

(19) A: [Ede didn't [~~Ede~~ steal the cookie]$^{\phi_2}$]$^{\phi_1}$

 a. B: Yes$_{\phi_1}$, he didn't. (agreement)
 b. B: Yes$_{\phi_2}$, he did. (disagreement)
 c. B: No$_{\phi_2}$, he didn't. (agreement)
 d. B: No$_{\phi_1}$, he did. (disagreement)

No negates its antecedent, so when it refers to the matrix content (ϕ_1), it entails disagreement. Therefore, agreeing uses of *no* always point to a proposition in the scope of negation (ϕ_2). This explains why such uses are restricted to negative antecedents. These representational assumptions readily apply to our data, as long as we extend the class of negative antecedents to encompass counterfactual propositions more broadly, not just those in the scope of negation.

The saliency account further suggests that ambiguity resolution with bare PolPs, and production choices when two distinct PolPs can express the same answering relation are modulated by salience, assuming that matrix and embedded propositions have different levels of salience. However, the account lacks an explicit operationalization of propositional salience, and experiments in Claus et al. (2017) found no effect of contextually modulated salience on the acceptability of PolPs. Furthermore, Farkas and Roelofsen (2019) argue that the salience-based constraints cannot explain the typology of answering systems, particularly the behavior of negative PolPs in languages where they cannot affirm negative utterances. Additional assumptions would be required to exclude the possibility of a counterfactual dref as a potential antecedent, specifically in these languages and to the exclusion of other propositional anaphora.

I adopt the representational assumptions of this account: negative antecedent utterances are ones introducing a certain kind of embedded propositional content into the discourse. Based on the generalization from Section 2, this extends to counterfactual content beyond just content introduced under negation. On the anaphoric side, the saliency account posits that negative PolPs involve anaphoric expressions under negation. We adopt this assumption for negativity-tags more broadly—they involve anaphora in anti-veridical contexts. However, given the typological limitations of the saliency account, I contend that the constraints on PolPs can be better understood by parametrization based on absolute/relative polarity.

3.3. Ellipsis-based accounts of PolPs

According to ellipsis-based accounts of PolPs (e.g. Kramer and Rawlins 2009; Holmberg 2013), PolPs connect to their antecedent by appering in utterances with clausal ellipsis, and their sensitivity to antecedent polarity arises from a negative syntactic dependency (e.g., based on Zeijlstra 2004). This dependency links polarity features associated with the PolP to syntactic expressions of polarity in the ellipsis site. Since this type of account relies on a morphosyntactic realization of negation, it cannot readily be extended to cases of negativity without explicit negation.

3.4. Local contextual entailment

The analysis of polarity-reversing sluices in Kroll (2019, 2020) explains the interaction between clausal ellipsis and negation at the discourse level, through a pragmatic licensing condition of local contextual entailment (20).

(20) **Local givenness**: (simplified version, adapted from Kroll 2020: 62)
A clause α can be deleted only if α expresses a proposition *p*, such that *p* is contextually entailed in the local context of α.

Kroll uses (20) to explain the interpretation of polarity-reversing sluices with neg-raising antecedents in (5), repeated here.

(5) Kroll 2019: (2)
I don't think that California will comply but I don't know why ~~California won't comply.~~

The polarity-reversing interpretation is derived in a dynamic semantic framework, by interpreting the ellipsis in a context that results from an update with the first conjunct, which contextually entails that *California won't comply*. This inference is derived by two assumptions: (i) the neg-raising inference arises from an excluded-middle presupposition associated with neg-raising predicates (Gajewski 2007), and (ii) a speaker's self-ascription of belief leads to discourse commitment. The analysis is fomulated in a version of update semantics (Heim 1983), with relevant definitions given in (21). The notation below differs slightly from Kroll (2019, 2020).

(21) a. Discourse update (assertion): $c+p$
(i) If c entails the presuppositions of p (i.e. $c \subseteq ps(p)$), then $c+p=c\cap p$.
(ii) If c does not entail the presuppositions of p, then $c+p$ is undefined.
(iii) If $c+p$ is undefined and c does not contradict the presuppositions of p, presuppositions may be accommodated:
$c+p=(c+ps(p))+p$
b. Negation: $c+\neg p=c\setminus(c+p)$
c. Dynamic conjunction: $c+p+q=(c+p)+q$

The interpretation of (5) is based on a standard treatment of *think* as a doxastic attitude in a Hintikkan semantics for propositional attitudes (based on Heim 1992).

(22) *think* as a doxastic attitude:
a. $[\![think(x_e)(p_{wt})(w_w)]\!]^{M,g} = [\![\textsc{Dox}_x(w) \subseteq p]\!]^{M,g}$, where:
b. $[\![\textsc{Dox}_x(w)]\!]^{M,g} = \{w' \in D_w : w'$ conforms to what $[\![x]\!]^{M,g}$ believes in $[\![w]\!]^{M,g}\}$

Besides its assertive content, the neg-raising verb *think* contributes an excluded-middle presupposition (Gajewski 2007), which we assume is accommodated (though Kroll does not explicitly make this assumption). Further, speaker self-ascription of belief leading to pragmatic assertion is captured by adding the embedded content to the superordinate context. Here, we state this discourse-effect as the presupposition in (23b-ii). Based on these assumptions, the content in the scope of negation in the first conjunct in (5) is stated as (23).

(23) a. Asserted content: $\lambda w'.think_{w'}(\mathbf{sp})(\lambda w.comply_w(cal))$
b. Presuppositions:
(i) Excluded middle:
$\lambda w'.[think_{w'}(\mathbf{sp})(\lambda w.comply_w(cal) \vee think_{w'}(\mathbf{sp})(\lambda w.\neg comply_w(cal))]$

(ii) Self-ascription of belief: $\lambda w.\forall p[think_w(\mathbf{sp})(p) \rightarrow p(w)]$

The update of the first conjunct in (5) is derived as follows:

(24) a. Starting context (by assumption): $c = W$
b. Negation: $c + (5) = c \setminus c'$, where $c' = (c + (23))$
c. Presupposition failure: $c' = (c + (23))$ is undefined, because $c \nsubseteq ps(23)$.
d. Accommodation: For $c \nsubseteq \neg ps(23)$, we get (global) accommodation:[3]
$c + (5) = c'' + \neg(23a)$, where:
$c'' = (c + ps(23)) = (c + (23bi) + (23bii))$
e. Negation: $c'' + \neg(23a) = c'' \setminus c'''$, where $c''' = (c'' + (23a))$

Due to global accommodation of the presuppositions and negation of the assertive content in (23), the resulting context entails $\lambda w.\neg comply_w(cal)$. Kroll suggests that this functions as the local context for the ellipsis in the second conjunct. Thus, the clause may be elided when interpreted as expressing this proposition, provided that syntactic isomorphism is also satisfied.

The analysis uses local contextual entailment at a discourse-level representation, which can be enriched by pragmatic inferences like neg-raising. This suggests that clausal ellipsis behaves similarly to other types of anaphora, as local contextual entailment within dynamic semantics has also been proposed as a condition on interpreting of pronominal anaphora, both for individuals (Stone 1999; Brasoveanu 2006; Hofmann 2019a, 2022), and propositions (Hofmann 2022). Extending a discourse-based approach with local contextual entailment to negativity-tags will allow us to include implicitly negative antecedents in the class of discourse-negative utterances.

Further, when treating negativity-tags as involving anaphora in non-veridical contexts, a condition of local contextual entailment can help us understand why they need counterfactual propositional antecedents. However, for ellipsis in local contexts under negation, like in factive *why-not*-interrogatives, Kroll's condition is slightly too strong. The example of clausal ellipsis under *not* in (25b) suggests that local contextual entailment should be considered a condition on ellipsis interpretation rather than licensing.

(25) a. Mary didn't dance,
b. but she didn't say why not ~~[Mary danced]~~
c. not ~~[Mary danced]~~

The *why*-interrogative in (25b) is factive (Fitzpatrick 2005), and presupposes the truth of its prejacent (i.e. its propositional argument), given in (25c). We can therefore assume that the local context for its prejacent is the global context after updating with (25a), and illustrate the problem for an update with (25a) + (25c).

(26) a. $c + (25a) = c \setminus (c + (\lambda w.dance_w(mary))) = c'$
b. $c' + (25c) = c' \setminus (c' + \cancel{[Mary\ danced]})$

The context c', created by updating with the first conjunct (26a), contains only worlds where *Mary didn't dance*. Since the semantics of negation in (24e) assumes that the superordinate context is passed down as the local context under negation, the ellipsis is interpreted in c'. Because c' does not entail the elided proposition *Mary danced* (but its opposite), ellipsis is not predicted to be possible with the attested interpretation.

[3]Heim (1983) suggests that global accommodation, if possible, is strongly preferred, and this assumption will be sufficient for our current purposes.

To salvage this, we could assume that the local context under negation doesn't have to the superordinate context. Instead, we could consider it to be the universe containing all possible worlds. This way, the content of the elided presupposition could be consistently locally accommodated, but it would still not be previously entailed. Another option would be adopting a Lewisian counterfactual semantics for counterfactual local contexts, i.e. picking out a set of worlds that is like the global context, except that the locally expressed proposition is true (e.g. Heim 1992; Stone 1999). But using this as a way of recovering interpretations for ellipsis creates circularity in the explanation. We would have to claim that the proposition is entailed in the local context because it is interpreted in the context, and the ellipsis is interpreted as expressing the proposition because it is entailed in the context. In either case, the previous semantic and pragmatic context, without the elided content, does not already entail the elided proposition.

3.5. Interim conclusion

A discourse-negative utterance overtly expresses a proposition, which is (possibly implicitly) interpreted as counterfactual. This characterization builds on Krifka's observation that negated content is available for anaphora, the generalization in Section 2, and Kroll's dynamic account of how propositional content in discourse can be pragmatically construed as counterfactual.

Negativity-tags can be seen as having a negative absolute polarity. When defining discourse-polarity in terms of counterfactual content, this means they involve anaphoric elements in a anti-veridical context. Interpreting the anaphor locally in such a context is one aspect of explaining their negative antecedent requirement. The second aspect of the explanation can be seen as a reflection of relative polarity, requiring that the utterances containing the anaphor and its antecedent convey non-contradictory matrix propositions. The following section will elaborate on this aspect, suggesting that negativity-tags are complex anaphoric expressions involving the the interplay of multiple discourse-dependencies and negation.

4. A recipe for negativity-tags: anti-veridical anaphora and non-contradiction

Combining insights from the generalization in Section 2 and previous approaches to polarity-sensitive propositional anaphora (Section 3), we understand negativity-tags as complex anaphoric expressions. They require a negative antecedent due to the interplay of an anaphoric element in an anti-veridical context and a second discourse-requirement that the utterances containing the negativity-tag and its antecedent are non-contradictory. This section explores the implications of this characterization for *why not*, *neither*-tags, and agreeing uses of negative PolPs.

The requirement for the antecedent of *'why not ~~p~~'* to be negative arises from a combination of: (i) clausal ellipsis under negation, requiring an antecedent for the ellipsis of the clause expressing the proposition p, and (ii) the factivity associated with information-seeking uses of *why*, presupposing $\neg p$ (Fitzpatrick 2005). Together, these two components require that p has been introduced counterfactually in the discourse, whereas individually, they do not impose the same requirement. For example, a factive use of a negative *why*-question without ellipsis (27) does not require a negative antecedent.

(27) A: Mary sat in her chair all night at the party.
B: Why didn't Mary dance?

(27) shows that the factive presupposition of negative *why*-questions can be met by an affirma-

tive utterance that entails the prejacent of *why*. Likewise, negative polarity ellipsis (i.e., clausal ellipsis of the complement of a high polarity head, e.g., Kramer and Rawlins 2009; Gribanova 2017; McCloskey 2017) in non-factive contexts does not require a negative antecedent (27).

(28) Maybe Mary danced at the party
   a. …but maybe/probably not. (maybe/probably she didn't dance)
   b. If not, it must have been a boring party. (if Mary didn't dance)

Although we focus here on analyzing *why not*, we can test the predictions for other negativity-tags by identifying similar conspiring discourse-requirements. In the case of negative additive tags, there is verb-phrase ellipsis (VPE) under negation, which is licensed by an overt verb-phrase in the discourse, while the negative additive presupposes that the proposition expressed by that VP is false (i.e. interpreted counterfactually). In combination, we get a negative-antecedent requirement, not only for *neither*-tags, as Klima (1964) observed, but also for *not either* + VPE, i.e. both utterances in (30) are acceptable after (29a), but not (b).

(29) a. Mary didn't pass the test.
   b. Mary failed the test.

(30) a. Neither did Sue ~~pass the test~~.
   b. Sue didn't either ~~pass the test~~.

Either one of these discourse-links on its own does not lead to a negative antecedent requiement, as illustrated for VPE under negation in (31), and negative additives in (32).

(31) Mary danced,
   but Agatha didn't.

(32) Mary aced syntax.
   a. She didn't fail any of her other classes either.
   b. Neither did she fail any of her other classes.

Agreeing uses of *no* can be viewed similarly: Following Krifka's (2013) assumption that negative PolPs negate the antecedent proposition, they can be seen as propositional anaphors in anti-veridical contexts. The second discourse-link comes from the agreeing interpretation: If the PolP were to negate a (veridical) matrix proposition, the response couldn't be interpreted as affirming the previous utterance. In case of designated particles for rejecting negative utterances (like German *doch*), we can follow Krifka's assumption that they are positive PolPs, asserting their antecedent, and carry an additional presupposition forcing their antecedent to be a counterfactual proposition (p 15). While Krifka simply states that *doch* should pick up a negated proposition, we might propose that the presupposition of *doch* demands that the response is interpreted as disagreeing with the previous utterance. This aligns with our understanding that polarity-sensitivity arises as a reflection of specifying the relationship with the prior utterance.

Finally, if the proposed analysis of negativity-tags is right, we expect pronominal anti-veridical anaphora in a non-contradictory discourse relations to exhibit the a negative antecedent requirement as well. This is borne out, illustrated in (33): In an anti-veridical context, the pronoun *that* may have a counterfactual antecedent (33a), but not a veridical one (33b). That applies, when they are subsequent assertions by the same speakers, which requires the two utterances to be non-contradictory. In case of utterances by different speakers (33c), an anti-veridical anaphor can pick up the matrix assertion, as this discourse allows for an interpretation where the two utterances contradict each other.

(33) a. Mary didn't dance at the party. That's a lie. (✓*that:* that Mary danced)
   b. #Mary danced at the party. That's a lie. (✗ *that:* that Mary danced)
   c. A: Mary danced at the party. B: That's a lie. (✓*that:* that Mary danced)

The anaphoric polarity-sensitvity of negativity-tags presents itself as a complex phenomenon, which has many researchers led to assume anaphoric mechanisms that make reference to clausal negation. However, the argument presented here suggests that it comes about as a combination of regular kinds of anaphoric dependencies that are otherwise well-behaved, like propositional anaphora and ellipsis, and their interaction with their semantic and pragmatic context. The central contrasts can be explained by appealing to a generalization that anaphoric expressions are interpreted in their local context, and the basic principle of discourse consistency.

5. Analysis of discourse-negative utterances

While negativity-tags generally involve anaphoric elements in anti-veridical contexts, Section 4 showed that the nature of these elements varies between tags. For instance, ellipsis in *why not* interacts with the discourse in a way that can be modeled using Heimian local contexts, while PolPs and pronominal anaphora can be seen as picking up propositional drefs. To address this diversity, Section 5.1 sets up the analysis of discourse-negativity in a dynamic system where propositional operators systematically provide Heimian local contexts for interpreting their prejacent and also introduce propostional drefs (based on Stone 1999; Brasoveanu 2010; Snider 2017; Hofmann 2019a, 2022). The analysis of semantically counterfactual content is then extended to implicitly negative propositions under neg-raising in Section 5.2. Although Section 6 focuses on deriving the anaphoric requirements of *why not*, this framework lays the foundation for extending it to other negativity-tags in future research.

5.1. Counterfactual content in a propositional logic of change

5.1.1. Updates

I implement the analysis in a version of intensional CDRT (based on Muskens 1996; Brasoveanu 2006; Hofmann 2022), where propositional operators introduce drefs for the set of worlds in which their prejacent is true, and their truth-functional meaning is expressed in terms of relations over these drefs (Stone 1999; Brasoveanu 2010; Krifka 2013; Snider 2017). Discourse states store the information about propositional drefs and relations between them, allowing us to keep track of speaker commitments about drefs, and capture the generalization about anaphora and propositional antecedents in anti-veridical contexts.

The basic types are: t (truth-values), e (entities), w (worlds), s (variable assignments). A propositional dref ϕ is a function from assignments i_s to propositions p_{wt}. Utterances are interpreted as discourse updates, which are interpreted within an underlyingly static logic as relations of type $s(st)$ between input and output states i_s, j_s, where discourse states are variable assignments. Updates are represented as in (34c). They contain a list of new drefs, introduced by variable update (34a), and properties of the output state, which are imposed as output conditions (34b).

(34) a. Variable update:
$i[\phi]j$ is true iff i and j differ at most wrt the values assigned to the variable ϕ

b. Output conditions: $Dance_{\phi}\{Mary\} := \lambda i_s.\forall w \in \phi(i).dance_w(mary)$

c. Updates: $[\phi_1,\ldots,\phi_n \mid C_1,\ldots,C_n] := \lambda i_s.\lambda j_s.i[\phi_1,\ldots,\phi_n]j \wedge C_1(j) \wedge \ldots \wedge C_n(j)$

Variable update (34a) is defined as random assignment of values to a variable, following Groenendijk and Stokhof (1991). In (34b), the dynamic predicate *Dance* takes two arguments: an individual discourse constant (*Mary*) and a propositional dref (ϕ), indicated as a subscript on the predicate. In this propositional logic of change, we simplify by using only discourse constants (type se) associated with proper names and no individual variables.[4] Individual constants point to the same entity across assignments (e.g. $Mary_{se} := \lambda i.mary_e$). (34b) holds of some i_s, iff the corresponding static predicate (in lowercase) holds of $mary_e$ in each world in $\phi(i)$. Stone (1999) introduced this mechanism of point-wise checking across all worlds of evaluation, proposing that lexical meanings encapsulate universal quantification over possible worlds in their local context. Dynamic concjunction is defined in the usual way, as relation composition:

(35) Dynamic conjunction: $D_{s(st)}; D'_{s(st)} := \lambda i_s.\lambda j_s.\exists h_s.[D(i)(h)](D'(h)(j))$

5.1.2. Assertion

To embed a version of Heimian (propositional) update in a system with propositional drefs, we need propositional drefs representing our global and local contexts. For the global context, we assume a indexical propositional dref ϕ_{DC_S} pointing to the discourse-commitment set of the speaker S (Gunlogson 2004).

Assertion is modeled as intersective update of the global context (Stalnaker 1978; Heim 1983) by imposing an output condition that ϕ_{DC_S} entails the asserted proposition at the output. Here, we attribute this function to a declarative sentential mood operator that combines with a propositional prejacent, following Bittner (2009); Murray (2014). The prejacent of a propositional operator is represented as a 'dynamic proposition' (type $s(wt), s(st)$), which takes a propositional variable as an argument to return an update (e.g. $\lambda\phi.[Dance_\phi\{Mary\}]$). The declarative operator provides this argument as a propositional dref, and imposes the condition that the proposition is entailed by speaker commitments. (36) illustrates the assertion of *Mary danced.*

(36) a. S: DEC$_S$(*Mary danced*) $\rightsquigarrow$ $[\phi \mid \phi_{DC_S} \Subset \phi]; [Dance_\phi\{Mary\}]$
b. Dynamic inclusion: $\phi_1 \Subset \phi_2 := \lambda i_s.\phi_1(i) \subseteq \phi_2(i)$
c. Indexical dref for speaker commitments: $\phi_{DC_S} := \lambda i.DC_S$

In (36a), the condition $Dance_\phi\{Mary\}$ ensures that the output state j can only be one where the values for $\phi(j)$ are sets of worlds such that *Mary danced* in each world. The condition $\phi_{DC_S} \Subset \phi$ indexically invokes the commitment set of the speaker S, and states that $\phi(j)$ is entailed by S's discourse commitments at j. This is defined in terms of dynamic set inclusion (36b). As a result, all ϕ_{DC_S}-worlds are ϕ-worlds, and S is committed that *Mary danced*. This means that ϕ is a *veridical propositional dref* relative to S.

5.1.3. Negation

For negation, the assumed propositional relation is one of non-overlap (contrary negation). The discourse-effect of a negative utterance is captured in (37).

(37) Mary didn't dance $\rightsquigarrow$ $[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; [\phi_2 \mid \phi_1 \Cap \phi_2 = \varnothing]; [Dance_{\phi_2}\{Mary\}]$

An update with (37) introduces two propositional drefs ϕ_1 and ϕ_2. The condition $Dance_{\phi_2}\{Mary\}$ restricts ϕ_2 to worlds where *Mary danced*. The condition $\phi_1 \Cap \phi_2 = \phi_\varnothing$ states that ϕ_1 and ϕ_2 have no overlap, and is defined in terms of dynamic intersection over drefs, while invoking a discourse constant for the empty set, as defined in (38).

[4]See Hofmann (2019b, 2022) for details on how the presented system can incorporate individual quantification.

(38) a. Dynamic intersection: $\phi_1 \Cap \phi_2 := \lambda i_s.\phi_1(i) \cap \phi_2(i)$
b. Discourse constant for empty set: $\phi_\varnothing := \lambda i.\varnothing$

We implicitly assume maximization over propositional drefs throughout (discussed in detail in Hofmann 2022, pp. 155–160), based on Brasoveanu (2006). Maximization takes scope over the sentence radical of a clause, as illustrated in (39), so ϕ_2 is the maximal proposition where *Mary danced*, and ϕ_1 is the maximal proposition where she did not.

(39) Mary didn't dance $\rightsquigarrow$
$$[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; \mathbf{max}_{\phi_1}([\phi_2 \mid \phi_1 \Cap \phi_2 = \varnothing]; \mathbf{max}_{\phi_2}([Dance_{\phi_2}\{Mary\}]))$$

This results in a complementation relation, implementing the standard boolean truth-functional meaning of negation (contradictory negation). Accordingly, ϕ_1 points to the set of worlds in which *Mary didn't dance*. By assertion, all worlds in ϕ_{DC_S} are ϕ_1-worlds. A crucial consequence of this it that no world in ϕ_{DC_S} will be a ϕ_2-world, rendering ϕ_2 a *counterfactual propositional dref* for *S*, i.e. one referring to a proposition that *S* is committed to being false. For the rest of this paper, I will leave the maximization assumed for propositional drefs implicit. Therefore, we can understand (37) as an abbreviation of (39).

5.1.4. AV-attitudes

Like negation, anti-veridical attitude introduces a counterfactual dref for the embedded content, here exemplified for the AV-predicate *be wrong* (40).

(40) Sue was wrong that Mary danced $\rightsquigarrow$
$$[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; [\phi_2 \mid Wrong_{\phi_1}\{Sue, \phi_2\}]; [Dance_{\phi_2}\{Mary\}]$$

Following Anand and Hacquard (2014), I treat *be wrong* as an anti-veridical assertive attitude:[5]

(41) a. $[\![wrong_w(x_e)(p_{wt})]\!]^{M,g} = [\![\textsc{Assertive}_x \subseteq p \wedge \neg p(w)]\!]^{M,g}$

The condition $Wrong_{\phi_1}\{Sue, \phi_2\}$ holds of an output state j iff for each world w in $\phi_1(i)$, Sue asserted $\phi_2(i)$, and $\phi_2(i)(w) = 0$. Accordingly $\phi_2(i)$ is false in each ϕ_1-world, which commits the speaker that ϕ_2 is false. Here, the propositional dref ϕ_2 for the embedded content (*Mary danced*) is counterfactual due to the relation introduced by *be wrong*.

5.2. Neg-raising and accommodation

The proposed system embeds Heimian-style intensional contexts in a referential context by using propositional drefs. This allows us to analyze neg-raising antecedents, by adapting Kroll's (2019; 2020) approach (Section 3.3) to this system. In the following, I show how a counterfactual dref can be introduced under neg-raising, and illustrate how discourse inferences can enrich our discourse-semantic representations. Importantly, propositional drefs for embedded content are introduced explicitly (c.f. Heim's, 1982 formal link condition), while information about previously introduced drefs can be conveyed implicitly. Neg-raising utterances provide a dref

[5] We may assume the following definition of an assertive information-state:
(i) $[\![\textsc{Assertive}_x(w)]\!]^{M,g} = \{w' \in D_w : w'$ conforms to the (communicative) commitments of some assertion made by $[\![x]\!]^{M,g}$ in $[\![w]\!]^{M,g}\}$
This is a simplification. E.g., Anand and Hacquard (2014) suggest the relevant information state is a projected common ground (in the sense of Farkas and Bruce 2010) associated with a reported communicative event.

for the embedded clause, which would be non-veridical (but not counterfactual), if interpreted based on the semantic at-issue content alone, as illustrated in (42).

(42) I_S don't think that Mary danced $\rightsquigarrow$
$$[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; [\phi_2 \mid \phi_1 \Cap \phi_2 = \phi_\varnothing]; [Think_{\phi_2}\{S, \phi_3\}]; [Dance_{\phi_3}\{Mary\}]$$

(42) introduces a dref ϕ_3 for a set of worlds where *Mary danced*, and a dref ϕ_2 for a set of worlds where *S thinks* ϕ_3. Based on (42), ϕ_2 can contain worlds where ϕ_3 is true and worlds where it is false. As a result, the same applies to its negation, ϕ_1, and the assertion does not commit the speaker to the truth or falsity of ϕ_3. This makes ϕ_3 a *hypothetical dref* (but not a counterfactual one), based on the semantic content alone. Speaker commitment to ϕ_3 being false is derived pragmatically, by accommodating an excluded middle presupposition associated with uses of *think*, and self-ascription of belief leading to discourse commitment. This paper does not offer an account of projection or the contextual requirements of presuppositions. It merely illustrates how the inferences can be stated and accommodated as presuppositions within the proposed system: The expressions in (42) are interpreted as conditions on a discourse state *i*, in relation a propositional variable ϕ provided in discourse.

(43) Presuppositions
a. Excluded middle: $\langle \phi(i) \subseteq \lambda w.[think_w(S(i))(\phi_3(i)) \vee \neg think_w(S(i))(\phi_3(i))] \rangle_{i,\phi}$
b. Self-ascription of belief: $\langle \phi(i) \subseteq \lambda w.[think_w(S(i))(\phi_3(i)) \rightarrow \phi_3(i)(w)] \rangle_{i,\phi}$

While the contents in (43) are not dynamically active like explicit content, and cannot introduce new drefs, they can provide information about existing ones. Thus, the content α of $\langle \alpha \rangle_{i,\phi}$ is stated as a condition in the underlying static logic. Recall that we assume accommodation in the global context, so the propositional variable ϕ is interpreted as pointing to ϕ_{DC_S}:

(44) I_S don't think that Mary danced $\rightsquigarrow$
$[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]$; $[\phi_2 \mid \phi_1 \Cap \phi_2 = \phi_\varnothing]$;
$\langle \phi_{DC_S}(i) \subseteq \lambda w.[think_w(S(i))(\phi_3(i)) \vee \neg think_w(S(i))(\phi_3(i))] \rangle_i$;
$\langle \phi_{DC_S}(i) \subseteq \lambda w.[think_w(S(i))(\phi_3(i)) \rightarrow \phi_3(i)(w)] \rangle_i$; $[Think_{\phi_2}\{S, \phi_3\}]$; $[Dance_{\phi_3}\{Mary\}]$

Setting aside questions of presupposition satisfaction or failure here, we state an accomodation update which states a discourse-condition on the input assignment:

(45) $\langle \alpha \rangle_i := \lambda i.\lambda j.[i = j \wedge \alpha]$

Assuming that the contents in (43) are accommodated globally, and combining this with the assertion of (42), the output *j* will be s.t. $\phi_{DC_S}(j) \subseteq \lambda w.[\neg \phi_3(i)(w)]$. This means that all worlds $w \in \phi_{DC_S}(j)$ are non-ϕ_3-worlds, and ϕ_3 is a counterfactual dref for *S*. While this does not provide an account of presupposition projection or interpretation, it serves as a demonstration of how presupposition accommodation can lead to pragmatic enrichment in the proposed system.

5.3. Interim conclusion

We have characterized discourse-negative utterances as ones that introduce a counterfactual propositional dref, and presented a formal analysis within a version of intensional CDRT. This dynamic system provides a level of representation that is based on semantic content, but amenable to pragmatic enrichment due to discourse inferences. It can address utterances with sentential negation, but also other kinds of counterfactual content under AV-attitudes and neg-raising.

6. *why not* — licensing clausal ellipsis under negation

To derive that the negativity-tag *why not* is sensitive to the presence of a counterfactual proposition in the discourse, I give an analysis of the contrast in (46).

(46) a. Mary didn't dance. Sue explained why not.
b. Mary danced. # Sue explained why not.

6.1. *why*-questions

We assume that the unavailability of (46b) results from a combination of clausal ellipsis under negation and the factivity associated with *why*-questions (as discussed in Section 4). To develop the formal analysis, let us first make explicit our assumptions about a non-elliptical case in (47).

(47) a. S: Mary didn't dance. $\rightsquigarrow$ $[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; [\phi_2 \mid \phi_1 \Cap \phi_2 = \phi_\varnothing]; [Dance_{\phi_2}\{Mary\}]$
b. S: Sue explained why Mary didn't dance $\rightsquigarrow$
$[\phi_3 \mid \phi_{DC_S} \Subset \phi_3]; [\phi_4 \mid Explain_{\phi_3}\{Sue, \phi_4\}]; [\phi_5, \phi_6 \mid Because_{\phi_4}\{\phi_5, \phi_6\}];$
$\langle \phi_{DC_S}(i) \subseteq \phi_5(i) \rangle_i; [\phi_7 \mid \phi_5 \Cap \phi_7 = \phi_\varnothing]; [Dance_{\phi_7}\{Mary\}]$

For simplicity, we treat *explain* as a basic assertive attitude, glossing over some aspects of the semantics of the predicate that are not directly relevant here. Accordingly, the condition $Explain_{\phi_3}\{Sue, \phi_4\}$ states that the ϕ_4-worlds are the ones consistent with what Mary explained in ϕ_3. The interpretation of *why*-interrogatives invokes the condition $Because_{\phi_4}\{\phi_5, \phi_6\}$ states that ϕ_6 is a reason for ϕ_5 in ϕ_4. Here, ϕ_5 is the proposition corresponding to the prejacent of *why*. We make the simplifying assumption that ϕ_6, the proposition serving as a reason for ϕ_5, is introduced as a dref, sidestepping other aspects of the interrogative semantics here. We capture the factivity of *why*-questions analogously to the presuppositional contents in Section 5.2. We assume that they carry a presupposition $\langle \phi(i) \subseteq \phi_5(i) \rangle_{i,\phi}$, which is interpreted in ϕ_{DC_S}. This allows us to state that the content is interpreted globally.

6.2. Clausal ellipsis

I adopt a dual approach to clausal ellipsis licensing (Chung 2013; Kroll and Rudin 2017; Rudin 2019; Anand et al. 2023), which involves (limited) syntactic isomorphism over the *v*P-domain, while the syntactic form of the rest of the elided clause is recovered based on semantic and pragmatic information in the discourse. This approach is motivated by observations that syntactic isomorphism is required for the argument structure of the elided clause, whereas mismatches are possible in other parts of the clause. Specifically, I adopt the syntactic condition in (48).

(48) Syntactic isomorphism condition: (adapted from Anand et al. 2023)
The argument-domain in the elided clause (i.e. the smallest phrase denoting a property of eventualities) is syntactically isomorphic to a phrase in the discourse context.

The condition (48) requires the syntactic isomorphism indicated in (49).

(49) Mary didn't [~~Mary~~ dance]$_{vP}$. Sue explained why not ~~[Mary danced]$_{vP}$~~.

Further, the recovery of the parts of the elided clause that lie outside of the *v*P-domain is constrained by local contextual entailment as well as independent pragmatic constraints on discourse interpretation. Clausal ellipsis generally allows for mismatches in modality or polarity (Rudin 2019), and when a modal is introduced in the ellipsis site, it often has vague or underdetermined force and flavor (Anand et al. 2021). Therefore, we need to rule out the interpretations in (50), where the recovered ellipsis site includes an additional instance of negation, or some modal (indicated here as MODAL).

(50) Unavailable interpretations
  a. Mary didn't [~~Mary~~ dance]$_{vP}$. She explained why not ~~NEG [Mary danced]$_{vP}$~~.
  b. Mary didn't [~~Mary~~ dance]$_{vP}$. She explained why not ~~MODAL [Mary danced]$_{vP}$~~.

Based on the discussion in Section 3.3, we weaken Kroll's local contextual entailment to be understood as a constraint on interpretation, rather than licensing. In the intensional dynamic system presented here, this follows automatically from interpreting the elided clause within its local context, and we do not need to explicitly state local contextual entailment as a condition on ellipsis. An elided clause is interpreted as expressing a proposition which, when interpreted in its local context, does not create an inconsistent discourse (or violate other independent pragmatic constraints). This allows us to rule out the unavailable interpretations: (50a) would create an inconsistent discourse: The first sentence states that *Mary didn't dance*, and the factive use of *why* presupposes its prejacent (here: *Mary danced*). (50b) can be ruled out as being uninformative, given that the context already entails that *Mary didn't dance*.

6.3. Negative antecedent requirement

The unavailability of *why not* with positive antecedents comes about as a combination of ellipsis in the scope of negation and the factivity of *why*. We now have an explanation of why none of the interpretations in (51) are available.

(51) a. [Mary danced]$_{vP}$. She explained why not ~~[Mary dance]$_{vP}$~~
  b. [Mary danced]$_{vP}$. She explained why not ~~MODAL [Mary dance]$_{vP}$~~
  c. [Mary danced]$_{vP}$. She explained why not ~~NEG [Mary dance]$_{vP}$~~

The interpretations in (51a+b) would create an inconstent discourse: Since the first conjunct asserts that *Mary danced*, presupposing that *Mary did/would not dance* is inconsistent. In contrast, (51c) would yield a non-contradictory discourse. Here, we will have to assume that this interpretation is ruled out on the basis of syntax, ruling out the sequence of two instances of negation, or Gricean manner, which might favor an affirmative utterance over such a sequence.

6.4. Extensions: Pronominal anaphora and other negativity-tags

The analysis straightforwardly applies to anti-veridical pronominal anaphora, and explains why they cannot combine with veridical antecedents, when both the anaphor and antecedent are provided by assertions from the same speaker. The unacceptability of (52) arises as a contradiction:

(52) a. S: *Mary danced* $\rightsquigarrow$ $[\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; [Danced_{\phi_1}\{Mary\}]$
  b. S: *That is a lie.* $\rightsquigarrow$ $[\phi_2 \mid \phi_{DC_S} \Subset \phi_2]; [Lie_{\phi_2}\{\phi_1\}]$

We treat *lie* as an anti-veridical assertive attitude like *be wrong*. This glosses over some details, but the key aspect here is its anti-veridical nature. The condition $Lie_{\phi_2}\{\phi_1\}$ refers to ϕ_1 in an anti-veridical context, stating that in an output state j, $\phi_1(j)$ is false in all ϕ_2-worlds. Because ϕ_1 and ϕ_2 are assertions by the same speaker S, this leads to inconsistency, and thus inacceptabiliy. In contrast, in (53), the first utterance makes available a counterfactual propostional dref:

(53) a. S: *Mary didn't dance.* $\rightsquigarrow [\phi_1 \mid \phi_{DC_S} \Subset \phi_1]; [\phi_2 \mid \phi_1 \Cap \phi_2 = \phi_\varnothing]; [Danced_{\phi_2}\{Mary\}]$
b. S: *That is a lie.* $\rightsquigarrow [\phi_3 \mid \phi_{DC_S} \Subset \phi_3]; [Lie_{\phi_3}\{\phi_2\}]$

(53b) refers to ϕ_2 in an anti-veridical context: it is false in all ϕ_3-worlds. That is consistent with (53a), which asserts that ϕ_2 is false in all ϕ_1-worlds. *S*'s subsequent assertions of ϕ_1 and ϕ_3 remain non-contradictory. The contrast between (53) and (52) arises from the requirement of discourse consistency, which prevents assertions by the same speaker from contradicting each other. However, this does not apply with anti-veridical discourse relations (in the sense of Asher and Lascarides 2003), such as the disagreement between two speakers *A* and *B* in (54).

(54) a. A: *Mary danced* $\rightsquigarrow [\phi_1 \mid \phi_{DC_A} \Subset \phi_1]; [Danced_{\phi_1}\{Mary\}]$
b. B: *That is a lie.* $\rightsquigarrow [\phi_2 \mid \phi_{DC_B} \Subset \phi_2]; [Lie_{\phi_2}\{\phi_1\}]$

Being asserted by two speakers disageeing with each other, ϕ_1 and ϕ_2 can be construed as contradictory. Here, *A* and *B* may need to resolve their disagreement to continue their conversation, but (54b) is an acceptable utterance. The interplay between propositional anaphora with antecedent polarity is understood by considering the veridicality of the local context of the anaphor, and the discourse relation between the utterances containing anaphor and antecedent—just like we established for negativity-tags. This provides further support for the claim that negativity-tags do not necessitate a special mechanism making reference to antecedent polartiy; rather, they are complex anaphoric expressions subject to regular constraints on discourse interpretation.

To extend the analysis to PolPs, we would assume that differences in absolute polarity stem from a propositional anaphor in a veridical vs. an anti-veridical context, drawing on Krifka's representational assumptions. Future research might explore a semantics of relative polarity features that encodes constraints on veridical (conjunctive) and non-veridical (disjunctive) discourse relations (e.g., in an SDRT framework, see Asher and Lascarides 2003). For *neither*-tags, the analysis might resemble that of *why not*: VPE imposes a condition of isomorphism over the elided VP, while the additive presupposition contributes parallelism with the previous utterance.

7. Conclusion

Anaphoric polarity-sensitivity is sensitivity to speaker commitments about the truth or falsity of contents in discourse. Therefore, the discourse-effect of negation cannot be explained at the clausal level, but is tied to its anti-veridical semantics. Further, discourse-negativity should be analyzed at a discourse-level which allows for pragmatic enrichment. This paper has presented a discourse-level analysis of discourse-negativity and the anaphoric polarity sensitivity of *why not* (Sections 5+6). It has also provided evidence for this view, showing that negativity-tags are licensed by counterfactual propositional content, even in cases where the counterfactual interpretation is supported by pragmatic reasoning (Section 2). Drawing from previous accounts of anaphoric polarity sensitivity (Section 3), I have shown how negativity-tags can be understood as complex anaphoric expressions. They involving an anaphoric element in an anti-veridical context and a second discourse requirement that enforces a non-contradictory interpretation of the utterances containing the anaphor and its antecedent (Section 4).

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Conversational dynamics of Russian questions with *razve*[1]

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Abstract. Russian questions with the particle *razve* appear to convey negative bias in conflicting-evidence scenarios, thus bearing superficial resemblance to English questions with *really* (cf. Repp and Geist forth.). I argue that *razve*-questions convey a novel type of bias and signal that the speaker is in a situation with belief revision potential, facing a conflict between a prior belief and a current abductive inference. Depending on context, such questions receive (i) an information-seeking interpretation or (ii) what I will call a 'point-making' interpretation. I propose a unified semantics for *razve*, while also showcasing the limitations of current approaches to question bias and making a case for sensitivity to abduction in a novel empirical domain.

Keywords: abduction, belief revision, non-canonical questions, question bias, Russian.

1. Introduction

Razve is a Russian left-periphery particle used in matrix polar questions. Previous descriptions attribute to it a sense of incredulity (Baranov 1986; Bulygina and Shmelev 1987; Shvedova et al. 1980) and analyze it as an equivalent of English *really* (Repp and Geist forth.). I argue for a more nuanced view on *razve*'s contribution and propose that its main function is to signal that the speaker is in a situation with belief revision potential. (1) illustrates.[2]

(1) *Context: Bear decides to be a tree and begins to wave his four paws, while running around the clearing. When asked by Squirrel what he's doing, he says he's swaying his branches.*

a.

Ty	**razve**	derevo?	— udivilas'	Belka.	[...]
you.NOM	**RAZVE**	tree.NOM.SG	wonder.SG.F.PST	squirrel.NOM.SG	

' "You are a tree?", Squirrel wondered.'

b.

Razve	ty	kogda-nibud'	videl,	chtoby	derev'ia	begali?
RAZVE	you.NOM	ever	see.SG.M.PST	COMP	tree.NOM.PL	run.PL.PST

' "Have you ever seen trees run?" ' (*That Kind of Tree*, Sergey Kozlov)

(1) features *razve* twice, in (1a) with $p =$ 'that Bear is a tree' (Russian is a null-copula language) and in (1b) with $q =$ 'that you have at some point seen trees run' (likely a generic use of the second person pronoun). Following the literature on question bias and especially existing accounts of English *really* (Romero and Han 2004; Repp 2013), Repp and Geist (forth.) treat *razve* as a marker of conversational denial whose contribution is supposed to be roughly as follows. The speaker (i) has a pre-existing belief that $\neg p$ and (ii) wants to hold on to this belief, (iii) even though there is evidence to the contrary. This analysis incorrectly predicts that Squirrel is against adding p to the common ground (which she would have been had she

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[2]The Library of Congress' transliteration conventions for Cyrillic are used throughout. Glosses: 1,2,3 person, ACC accusative, COMP complementizer, DAT dative, GEN genitive, F feminine, FUT future, INF infinitive, M masculine, N neuter, NEG negation, NOM nominative, PL plural, PRED predicative, PREP prepositional, PRS present, PST past, SG singular.

asked *Are you really a tree?*). I argue that the overall effect in (1) is in fact different—it signals Squirrel's being perplexed. More specifically: (i) Squirrel had prior beliefs that Bear is not a tree ($\neg p$) and that Bear, or anyone else, would not have seen trees run ($\neg q$) (implying that trees don't run); (ii) Bear's words and actions present evidence conflicting with those beliefs ($p \wedge q$); (iii) accepting this new information will result in inconsistent beliefs ($[p \wedge \neg p] \wedge [q \wedge \neg q]$); (iv) Squirrel asks genuine questions to resolve the conflict. *Razve* is different from *really* or other previously described markers of bias, and this paper develops an analysis for it.

I argue that *razve* conveys a special type of question bias associated with belief revision potential and the speaker's private epistemic crisis. I develop a semantics that captures this core meaning and accommodates two related uses of *razve*-questions that are sometimes hard to distinguish: (i) as information-seeking questions, in cases when the speaker gives up their prior belief, and (ii) as what I will call 'point-making' questions, in cases when the speaker is reluctant to let go of a prior belief (this use is similar, but not identical, to classic rhetorical questions). The paper is structured as follows. Section 2 provides background on polar interrogatives in Russian. Section 3 focuses on information-seeking uses of *razve*-questions and shows why they do not fully fit into the existing typology of question bias. Section 4 introduces point-making uses and lays out the proposal that unifies the two uses. Section 5 concludes.

Before I proceed, two caveats on the empirical scope of the paper. First, I only discuss cases when *razve* combines with the positive content proposition to isolate its core meaning. It is likely that the contribution of clausal negation, when it is present, is fully compositional (see Repp and Geist (forth.), Zanon (2023) for detailed discussion of negated questions). Second, I focus on *razve* in interrogatives. It has another life in nominal exceptives (≈'except for') and exceptive conditionals (≈'except if'). I leave it to future research to see if the interrogative and the exceptive use can be attributed a unified synchronic semantics.

2. Background on polar interrogatives in Russian

Setting alternative questions aside, Russian has two types of polar questions (Comrie 1984; Shvedova et al. 1980): (i) questions with the particle *li* (often perceived as more formal; Schwabe, 2004) and (ii) declarative string questions formed by intonation. Both types of questions—and only those types of questions—can be used in neutral contexts where the speaker has no prior expectations, or contextual indications, regarding the answer (2 and 5).

(2) *Adapted from a visa application form:*

Imeete	**li**	vy	rodstvennikov	v	Rossiiskoi	Federatsii?
have.2PL.PRS	LI	you.NOM	relative.ACC.PL	in	Russian.F.PREP.SG	federation.PREP.SG

'Do you (formal) have any relatives in Russian Federation?'

Li is a second-position clitic (Franks and King 2000: 349-357) whose host—main predicate by default—is the focus of the question. *Li* is optional in matrix polar questions, obligatory in embedded polar questions (7a) and banned in *wh*-questions (3).

(3) [*li-Q + wh-Q]

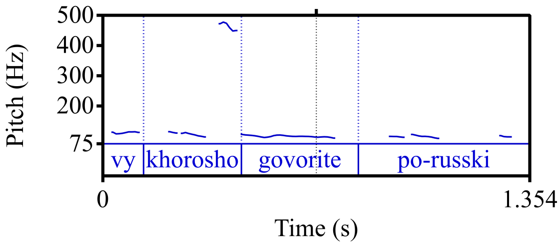
Gde	(***li**)	ty	(***li**)	byla	(***li**)?
where	LI	you.SG	LI	be.SG.F.PST	LI

'Where have you been?'

Li has been analyzed as a complementizer (King 1994; Schwabe 2004), which would explain the ungrammaticality of (3) as a ban on the doubly-filled COMP. However, from a semantic standpoint, *li* is likely not a clause-typing element but a quantifier particle (Szabolcsi 2015), as it occurs precisely in those environments where such particles are expected: interrogatives, disjunctions (e.g., the alternation disjunction *to li X, to li Y* 'now X now Y'), modals (e.g., *edva li* 'hardly', *chutj li* 'almost'). Treating *li* as a complementizer requires us to postulate several *li*'s to explain those other uses (see also Rudnitskaya (2000) for additional evidence against the complementizer view). Not treating *li* as a complementizer allows us to maintain one question operator across different question strategies—with *li* and without, and this is the view I adopt.

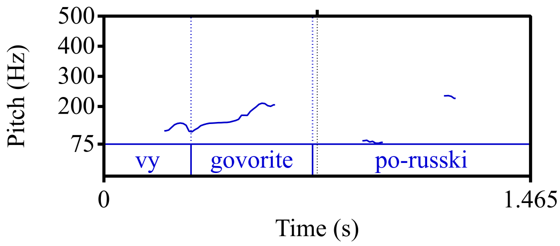
Another question strategy is based off declarative strings with a special intonation that differentiates them from assertions.[3] Declarative string assertions, as in (4), typically have a falling intonation throughout (see discussion and references in Jasinskaja 2014).[4]

(4) Vy khorosho govorite po-russki.
you.NOM well speak.2PL.PRS Russian
'You (formal) speak Russian well.'
(*It Was in May*; 1970)

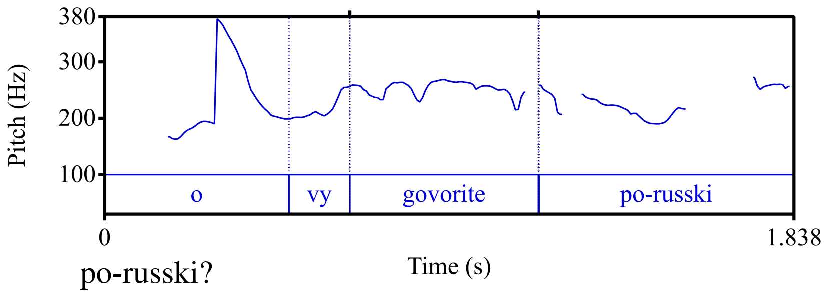


Declarative string questions in Russian have two distinct intonational patterns (Esipova 2022), illustrated by the near-minimal pair in (5) and (6). Neutral questions (5) are characterized by falling intonation and a sharp rise typically on the main predicate (see detailed discussion in Meyer and Mleinek 2006). The same string with a final rise, as in (6), is also a question, but not a neutral one. Dubbed explanation-seeking in Esipova and Romero (2023), such questions carry an evidential bias (see Section 3.2) and are infelicitous out of the blue.

(5) *Neutral context: Gérard Simon is interviewing a prospective secretary Marie, asking her whether she understands her duties. He says:*
Vy govorite po-russki?
you.NOM speak.2PL.PRS Russian
'Do you (formal) speak Russian?'
(*Teheran 43*; 1981)



(6) *Non-neutral context: Mary Stuart hears an Arab sheikh to be using Russian swearwords. She says:*



O, vy govorite po-russki?
oh you.NOM speak.2PL.PRS Russian
'Oh, you (formal) speak Russian?'
(*Weather Is Good on Deribasovskaya, It Rains Again on Brighton Beach*; 1992)

[3] The default word order is SVO, with other options possible based on information structure (Jasinskaja 2014).
[4] Unless indicated otherwise, sound files were extracted from the multimedia corpus within the Russian National Corpus, with the film's name and year in parentheses. Pitch contours and text annotations were generated in Praat.

Importantly, there is a mapping between intonation and meaning. The final rise contour, as in (6), will be inappropriate in the unbiased-inquiry context of (5). And the contour with the sharp rise on the predicate, as in (5), will be infelicitous in the explanation-seeking context of (6).

One final fact to conclude this discussion with. *Li* is obligatory in embedded polar interrogatives (Schwabe 2004) regardless of the embedding environment (7a).[5] Declarative string questions, on the other hand, are limited to matrix clauses (7b) (‘ask’ allows a quotation interpretation), as is common—if not universal—for question strategies that are formed exclusively by intonation.

(7) a. Masha sprashivaet / somnevaetsja, [embedded *li*-Q]
masha.NOM ask.3SG.PRS / doubt.3SG.PRS

govorite **li** vy po-russki.
speak.2PL.PRS **LI** you.NOM Russian
‘Masha asks / doubts whether you (formal) speak Russian’.

b. *Masha sprashivaet / somnevaetsia, [*embedded declarative string Q]
masha.NOM ask.3SG.PRS / doubt.3SG.PRS

vy govorite po-russki.
you.NOM speak.2PL.PRS Russian
Intended: ‘Masha asks / doubts whether you (formal) speak Russian’.

3. *Razve*-questions: core data

Unlike *li*-questions (2) or declarative string questions with a sharp rise (5), *razve*-questions are not neutral and are inappropriate, even rude, in scenarios intended as unbiased inquiries (8).

(8) *Question during a job interview:*
#**Razve** vy govorite po-russki? [well-formed on its own]
RAZVE you.NOM speak.2PL.PRS Russian
‘Do you (formal) speak Russian? (I thought you didn’t).’

3.1. Distribution

Razve is a left periphery particle typically occupying a clause-initial position (1b, 8), though sometimes material scrambles to its left (1a).[6] *Razve* is incompatible with *wh*-questions (9a), which are formed by the obligatory *wh*-fronting, but licenses non-fronted *wh*-pronouns interpreted as indefinites (9b) (cf. Tretyakova 2009: 52).

(9) a. ***Razve** gde ty byla? [**razve* + *wh*-Q]
RAZVE where you.NOM be.F.SG.PST

b. **Razve** ty gde byla? [*razve* + *wh*-indefinite]
RAZVE you.NOM where be.F.SG.PST
‘Have you been anywhere? (I thought you hadn’t).’

[5] *Li* can be absent in embedded alternative questions with the disjunction *ili* (> *i* ‘and’ + *li*), supporting a separate treatment of alternative questions as a class (Biezma and Rawlins 2012). I thank Masha Esipova for the pointer.

[6] *Razve* can be used on its own, without a full clause, as a reaction to a previous assertion (so it is a likely case of ellipsis). With negation, it is also used after declarative hosts as a reverse-polarity tag, e.g., *Razve net?* ‘Is this not so?’ (RAZVE be.PRS.NEG). I leave those uses aside and concentrate on stand-alone *razve*-clauses in this paper.

Razve is also incompatible with *li*-questions (10) as well as with alternative questions. Importantly, embedded *razve* is always bad, regardless of the semantic subtleties of the embedding environment. Since *li* is obligatory in embedded polar non-alternative interrogatives, the ungrammaticality of (10b) can be also driven by the incompatibility with *li*.

(10) a. **Razve** (*__li__) vy (*__li__) govorite po-russki? [**razve* + *li*-Q]
RAZVE LI you.NOM LI speak.2PL.PRS Russian
= (8) 'Do you (formal) speak Russian? (I thought you didn't).'

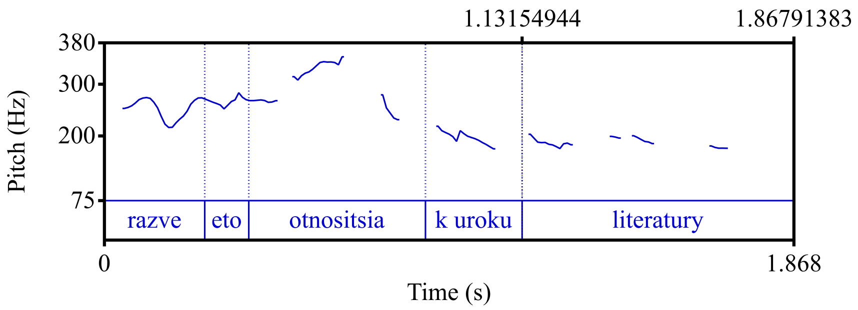
b. *Masha sprashivaet / somnevaetsia [*embedded *razve*]
Masha ask.3SG.PRS / doubt.3SG.PRS

/ ne znaet, **razve** vy govorite po-russki.
/ NEG know.3SG.PRS RAZVE you.NOM speak.2PL.PRS Russian
Intended: 'Masha asks / doubts / doesn't know if you (formal) speak Russian.'

	Polar Qs		Wh-Qs	
	root	embed	root	embed
li-Qs	✓	✓	*	*
decl-Qs	✓	*	N/A	N/A
razve	✓	*	*	*

The distribution of *razve*-clauses mirrors that of declarative string questions. But we have yet to show that *razve*-clauses are in fact interrogatives. There are two pieces of evidence in support of this: licensing of indefinite pronouns, and intonation. First, *razve*-clauses license *nibud'*-indefinites (1b) and *wh*-indefinites (9b). Those pronouns are banned in unmodified matrix declaratives and require the presence of certain operators, such as the question operator, some modals and quantifiers (Tretyakova 2009; Yanovich 2005). This shows that *razve*-clauses can be interpreted as questions, but not that they have to. The second, and conclusive, piece of evidence comes from intonation. *Razve*-clauses have the same intonation as neutral declarative string questions. (11) is a clear example of the pattern, with the sharp rise on the main predicate *otnositsia* and falling intonation elsewhere. Sometimes we can see focus on other constituents (cf. 12) or the final rise if the sentence actually ends with the predicate. Crucially, as discussed in Section 2, declarative string assertions have a different prosody.

(11) *Context: Tania, a highschool student, is instructed by the teacher to pay more attention to another student's presentation. She says:*
Razve eto otnositsia k uroku literatury?
RAZVE this.N.NOM.SG belong.3SG.PRS to lesson.DAT.SG literature.GEN.SG
'Does it have to do with the literature class? (I thought it didn't.)'
(*Wild Dog Dingo*; 1962)



To sum up, *razve* only occurs in matrix polar interrogatives, thus fitting well into the cross-linguistic picture. Expressions of bias normally do not occur in alternative questions, *wh*-

questions, or embedded questions (this latter fact sometimes attributed to the syntactic height of bias; Dayal 2021). Borrowing Bhatt and Dayal's (2020) idea on Hindi/Urdu *kya* (argued to be incorrect for the Hindi/Urdu data; Biezma et al. 2022), I propose in Section 4.3 that *razve* places a singleton constraint on its complement, which makes it semantically incompatible with all but matrix polar questions.

3.2. *Razve* and current typology of question bias

Canonical information-seeking questions are naive inquiries for information, with the speaker genuinely agnostic about the answer and expecting the addressee to be able to provide it. Non-canonical questions comprise a large class of interrogative strategies that diverge from this standard in various ways. In particular, question bias is typically understood as the speaker's attitude towards the truth or likelihood of the content proposition (Goodhue; Romero, 2022; 2020, a.o.). It is clear that *razve*-questions are not neutral and can be treated as conveying some type of bias. Thus, Shvedova et al. (1980: 388) attribute to *razve* a sense of incredulity or confusion. In this section, I show why *razve* does not quite fit into the existing typology, focusing on its information-seeking uses (its point-making uses are discussed in Section 4.2).

Question bias is commonly parameterized as follows (see especially Domaneschi et al. 2017):

— **Epistemic bias**: speaker's belief about p prior to conversation (Romero and Han 2004).

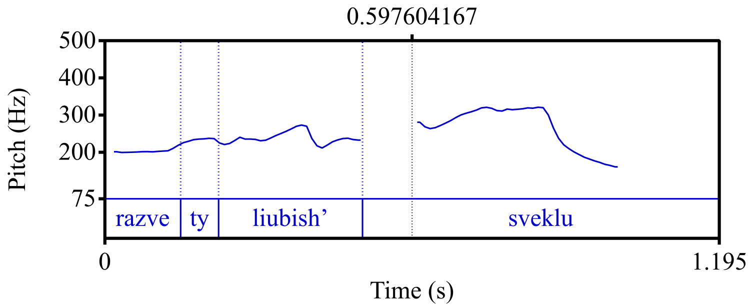
— **Contextual bias:** mutual evidence about p during conversation (Büring and Gunlogson 2000; Sudo 2013; this literature does not discuss evidence type, see Section 3.3).

— **Polarity:** positive (belief/evidence for p), negative (belief/evidence for $\neg p$), neutral.

At first blush, *razve* seems to squarely fit into the above taxonomy, as it only occurs in scenarios with (i) negative epistemic bias, i.e., prior belief that $\neg p$; and (ii) positive contextual bias, i.e., mutual evidence that p (cf. Baranov 1986; Bulygina and Shmelev 1987; Comrie 1984). Importantly, *razve*-questions have the intonation of neutral declarative string questions, such as (5). Unlike the contour of explanation-seeking questions (6), this contour is not on its own associated with any type of bias. The intonational pairing between *razve* and the 'neutral' contour demonstrates that the bias requirements of *razve*-questions come from the presence of *razve* itself.[7]

(12) is the target sentence, with the prosody of a neutral question: falling intonation and a sharp rise on the direct object.[8]

(12) **Razve** ty liubish' sveklu?
RAZVE you.NOM love.2SG.PRS beet.ACC.SG
'Do you like beets? (I thought you didn't.)'



[7]These data corroborate the findings in Repp and Geist (forth.) though I would like to make a methodological remark here. Repp and Geist do not look at intonation, and focus on negative questions, with and without *razve*. This may introduce additional confounds, and I maintain that it is more helpful to start with *razve* on its own.

[8]The sentence has been recorded by an adult native speaker living in Russia and analyzed in Praat.

(13)-(15) present scenarios that manipulate different parameters of bias.

(13) **Neutral epistemic:** I meet you for the first time, we go out for lunch.
  a. **Neutral contextual:** I order for both us and check with you beforehand.
  b. **Positive contextual:** You order beetroot hummus.
  c. **Negative contextual:** You avoid all beet mezzes.

(14) **Positive epistemic:** Based on what I know about you, I was sure you like beets.
  a. **Neutral contextual:** I invite you over and double-check before cooking.
  b. **Positive contextual:** We go out for lunch and you order beetroot hummus.
  c. **Negative contextual:** We go out for lunch and you avoid all beet mezzes.

(15) **Negative epistemic:** Based on what I know about you, I was sure you hate beets.
  a. **Neutral contextual:** I invite you over and double-check before cooking.
  b. **Positive contextual:** We go out for lunch and you order beetroot hummus.
  c. **Negative contextual:** We go out for lunch and you avoid all beet mezzes.

	Cont: neut	Cont: p	Cont: $\neg p$
Epi: neut	# (13a)	# (13b)	# (13c)
Epi: p	# (13a)	# (13b)	# (13c)
Epi: $\neg p$	# (15a)	**✓(15b)**	# (15c)

Of the scenarios above, the *razve*-question in (12) is only licensed in (15b): (i) a pre-existing belief that the addressee does not like beets in the face of (ii) contextual evidence to the contrary. These data suggest a family resemblance between *razve* and other markers of negative epistemic bias, such as English *really* (Romero and Han 2004), Italian *mica* (Frana and Rawlins 2019) and German *etwa* (Xu 2017). To this end, Repp and Geist (forth.) analyze *razve* precisely as a Russian counterpart of *really*. I show that the resemblance is only superficial.

Expressions associated with bias are typically viewed as a means of conversation negotiation (see especially Goodhue 2022). They have been analyzed as (i) operators updating discourse commitments of the interlocutors (Gunlogson 2003; Malamud and Stephenson 2015; Xu 2017), or as (ii) operators that allow the speaker to mediate, and possibly manipulate, the common ground (Repp 2013; Romero and Han 2004; Silk 2019). Expressions of negative epistemic bias have been argued to signal a conversational crisis and, under many analyses, to express the speaker's denial to accept some information or actions. By Repp and Geist's lights, this should be the sole function of *razve*-questions as well—to indicate that the content proposition is not part of the common ground in all worlds compatible with the speaker's conversational goals. I argue against this view.

First, *razve* signals not a conversational crisis but the speaker's private crisis, a tension between their prior beliefs and current conflicting evidence. Unlike *really*, *razve* is natural in (16)–(17). It does not express doubt, but conveys the speaker's willingness to reconsider their prior belief.

(16) *Context: My spouse brought strawberries from the market.*

Razve	v	avguste	eshche	est'	klubnika?
RAZVE	in	august.SG.PREP	still	be.PRS	strawberry.NOM.SG

'Do they still have strawberries in August? (I thought they didn't).'
≉ 'Do they really have strawberries in August?'

(17) *Context: I overhear a friend thanking the waiter in Turkish at a coffee shop.*
Razve ty govorish po-turetski?
RAZVE you.NOM speak.2SG.PRS Turkish
'Do you speak Turkish? (I thought you didn't.)'
≉ 'Do you really speak Turkish?'

Second, *razve* may void the speaker's commitment entirely, as follow-ups in (18) show:

(18) *Context: I see infrared pictures of wolves on the slopes of a nearby mountain.*
Razve v Al'pax est' volki?
RAZVE in Alps.PREP.PL be.PRS wolf.NOM.PL
'Are there wolves in the Alps? (I thought there weren't.)'

a. Mne ✓kazalos' / ??kazhetsja, chto net.
I.DAT seem.N.SG.PST seem.PRS COMP be.PRS.NEG
'It seemed to me / (??) seems to me there aren't.'

b. Ja ✓nadeius' / ✓dumala / ??dumaiu, chto net.
I.NOM hope.1SG.PRS think.F.SG.PST think.1SG.PRS COMP be.PRS.NEG
'I hope / thought / (??) think there aren't.'

c. ✓Ja somnevaius'.
I.NOM doubt.1SG.PRS
'I doubt it.'

Epistemic bias is typically analyzed as a belief acquired prior to, and held during, the conversation. The speaker is predicted to be committed to p or $\neg p$ at least weakly (cf. Malamud and Stephenson 2015). The data on *razve* in (18) paint a different picture, as the speaker may have no current belief. As I argue in Section 4, with information-seeking uses of *razve* belief revision is in progress, which is why the present-tense 'seem' (18a) and 'think' (18b) are degraded compared to the perfectly acceptable past-tense variants. Follow-ups with 'hope' (18b) and 'doubt' (18c) are also telling, as they signal that the agent's doxastic state is undecided.

To recapitulate, *razve* may look at first like a vanilla marker of negative epistemic bias that also carries positive evidential bias. Intonation data prove that the bias component comes from *razve*, as *razve*-questions have a neutral contour that is not associated with bias on its own. A closer look reveals that taking an off-the-shelf analysis makes wrong predictions (pace Repp and Geist forth.). *Razve*, unless used to make a point, signals the speaker's perplexity and as such does not require the speaker to be committed to their prior belief. This is in contrast with its putative cousin *really* that signals disagreement rooted in strong conviction. I argue that *razve* represents a novel type of bias and current approaches, often designed for *really*, are not fine-grained enough to capture it. Crucially, my claim goes beyond two specific particles. My goal is to expose the limitations of the widespread view wherein the phenomenon of question bias is understood almost exclusively as a means of carrying out a certain conversational agenda, such as the agenda of disbelief in case of negative epistemic bias.

3.3. Evidence, inference, abduction

In this section, I refine the notion of 'evidence' associated with *razve*-questions and show that they require the presence of an abductive inference, thus making a case for sensitivity to abduction in a novel empirical domain. First, as is common for expressions of contextual bias (Büring and Gunlogson 2000; Sudo 2013), *razve* requires contextual evidence to be mutual:[9]

(19) *We're at a bar in New York where I thought indoor smoking was banned.*
✓**Context 1, mutual**: *Another guest lights a cigarette.*
#**Context 2, non-mutual**: *While you were at the counter, another guest lit a cigarette.*

Razve	zdes'	mozhno	kurit'?
RAZVE	here	can.PRED	smoke.INF

'Is it allowed to smoke here? (I thought it wasn't.)'

Mutual availability is not the only constraint on evidence placed by *razve*—strength and type of evidence also play a role, as is the case with evidential restrictions elsewhere in the grammar (Matthewson 2020). The evidence must be strong enough to have the potential to cause belief revision. If a piece of evidence is too weak, the speaker has no reason to change their pre-existing belief. And if it is too strong, there is no point in asking an information-seeking question (see Section 4.2 for another interpretation). (20) illustrates.

(20) *We're hiking above the tree line on what was supposed to be a fine day.*
#/??**Context 1, weak**: *Cumulus clouds start forming in the distance.*
✓**Context 2**: *My companion is donning raingear / says that they will put raingear on.*
#**Context 3, too strong**: *Large rain drops are falling with an increasing speed.*

Razve	budet	dozhd'?
RAZVE	be.3SG.FUT	rain.NOM.SG

'Will there be rain? (I thought there wouldn't be).'

Cumulus (puffy, cauliflower-shaped) clouds typically indicate a thunderstorm, but not rain as such, so a *razve*-question in Context 1 sounds odd. Context 3, on the other hand, entails the truth of the content proposition under normal circumstances. It is clear that there will be rain in a matter of minutes, so a question (with or without *razve*) cannot be sincere. Finally, Context 2 naturally supports a *razve*-question: putting raingear on suggests the possibility of rain (in the mind of my hiking partner, whose judgment I trust) but it can have other reasons, e.g., wind protection or warmth, so the question about rain is genuine.

Finally, *razve*-questions require public evidence that supports a mutual abductive inference. Abductive inference is also called an inference to the best explanation, and refers to reasoning from an observed effect to the most plausible explanation thereof (Douven 2021). If I see that everything is wet in the morning (effect) I'm entitled to make an abductive inference that it rained the night before (explanation, and, in this case, likely cause). A cause-to-effect inference that the ground will be wet tomorrow because it is raining tonight may be valid, but it is not abductive. (21)-(24) demonstrate that abduction plays a role in the licensing of *razve*.

(21) *Context: I am over at your house in the country and see a mouse. I ask:*

Razve	u	vas	net	kota?
RAZVE	by	you.PL.DAT	be.PRS.NEG	cat.GEN.SG

'Do you guys not have a cat? (I thought you would, like every village house.)'
Background assumption (likely mutual), effect-to-cause:
The absence of cats is a very plausible explanation for the presence of mice.

[9]This is in contrast with bona fide evidentials, which do not require shared evidence (Korotkova 2016).

(22) *Context: I am over at your house in the country and ask where your cat is. You tell me you don't have one. My next question is:*

#**Razve**	u	vas	net	myshei?
RAZVE	by	you.PL.DAT	be.PRS.NEG	mouse.GEN.PL

'Do you guys not have mice? (I thought you would, like every village house.)'

Background assumption (unlikely mutual), effect-to-explanation:
The absence of mice is a very plausible explanation for the absence of cats.

(23) *Context: You say that Masha got sick with Covid-19. Her test yesterday was negative.*

Razve	u	nee	polozhitel'nyi	test?
RAZVE	by	she.DAT	positive.M.NOM.SG	test.NOM.SG

'Does she have a positive test? (I thought she would be still negative.)'

Background assumption (likely mutual), effect-to-explanation:
Masha's having tested positive is a very plausible explanation for your assertion.

(24) *Context: Venice banned passengers of cruise ships from disembarking on weekdays. It's Monday and I see a huge ship stopping.*

#**Razve**	segodnia	snova	budut	tolpy	liudei?
RAZVE	today	again	be.3PL.FUT	crowd.NOM.PL	people:PL.GEN

'Will there will be crowds again today? (I thought there would be none.)'

Background assumption (likely mutual), cause-to-effect: Ships cause crowds.

Razve-questions are licensed in situations when a mutually available observation can be explained by a shared abductive inference that *p*, as in (21) where the speaker reasons from the presence of mice (effect) to the absence of cats (explanation). Abduction is not limited to causation (Kment 2014), and *razve* is licensed in a non-causal scenario in (23) where the speaker reasons from a statement that Masha is sick (effect) to Masha's having tested positive (explanation). A non-trivial, and likely non-shared, inference that the absence of cats is plausibly explained by the absence of mice does not support *razve* (22). Finally, non-abductive inferences, even when shared, do not provide necessary grounds for a *razve*-question (24).

Such restrictions have not been discussed before in the context of bias. However, they are only expected if question bias is to be understood as a modal notion, given that abduction plays a role in the semantics of various modal operators.

4. Proposal

To recapitulate, *razve*-questions differ from ordinary polar questions in that they conventionally encode two types of bias: speaker's prior belief that $\neg p$ and mutual evidence that *p*. I propose that *razve* is an operator that places a singleton constraint on its prejacent and makes two not-at-issue contributions responsible for the biases. I further argue that *razve*-questions signal that the speaker is in a situation with belief revision potential caused by the tension between those two biases. Lest they end up with inconsistent beliefs, the speaker cannot both hold on to their prior belief and accept new evidence to the contrary. Depending on how the speaker prefers to resolve this tension, *razve*-questions can receive (i) an information-seeking interpretation (the speaker willing to give up their prior belief), or (ii) a point-making interpretation (the speaker unwilling to accept new evidence). I argue that both interpretations can be captured by a unified semantics, the actual interpretation being determined by context.

4.1. Two inferences: epistemic bias, evidential bias

Both inferences are a type of not-at-issue entailment: they are hard-wired and they are not part of the at-issue content of a *razve*-question. To this end, consider the question in (25).

(25)

Razve	slonopotamy	zhivut	v	lesu?
RAZVE	heffalump.NOM.PL	live.3PL.PRS	in	wood.SG.PREP

'Do heffalumps live in the woods? (I thought they didn't.)'

First, none of the sentences in (26) is a felicitous follow-up to (25). The speaker cannot void their own epistemic bias in a *razve*-question (26a) or the presence of mutual evidence (26b). This shows that those inferences are part of the semantic content and not, say, implicatures.

(26) Follow-ups to *Do heffalumps live in the woods*? (=25):

a.

#Ja	nikogda	ob	etom	ne	zadumyvalas'.
I.NOM	never	about	this.N.SG.PREP	NEG	think.F.SG.PST

'I've never considered this issue.'

b.

#U	nas	sovsem	net	prichin	tak	dumat'.
by	we.GEN	completely	be.NEG.PRS	reason.GEN.PL	so	think.INF

'We have no reasons whatsoever to think this way.'

Second, responses to a *razve*-question only target the content proposition, but not the speaker's prior belief or mutual evidence (27). In other words, neither of the biases can be directly replied to, a pattern that characterizes not-at-issue content in questions across the board.[10]

(27) Responses to *Do heffalumps live in the woods*? (=25):

a. Da. 'Yes'.
= 'They live in the woods.'
≠ 'You thought they didn't'.
≠ 'We have reasons to think so.'

b. Net. 'No'.
= 'They don't live in the woods.'
≠ 'You didn't think they didn't'.
≠ 'We have no reasons to think so.'

To sum up, both biases are conventionally encoded by *razve* and constitute a type of not-at-issue content, though of different sorts. The evidential bias has the signature behavior of presuppositions: it is a constraint on the input context (Tonhauser et al. 2013). Consider the contexts in (28). (25) is felicitous in Context 1, where the presence of evidence is part of mutual knowledge, and infelicitous in Context 2, where it isn't; see also (19).

(28) ✓*Context 1: In a forest, we come across the tracks resembling those of heffalumps.*
#*Context 2: In a magazine, I come across the claim that forest is a heffalump habitat.*
Razve slonopotamy zhivut v lesu? 'Do heffalumps live in the woods?' (=25)

The infelicity in Context 2 can be easily repaired by an accommodating addressee who may say something along the lines of *Net, a chto?* 'No, why?'. But a simple *yes/no* reply will be odd in a context where the availability of evidence is not established as part of the common ground.

The inference about the speaker's prior belief behaves differently. *Razve*-questions are perfectly felicitous even when the addressee knows nothing about the speaker's epistemic state with respect to the issue raised by the question. For example, the question in (20), *Razve budet dozhd'?* 'Will there be rain? (I thought there wouldn't be.)', is fine as a conversation starter between

[10]The answering pattern is the best diagnostic of not-at-issueness in this case, since other tests, e.g., projection, are not available given that *razve* is limited exclusively to matrix polar interrogatives.

strangers in a hallway, provided that the context establishes evidence for possible rain, e.g., one of the interlocutors is carrying an umbrella. Such data show that the speaker's bias inference contributes new information and therefore is not a presupposition (unless it as a presupposition that is always accommodated). I will analyze this inference as a type of parenthetical meaning—novel, by-the-way information the speaker conveys when asking a *razve*-question.

4.2. Belief revision and two interpretations: information-seeking, point-making

In the cases discussed so far, *razve*-questions receive an information-seeking interpretation such that the speaker is genuinely perplexed about the state of affairs with respect to p and expects the addressee to be in a better position to provide an answer. However, *razve*-questions also have another use that I will call 'point-making'. Those are cases when the speaker not only had a prior belief that $\neg p$, but wants to hold on to it and makes a point of it. (29) and (30) illustrate.

(29) *Context: To yet another young person in a war zone:*

Razve mozhno detej na vojnu posylatj.
RAZVE can.PRED child.ACC.PL to war.ACC.SG send.INF
≈ 'How can one even send kids to war?' (*Life and Fate*, Vasily Grossman)

(30) *Context: Amid pleas to somehow counteract the Red Terror during the Stalin years.*

a. **Razve** moi golos ostanovit rasstrely?
RAZVE my voice.NOM.SG stop.3SG.PRS shooting.ACC.PL
'Will my voice stop mass shootings?

b. Kto menia poslushaet.
who.NOM I.ACC listen.3SG.PRS
'Who will even listen to me.' (*Memoirs*, Nadezhda Mandelstam)

The context makes it clear that *razve* is not information-seeking in the examples above. In (29), the speaker believes that kids should not be sent to war. In (30a), the speaker is convinced that their voice will not stop mass shootings. In this respect, point-making uses are similar to rhetorical questions, which are often used to make a point and elicit a commitment from the addressee. The difference is that with rhetorical questions, either the answer is already known/obvious or the question is unanswerable (Biezma and Rawlins 2017; Farkas 2023; Rohde 2006). (30b) is a textbook rhetorical question, with the obvious answer *nobody*. *Razve*-questions, on the other hand, do not necessarily suggest, though they may, that the answer is in fact known and have an overall different discourse function.

Just like information-seeking uses of *razve*-questions, point-making uses also require the presence of evidential bias that may support p. In (29), the presence of a young person at war may be taken to support the idea that it is okay to send kids to war. In (30), pleas to counteract the terror may be taken to support the idea that one's voice may stop mass shootings. However, evidence is inconclusive in each case and the function of a *razve*-question is to indicate that the speaker would like the addressee to get on board with what they themselves think the answer—and the world—should be.[11] If nothing else, it is a protest. Common with normative claims, such uses often appear in political discourse and other situations of taking a public stance. I am not aware of previous descriptions of such questions and will use the term 'point-making'.

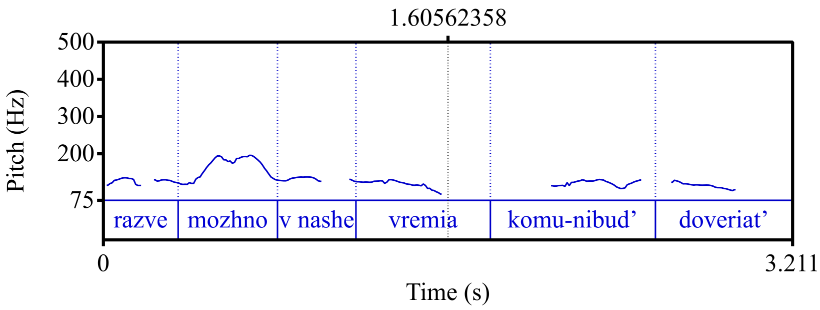
[11] Not the same as quiz questions, in which the speaker (instructor/quiz master) checks the addressee's knowledge.

Importantly, point-making uses of *razve*-questions have the same general properties as the information-seeking uses. First, they, too, require the presence of the epistemic and evidential biases. Second, *razve*-questions have the same intonational contour across the board: that of neutral declarative-string questions, with a sharp rise typically on the main predicate (see Section 2). Information-seeking interpretations were discussed in Section 3.1, and (31) illustrates it for point-making questions.

(31) *Context (point-making, not information-seeking): Followed up by the speaker's assertion that nobody is to be trusted.*

Razve	mozhno	v	nashe	vremia	komu-nibud'	doveriat'?
RAZVE	can.PRED	in	our.N.SG.ACC	time.ACC.SG	anyone.ACC	trust.INF

'Can one trust anyone nowadays?' (*A Cruel Romance*; 1984)



The data above suggest that the two interpretations of *razve*-questions, information-seeking and point-making, do not differ semantically or syntactically, but arise pragmatically. Below, I argue that the interpretation in a given context depends on how the speaker chooses to resolve the belief revision problem created by the two biases.

Consider the following idealized maxims that govern belief change of rational agents (formulation adapted from Roberts 2019; see extensive discussion and references in Hansson 2022):

- CONSISTENCY: Do not have inconsistent beliefs.
- CONSERVATION: Do not revise existing beliefs.
- JUSTIFICATION: Do believe that for which you have good evidence.

Recall that *razve*-questions always carry two biases: (i) the speaker's prior belief that $\neg p$ and (ii) mutual observation supporting an abductive inference that p. Together, those inferences create an epistemic conflict. If evidence for p is good enough, then, by JUSTIFICATION, the speaker is pressed to believe p. But if the speaker comes to believe that p and keeps their prior belief that $\neg p$, they end up with an inconsistent epistemic state, thus violating CONSISTENCY. Assuming that rational agents strive to be consistent, the conflict can be resolved in at least two ways—depending on the strength of the speaker's conviction that $\neg p$.

If the speaker accepts new evidence as valid, they may be willing to give up their prior belief (JUSTIFICATION $\simeq$ CONSERVATION). Given that the evidence can't be too strong (Section 3.3), there is still room for doubt, so the speaker asks a question. This is the information-seeking interpretation of *razve*—roughly, "Belief revision in progress, help me decide on an answer".

If the speaker is unwilling to give up their prior belief, they may not accept new evidence as valid (CONSERVATION $>$ JUSTIFICATION). This is the point-making interpretation of *razve*—

roughly, "I won't revise my beliefs based on this, and neither should you". Without this explicit challenge, p might be accepted by the interlocutors, and the speaker is against this.[12]

There is yet another option: the speaker goes along with new evidence, accepts p and gives up $\neg p$ (JUSTIFICATION > CONSERVATION; cf. English *can't believe*, Roberts 2019). I propose that *razve*-questions do not give rise to this interpretation due to a pragmatic competition with another particle, *neuzheli* (discussed in Baranov 1986; Bulygina and Shmelev 1987; Repp and Geist forth.). While for reasons of space I cannot delve into details in this paper, the core idea is as follows. *Neuzheli* is a veridical marker of violated expectations—roughly, "Belief revision completed, I was wrong in my assumptions". And while nothing in my proposed semantics for *razve* excludes *razve*-clauses from having this very interpretation, the existence of a dedicated expression just with this meaning makes it unlikely that *razve* will be chosen to convey it.

4.3. Formal implementation

I will assume that interrogative clauses have a question operator in C and that ordinary polar questions denote singletons, as in (32) (adapted from Biezma and Rawlins 2012: 392).

(32) $[\![\ [_{\text{CP}}\ Q\ [p]]\ ]\!]^c = \{\lambda w.p(w)\}$,
defined iff (i) $\{\lambda p.p(w)\} \subseteq$ ALTS(c) or ALTS(c) $= \emptyset$, and
(ii) $|\ \{\lambda p.p(w)\} \cup$ ALTS(c) $| > 1$.
(where ALTS(c) is a set of salient propositions that are possible answers to the QUD.)

One important thing about (32) is that the content proposition must be one of the salient alternatives—in other words, a question must address the QUD. Note that the treatment in (32) diverges from the standard Hamblin semantics wherein polar questions denote non-singletons; see discussion and references in Biezma and Rawlins (2012); Roelofsen and Farkas (2015).

Turning back to Russian, recall that one of the ways to form a neutral polar question is by using a dedicated intonational contour with a sharp rise on the main predicate (Section 2). For a declarative string to be interpreted as a question, this intonation is obligatory. To this end, I will assume a one-to-one mapping between form and meaning, and will treat this intonation as a Q-morpheme with the interpretation in (32). On this account, assertions have a different interpretation as they lack the question intonation.[13] (33b) is the derivation for the ordinary polar question in (33a).

(33) a. Ty derevo?
you.NOM tree.NOM.SG
'Are you a tree?'

b. $[\![$ (33a) $]\!]^c = [\![\ [_{\text{CP}}\ Q$ [you are a tree]] $]\!]^c = \{\lambda w.$you are a tree in $w\} = \{$you are a tree$\}$,
defined iff (i) $\{$you are a tree$\} \subseteq$ ALTS(c) or ALTS(c) $= \emptyset$, and
(ii) $|\ \{$you are a tree$\} \cup$ ALTS(c) $| > 1$.

I propose that *razve* is a left-periphery operator that selects for questions with singleton denotations and makes two non-at-issue contributions, one responsible for the speaker's epistemic bias

[12]This interpretation comes closer to the effect of conversational denial and is in line with Repp and Geist's (forth.) analysis of *razve*. However, they don't discuss such uses, and their analysis in fact makes wrong predictions for information-seeking uses (Section 3.2).

[13]I sidestep the unexplored issue of whether the intonational pattern in (5) can have a non-question interpretation.

and the other responsible for mutual evidence. This account aims at spelling out the semantics of the particle and at explaining its distribution. Let's start with the latter.

Distribution: *Razve* only occurs in matrix polar interrogatives formed from declarative strings with the neutral question intonation (Section 3.1). It does not co-occur with *li*, is not embeddable (regardless of the embedder) and is banned in *wh*-questions and alternative questions. I propose that all of those environments have in common that they denote non-singleton sets, and that the distribution of *razve* can be captured by the preliminary lexical entry in (34). In words, *razve* selects for questions, but only of a certain type:[14]

(34) ***Razve*, the first pass**:
$[\![\textit{razve} \; [_{\text{CP}} \; Q \; [p]] \;]\!]^c = [\![\; [_{\text{CP}} \; Q \; [p]] \;]\!]^c$, defined iff $| \, [\![\; [_{\text{CP}} \; Q \; [p]] \;]\!]^c \, | \leq 1$.

Let me unpack. It is standard to assume that (a) most, if not all, embedded polar questions and that (b) all *wh*-questions and alternative questions, matrix and embedded, have an anti-singleton constraint. (34) then takes care of this part of the distributional puzzle. What about *li*-questions? And what about those question embedders that take both declarative and interrogative complements (*doubt, don't know*), a selection problem that has been sometimes explained by invoking a singleton constraint? I propose, though I cannot argue for it in detail here, that *li*, as a focus particle, generates its own alternatives and therefore polar *li*-questions denote non-singletons, much like alternative questions. Furthermore, recall that *li* is obligatory in embedded polar questions (except for embedded alternative questions). If my hypothesis about *li* is on the right track, it means that all embedded polar questions in Russian denote non-singletons,[15] thus being incompatible with *razve*.

The idea of *razve*'s imposing a singleton constraint is inspired by Bhatt and Dayal's (2020) treatment of Hindi/Urdu *kya* (argued against in Biezma et al. 2022), though there is a major difference. Bhatt and Dayal (see also Dayal 2021) argue that *kya* is too high on the clausal spine to be embeddable under all but rogative predicates, in line with 'size' approaches to root phenomena (Aelbrecht et al. 2012). I propose instead that the non-embeddability of *razve* is semantic, while the benign syntax in (34) is not meant to exclude embedding wholesale.

Semantics: (35) spells out the semantics of *razve* and (37) is the derivation for (36).

(35) ***Razve*, the final version**:
$[\![\textit{razve} \; [_{\text{CP}} \; Q \; [p]] \;]\!]^c = [\![\; [_{\text{CP}} \; Q \; [p]] \;]\!]^c$,
defined iff (i) $| \, [\![\; [_{\text{CP}} \; Q \; [p]] \;]\!]^c \, | \leq 1$,
(ii) $[\exists q$ such that $[\, Pr(K_{(Sp+Ad,w,t)} \cup q) | p > Pr(K_{(Sp+Ad,w,t)} \cup q) | \neg p \,]] \wedge$
$[\neg\exists r$ such that $[\, Pr(K_{(Sp+Ad,w,t)} \cup q) \mid r \geq Pr(K_{(Sp+Ad,w,t)} \cup q) \mid p \,]]$,
felicitous iff (iii) $\exists t'.[\, t' < t \wedge DOX_{(Sp,w,t')} \subseteq \neg p \,]$.
(where Pr is a probability measure, $K_{(Sp+Ad,w,t)}$ is a set of propositions jointly known to the speaker and the addressee at the time of utterance t, and $DOX_{(Sp,w,t')}$ is the set of worlds compatible with what the speaker believes in w at t'.)

[14] An alternative would be to treat *razve* and *li* as complementizers (which cannot co-occur), explaining *razve*'s incompatibility with *wh*-questions as a ban on the doubly-filled COMP. This solution is problematic for *li* alone (Section 2). It also requires multiple question operators, a problem avoided under the semantic account I propose.
[15] This is not inconsequential for how we think about question embedding more generally, but I will not explore those consequences here. They largely depend on a full semantic account of *li*, a matter I leave for future research.

In words, a question with *razve* is a question that denotes a singleton and conveys two epistemic inferences (Section 4.1). The presupposition in (35.ii) states that there is a salient observation q such that p is a good-fit explanation for q in light of our joint knowledge and there is no other equally good alternative explanation for q. This specific formalization of abduction is adopted from Krawczyk (2012), but nothing hinges on it (see Bjorndahl and Snider (2015); Cumming and Winans (2021) for other options). The inference in (35.iii) states that at some prior time the speaker had a belief that $\neg p$. In this paper, I abstract away from how to model this not-at-issue contribution more precisely and will treat it as a kind of felicity condition whose effect is to shrink the context set to those worlds where the speaker had this particular prior belief.

(36) *Context: Bear decides to be a tree and begins to wave his four paws. When asked by Squirrel what he's doing, he says he's swaying his branches. Squirrel asks:*

Ty	**razve**	derevo?	(=1a)
you.NOM	**RAZVE**	tree.NOM.SG	

'You are a tree? (I thought you weren't).'

(37) $[\![(36)]\!]^c = [\![\textit{razve}\ [_{\text{CP}}\ Q\ [\text{you are a tree}]\ ]\ ]\!]^c$
$= [\![[_{\text{CP}}\ Q\ [\text{you are a tree}]\ ]\ ]\!]^c = \{\lambda w.\text{you are a tree in } w\} = \{\text{you are a tree}\}$,
defined iff (i) $|\,\{\text{you are a tree}\}\,| \leq 1$,
(ii) $\{\text{you are a tree}\} \subseteq \text{ALTS(c) or ALTS(c)} = \emptyset$,
(iii) $|\,\{\text{you are a tree}\} \cup \text{ALTS(c)}\,| > 1$,
(iv) $[\exists q[Pr(K \cup q)|p > Pr(K \cup q)|\neg p]] \wedge [\neg\exists r[\,Pr(K \cup q)|r \geq Pr(K \cup q)|p]]$,
($q =$ 'that Bear says that he is swaying his branches in w')
felicitous iff (v) $\exists t'.t' < t \wedge DOX_{(Sp,w,t')} \subseteq \neg p$.

(36), repeated from (1a), signals that (i) prior to conversation, Squirrel had a belief $\neg p =$ 'that Bear is not a tree' and that (ii) during conversation, there is a mutual observation supporting an abductive inference $p =$ 'that Bear is a tree'. This observation—Bear's saying that his paw-waving is in fact branch-swaying—is strong enough for Squirrel to possibly revise the initial belief but not too strong as to entail p. What (36) ultimately means is a matter of pragmatics.

As I have argued in Section 4.2, *razve*-questions can have an information-seeking or a point-making interpretation. The semantics in (35) does not distinguish between the two interpretations: this is the job of the context in which a *razve*-question is uttered. In (36) and the general context of the story it is taken from, the question asked by Squirrel is a genuine one. Being faced by the conflict between what she thought the world was like and what the world seems to be like, she asks a series of questions that aim at establishing what the world actually is like (=the ultimate QUD). Things could have been otherwise. The question in (36) could have had a point-making interpretation. For example, in a context where for some reason Bear's not being a tree were of public importance and where Squirrel were convinced that he is a not a tree, Squirrel's goal in uttering (36) would be to elicit the corresponding commitment from Bear.

Overall, my proposal predicts that the actual interpretation of any *razve*-question is determined by contextual factors such as the speaker's conviction and the importance of the issue, hence the speaker's desire to make a point. As far as semantics proper goes, there is no difference between information-seeking and point-making uses. There are, of course, differences at the level of conversational moves, but I will not attempt to articulate them in this paper (see, e.g., Farkas and Roelofsen (2017) for assumptions about the division of labor in similar cases).

5. Outlook

Previous work has characterized Russian *razve*-questions as non-neutral because they convey an attitude on part of the speaker. The main task this paper set out to accomplish was to refine the exact type of non-neutrality in a broader context of research on non-canonical questions.

I have argued that *razve* conveys a special type of bias associated with belief revision potential, a conflict driven by the incompatibility of (i) negative bias, the speaker's prior (but not necessarily current) belief that $\neg p$, and (ii) positive contextual bias, mutual evidence that p. Based on how this conflict can be resolved, *razve*-questions receive different interpretations. This is not accounted for by existing approaches, as they focus primarily on the conversational crisis signaled by expressions of negative bias and therefore do not pay attention to the speaker's private epistemic crisis. By examining the evidential requirements of *razve*, I have also made a case for sensitivity to abduction in a novel empirical domain. To the best of my knowledge, this is the first explicit connection between question bias and research on evidence in language.[16]

One of the overarching goals of this paper was to show how one particle can broaden our understanding of the phenomenon of question bias. Needless to say, many questions about the typology of bias remain open, and I hope that they will be addressed in future work.

— To what extent can the singleton denotation explain the limited distribution of markers of bias across languages? Does it matter that they do not all have the same distribution and that some, unlike *razve*, can also appear in assertions (e.g., English *really*, Italian *mica*)?
— To what extent does the system of question particles influence the interpretation of each of them, in Russian or other languages? I briefly touched upon *razve*'s pragmatic competition with *neuzheli* (Section 4.2), and it is likely that there is more to the story.
— To what extent is the behavior of *razve* unique? Are there other expressions that signal belief revision potential and have more than one interpretation as a result? One tentative cousin is Bulgarian *nima* (Tisheva 2001), whose behavior resembles that of *razve*.
— To what extent does abductive inference play a role in contextual bias across languages?

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A man who is married to Ann. – Blocking of indefinites with internal and external modifiers[1]

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Abstract. The definite article often blocks the indefinite article in case the uniqueness condition for definite articles is satisfied, as in #*a husband of Mary.* However, this is not always the case; there is no blocking in in *a man who is married to Mary.* We review Alonso-Ovalle, Menéndez-Benito & Schwarz 2011, who noted the phenomenon and proposed an account in terms of the weak/strong definite distinction. We point out problems in their approach, partly based on experimental results of a rating experiment. We then propose, based on German data, that blocking occurs with functional nouns like *husband* and superlatives like *highest mountain* but not when uniqueness arises through modification by prepositional phrases and relative clauses. We give a novel explanation that relies on a syntactic attachment ambiguity between internal and external modification, which results in a semantic ambiguity in case of definites, but no such ambiguity in the case of indefinites. Under low attachment, uniqueness does not hold, and hence the definite article does not compete with the indefinite article. We also consider the case of preposed participial modifiers in German and argue that they tend towards an external modification because they are backgrounded.

Keywords: definiteness, indefiniteness, uniqueness, blocking, syntactic ambiguities, superlatives, participial modifiers, syntactic ambiguities, maximize presupposition

1. Introduction: The problem

It is well-known that indefinite DPs imply non-uniqueness of their descriptive nominals. When talking on our planet Earth, (1) is odd, as it has only one moon. And when talking in our monogamous society, (2) is odd as people normally have maximally one spouse.

(1) #A moon was shining.
(2) #Yesterday, I talked to a husband of Ann's.

The generally accepted explanation, due to Hawkins (1991) and Heim (1991), is that the indefinite article competes with the definite article, where the definite article (in the singular and when used with count nouns) comes with a meaning component that expresses either uniqueness (cf. Russell 1905 and much subsequent work) or familiarity (Christophersen 1939 and much subsequent work). In case the definite article is avoided when it *could* be applied, as in (1) and (2), an inference of non-uniqueness will be triggered.

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This inference is an instance of the general scheme of scalar implicatures: If two expressions are alternatives of each other, where one is semantically stronger than the other, i.e. carries more specific information, the use of the weaker expression indicates that the stronger could not be used. Hence, the stronger expression "blocks" the weaker one in case the stronger expression is applicable. The nature of the meaning component that expresses uniqueness has been identified variously as entailment, presupposition, or conventional implicature; these are theoretical options that do not affect the general logic of this explanation (cf. Horn & Abbott 2012 for discussion). We assume here that it is a presupposition and use the term "presupposition maximization" (cf. Heim 1991, Sauerland 2008, Chemla 2008).

However, Alonso-Ovalle, Menéndez-Benito & Schwarz (2011), henceforward AMS, pointed out an interesting class of exceptions to this rule. For example, we observe that (3) is fine, in contrast to (2). The question is: Why is it not blocked by the sentence with the definite article, (4)? This sentence is fully felicitous, and could also be uttered when Ann has a unique husband.

(3) Yesterday, I talked to a man who is married to Ann.
(4) Yesterday, I talked to the man who is married to Ann.

In Section 2 we will present the solution of AMS and point out a number of problems. Section 3 will point out that cases in which uniqueness is triggered by functional nouns like *husband* are special. In section 4 we will present the core of our own analysis, backed up by experimental results from a rating study. Section 6 will adduce additional evidence for our analysis from coordinated DPs. In Section 7 we will back up our proposal with a formal implementation of low and high attachment modifiers. Section 8 will conclude this article.

2. The proposal of AMS

Alonso-Ovalle, Mendez-Benito & Schwarz (2011) follow the general reasoning of blocking the indefinite article by presupposition maximation. They make critical use of the idea that there are two distinct notions of definiteness. According to the first, which goes back to the philosophical literature such as Russell (1905) and Strawson (1950), the definite article expresses uniqueness. According to the second, which goes back to Christophersen (1939) and was further developed by Heim (1982, 1983), the definite article expresses familiarity. Uniqueness is at play in cases like (5) – even if Ann's husband is not familiar, he is presupposed to be unique due to the monogamy assumption.

(5) Yesterday, I talked to the husband of Ann.

While uniqueness is well motivated for examples like (1) and (2), the following examples do not necessarily have a unique referent for the subject. Rather, the definite DPs refer to entities that are treated as familiar to the participants in conversation. In (6) this is the president of the state or organization that is most salient in the situation; in (7) this is the girl that was mentioned in the preceding sentence.

(6) Ann talked to the president.
(7) A girl and a boy came in. The girl sat down.

AMS argue that *a husband of Ann* competes with *the husband of Ann* both in the uniqueness interpretation and the familiarity interpretation of the definite noun phrase. In contrast, *a man that is married to Ann* competes with *the man that is married to Ann* only in terms of familiarity, because this definite DP does not have the uniqueness interpretation. We then have the following situation: *A husband of Ann* will always be blocked, due to the uniqueness interpretation of *the husband of Ann*. In contrast, *a man that is married to Ann* will only be blocked by the familiarity interpretation of *the man that is married to Ann*. As a consequence, *a man that is married to Ann* survives in case that man is not familiar.

AMS cite supporting evidence for their theory from a peculiarity of definiteness marking in German. German distinguishes between so-called "weak" and "strong" definite DPs as objects of certain propositions, where weak definites require uniqueness, and strong definites require familiarity of the referent (cf. Schwarz 2009, 2014). AMS present the following minimal example to make their point:

(8) In der Kabinettssitzung wird ein Vorschlag $\left\{\begin{array}{l}\text{vom / \#von dem Kanzler}\\ \text{\#vom / von dem Minister}\end{array}\right\}$ erwartet.
‘At the cabinet meeting, people expect a proposal {by the chancellor / by the minister}’

In cabinet meetings, there is a unique chancellor but several ministers; this licenses the weak definite *vom Kanzler* but rules out *vom Minister*. We also should assume a principle that prefers weak definites over strong ones, dispreferring *von dem Kanzler* in (8).

AMS claim that weak definites are possible in cases like (9) but ruled out in case of modification by a relative clause like (10):

(9) Gestern habe ich bei dem / beim Mann von Maria angerufen.
‘Yesterday I rang up the man (= husband) of Mary’
(10) Gestern habe ich bei dem / #beim Mann, der mit Anna verheiratet ist, angerufen.
‘Yesterday I rang up the man who is married to Anna’

They predict that (11) is blocked due to the uniqueness definite *beim Mann*, whereas (12) is fine as the uniqueness definite would not be possible in this position.

(11) #Gestern habe ich bei einem Mann von Anna angerufen.
‘Yesterday I rang up a man (= husband) of Anna.’
(12) Gestern habe ich bei einem Mann, der mit Anna verheiratet ist, angerufen.
‘Yesterday I rang up a man who is married to Anna.’

Generalizing for the English case (and for most cases in German as well, as the special marker of uniqueness definites is restricted to DPs as complements certain prepositions), AMS assume that definites in general are ambiguous between a uniqueness reading and a familiarity reading, and that blocking of indefinite DPs may happen only in case a definite DP based on uniqueness is possible, e.g. in (2), but not in (3). AMS do not give arguments why the uniqueness interpretation of definite DPs is excluded in the case of relative clauses and mention this as an outstanding question, but see later work by Wiltschko (2012) and Grove & Hanink (2016) for further discussion of this issue.

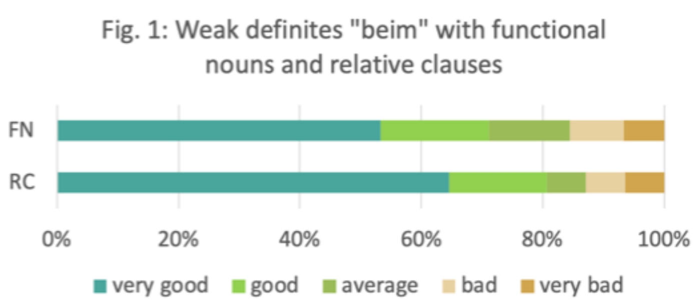
There are several premises of this argument that we would like to highlight. One is the assumption of wide-spread ambiguity or polysemy of the definite article between a uniqueness reading and a familiarity reading. A more plausible option may be to assume that definites always express uniqueness, but that the domain can be restricted to salient or familiar entities, leading to uniqueness with respect to familiar entities. But then it is not clear how the argument of AMS that rules out (2) still goes through.

Another problem of AMS is the following: If we assume an ambiguity of the definite article, then we should assume that *the husband of Ann* has two interpretations, which can be spelled out as 'the unique husband of Ann' and 'the husband of Ann that we know'. The latter interpretation does not block the indefinite *a husband of Ann*, which should refer to Ann's husband and indicate that this person is not familiar. But this interpretation does not exist. It appears that the expression of uniqueness dominates the expression of familiarity.

There is also an empirical problem with the claim that weak (uniqueness) definites are not possible for noun phrases that are modified by a relative clause. As the contrast between (9) and (10) seemed to be subtle to us, we conducted an experiment as part of a larger experiment in which we collected data in support of our own proposal to be discussed below. In this experiment, participants had to rate the grammaticality of the sentences with the functional noun *Mann* and *Ehemann* (13), to (14), with the noun modified by a relative clause. Note that in German, *Mann* 'man' in possessive and genitive constructions typically is interpreted as 'husband', with *Ehemann* 'husband' as an alternative expression in a higher register and is used for legally married men. We also compared the parallel pair (15) and (16).

(13) Der Detektiv hat beim {Mann, Ehemann} von Olga angerufen.
'The detective rang up the husband of Olga.'
(14) Der Detektiv hat beim Mann, der mit Olga verheiratet ist, angerufen.
'The detective rang up the man who is married to Olga.'
(15) Die Schülerin hat beim Mittelpunkt des Kreises ein Kreuz gemacht.
'The student drew a cross at the centerpoint of the circle.'
(16) Die Schülerin hat beim Punkt, der genau in der Mitte des Kreises liegt, ein Kreuz gemacht.
'The student drew a cross at the point which is exactly in the middle of the circle.'

Each participant saw one "Detective" sentence (with *Mann* or *Ehemann*) and one "Schülerin" sentence in one of the varieties, and the experimental items were not presented adjacent to each other. Ratings were on a Likert scale from 1 "very good" to 5 "very bad", consonant with the German grading system. We recruited 153 participants on the platform Clickworker, which is screening their participants to ensure good performance, and can guarantee that they were native or near-native speakers of German. We got the results in Figure 1:



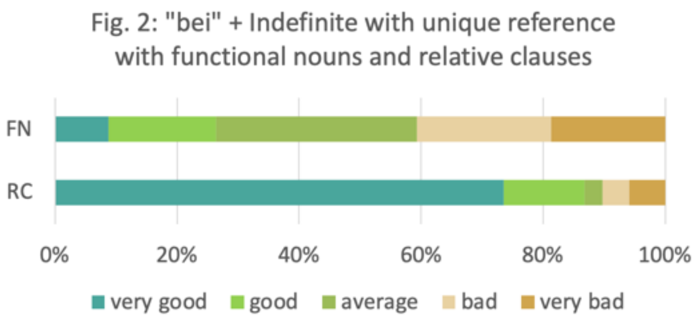
Mean [1…5]	Observed values v. good	else
FN: 1.98	24	21
RC: 1.74	20	11

ChiSquare:
p = 0.33

To put these results into perspective, grammatical violations like the wrong choice of the auxiliary (*sein* vs. *haben*) led to a mean rating of 4.2, and 76% of the evaluations being "very bad".

The ratings between FN (functional nouns, (13) and (15)) and RC (relative clauses, (14) and (16)) differ surprisingly little. Both FN and RC cases were rated "very good" more than 50% of the time. Applying a Chi-square test, contrasting "very good" with all other ratings, does not reveal a significant difference from the null hypothesis (p = 0.33). To be sure, our data point towards a difference between the acceptability of *beim* with FNs and RCs, but this difference appears to be too weak to account for the sharp contrast observed with (11) vs. (12).

To be sure, we tested sentences like (11) and (12) with the same material and in the same experiment that gave us the results of Figure 1, again under the condition that participants only saw one example of each test sentence. We found strong evidence for a contrast between FN and RCs, as illustrated in Figure 2.



Mean [1…5]	Observed values v. good	else
FN: 3.24	8	83
RC: 1.56	50	18
	ChiSquare: $p < 10^{-16}$	

The FN cases in Figure 2 contained *bei einem Mann* and *bei einem Ehemann* (besides *bei einem Mittelpunkt*). There was only a slight difference between *bei einem Mann* (Mean 3.05) and *bei einem Ehemann* (Mean 3.28), which was judged similarly to *bei einem Mittelpunkt* (3.32). The difference was not quite significant (p = 0.06), but the tendency is consistent with *Mann* being less clearly unique than *Ehemann.* We also found later that the mentioning of a detective might be a problem as it is suggestive of a bigamist scenario. Both findings would actually improve the rating of FN; nevertheless, we found that it is very low.

Figure 2 gives the results case of unique reference. We also tested cases with *non*-unique references like the following:

(17) Die Sekretärin hat bei einem Bekannten von Martha angerufen.
'The secretary rang up an acquaintance of Martha.'
(18) Die Sekretärin hat bei einem Mann angerufen, der mit Martha bekannt ist.
'The secretary rang up a man who is acquainted with Martha.'

As expected, the case with genitive modification (17) was rated very good (mean 1.42), even better than cases with RC clauses (18) (mean 1.97). The difference between the two cases, for which we did not form a hypothesis, is presumably due to the added complexity of relative clauses.

We conclude that the solution that AMS provide for the difference between sentences like (2) and (3) is problematic, and that we have to look for an alternative solution.

3. Uniqueness by functional nouns vs. other cases of uniqueness

We would like to consider the possibility that the difference between (2) and (3) is due to the way in which uniqueness is encoded: as part of the lexical meaning of the head noun, which is a functional noun, here *husband*, or as result of syntactic construction, here *man who is married to Ann.* It appears to us that the indefinite article is problematic if the head noun has a functional meaning, but fine in cases in which uniqueness results in other ways. This is illustrated in the following contrasts that go beyond the range of examples cited by AMS:

(19)	a.	# a husband of Mary	a man that Ann is married to
	b.	# a centerpoint of the circle	a point in the exact center of the circle
	c.	# a highest mountain	a mountain that is higher than all others
	d.	# a last scene of the movie	a scene at the very end of the movie

In (19a), it is the head noun *husband* itself (assuming a monogamous setting) that entails uniqueness. In (b), the composed noun *centerpoint* entails uniqueness, at least when talking about circles. In (c), uniqueness arises out of the semantics of the superlative *highest* that modifies the head noun, *mountain*. And in (d), uniqueness comes about through the superlative meaning of *last* 'later than all others'. For these cases, the indefinite article appears to be bad. For the corresponding expressions that achieve uniqueness by a relative clause, as in (19a,c), or by a prepositional phrase, as in (b,d), the indefinite article appears much better.

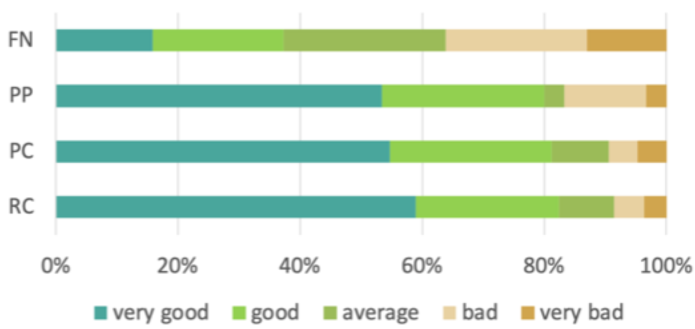
To investigate this issue further, we included in our rating experiment a survey of sentences that contrasted lexical functional nouns (FN) with three types of expressions that lead to a unique interpretation by a syntactically complex expression, other than modification by a superlative adjective. In addition to relative clauses (RCs) and prepositional phrases (PP), we investigated another type of a clausal modifier: participial phrases (PC). These modifiers differ from RCs insofar as they are non-finite and precede their head noun. The following examples illustrate this with one of the experimental items, where the English gloss for PCs tries to give an idea of the syntactic structure.

(20) FN: Die Schülerin hat einen Mittelpunkt des Kreises identifiziert.
'The student identified a centerpoint of the circle.'
PP: Die Schülerin hat einen Punkt genau in der Mitte des Kreises identifiziert.
'The student identified a point exactly in the middle of the circle.'
PC: Die Schülerin hat einen genau in der Mitte des Kreises liegenden Punkt identifiziert.
lit. 'The student identified [an exactly in the middle of the circle being] point'
RC: Die Schülerin hat einen Punkt, der genau in der Mitte des Kreises liegt, identifiziert.
'The student identified a point that is exactly in the middle of the circle.'

In a better design we would have also investigated functional nouns with superlative adjectives, such as *einen höchsten Berg* 'a highest mountain'; we suspect that they would be rated similarly to lexical functional nouns like *Mittelpunkt* 'center point'.

As before, each participant saw and rated each sentence only in one condition. We took all relevant cases in our experiment, including those in which the indefinite followed a *bei*-phrase. We also included appropriate cases from a follow-up experiment reported in section 6. This is the reason of the differences in the number of observations for each case. The results are displayed in Figure 3.

Fig. 3: Rating of indefinite unique DPs
Functional nous vs. PPs, Participles, Rel. Clauses



	Mean [1…5]	Observed values v. good	else
FN:	2.96	28	149
PP:	1.87	16	14
PC:	1.78	35	29
RC:	1.71	208	145

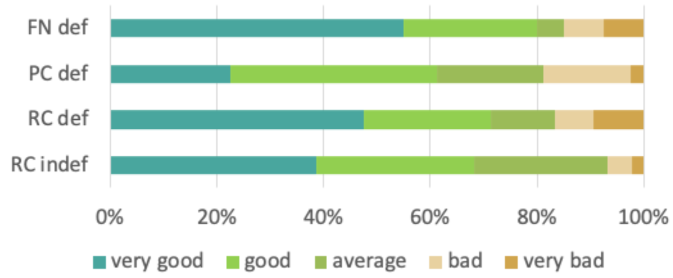
As it is clear from this figure, RC, PC and PP are judged similarly (the Chi-Square test for each combination is not significant, with $p > 0.5$). However, each of RC, PC and PP differ significantly from FN, with $p < 10^{-5}$, a value that is significant at the $p = 10^{-4}$ level after Bonferroni correction for multiple comparison.

The results reported in Figure 3 depend on the indefiniteness of the DP. When the participants rated unique DPs marked with the definite article, the difference between FNs and RCs vanish. Example (21) gives a subset of the test items that we compared directly; we did not test for PPs but we included a version of relative clauses marked as indefinite.

(21) FN: Petra hat gestern auf der Party den Mann von Olga getroffen.
'Petra met the husband of Olga yesterday at the party.'
PC: Petra hat gestern auf der Party den mit Olga verheirateten Mann getroffen.
lit. 'Petra met [the [with Olga married] man] yesterday at the party.'
RC: Petra hat gestern auf der Party den Mann, der mit Olga verheiratet ist, getroffen.
'Petra met the man who is married to Olga.'

Figure 4 gives our findings for sentences like (21). FNs and RCs are now rated similarly, as expected; the fact that the RC appear a bit degraded (but not significantly) may be attributable to RCs being more complex than FNs. But PCs are interpreted significantly worse than RCs (Chi-square test on very good vs. else: $p < 10^{-3}$), a result that we did not predict, and will come back to in Section 5. We also tested the RC sentence in the indefinite variety and found it to be slightly worse than with the definite article, but this was not significant.

Fig. 4: Rating of definite unque DPs: Functional nouns, Participles, Rel.Clauses (also indefinite)



Mean [1…5]		Observed values v.good	else
FN def:	1.88	22	18
PC def:	2.38	18	62
RC def:	2.07	20	22
RC ind:	2.02	17	27

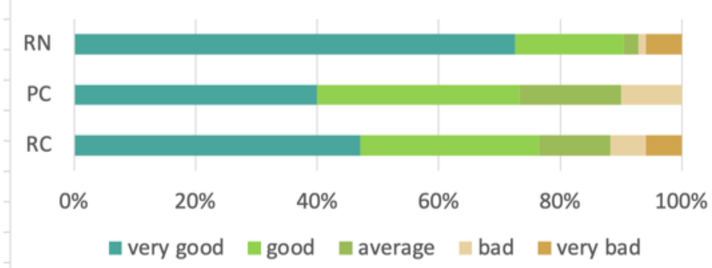
Our findings, of course, support the explanation that the definite article blocks the use of the indefinite article in FNs, leading to the contrast for FNs in Figure 3 vs. for FNs in Figure 4 (Chi-square test on very good vs. else $p = 10^{-7}$). But our results do not explain why there is no blocking effect with RCs under the assumption that there is only one definite article, as illustrated in the lack of a significant difference between RC def and RC indef in Figure 4 (Chi-square test on very good vs. else $p = 0.4$).

Returning to the main issue of this paper, we also observe that the difference between FNs and other noun phrases reported in Figure 3 should depend on the uniqueness implication of FNs. When looking at indefinite DPs that are not lexically unique, i.e. relational nouns RN like *friend* in contrast to *husband*, we should expect that FNs are fine. We tested this as well with examples like the following:

(22) RN: Die Sekretärin hat einen Bekannten von Marta erkannt.
'The secretary recognized an acquaintance of Marta.'
PC: Die Sekretärin hat einen mit Marta bekannten Mann erkannt.
lit. 'The secretary recognized [a [with Marta acquainted] man].'
RC: Die Sekretärin hat einen Mann, der mit Marta bekannt ist, erkannt.
'The secretary recognized a man that is acquainted with Marta.'

The results in Figure 5 below show that RNs are good with indefinites, as predicted. They are in fact better than the corresponding cases with PCs and RCs, presumably because the latter are syntactically more complex. But note that the rating is overall good (very good ≥ 40%).

Fig. 5: Rating of indefinite non-unique DPs Relational nouns vs. Participles, Rel. Clauses



Mean [1…5]		Observed values v.good	else
RN:	1.5	61	23
PC:	1.97	12	18
RC:	1.94	16	18

In this section, we have seen clear evidence for a difference between functional nouns (FNs) and cases in which uniqueness is the result of an interpreted syntactic construction (RCs, PCs, and PPs). Why should this be so? We will offer a proposal in the next section.

4. Our proposal: Fixed vs. ambiguous attachment

To rephrase this question: What makes the expression of uniqueness by functional nouns different from the expressions of uniqueness by other syntactic means so that in the first case, the indefinite article is blocked by the definite article, but there is no blocking in the second case? We propose that in cases of functional nouns, there is only one syntactic derivation, and in this derivation the definite article competes with, and blocks, the indefinite article. In contrast, in cases in which uniqueness comes about in other ways there are two distinct syntactic derivations, where in one derivation the definite article does not compete with the indefinite article, and hence the indefinite article is acceptable. One crucial element in our argumentation is the following: While the readings of the two syntactic structures with the definite article are different, they are identical for the indefinite article. This is the reason why the indefinite article is not blocked.

Let us go into the details of the argument. We start with the case of functional nouns like *centerpoint* or relational nouns like *friend*, for which we assume the structure (23), in which a phrasal constituent XP is a complement of the head N.

(23) [$_{DP}$ DET [$_{NP}$ N XP]]
  a. [$_{DP}$ der / #ein [$_{NP}$ [$_{N}$ Mittelpunkt] [$_{NP\text{-}GEN}$ des Kreises]]]
    'the / #a centerpoint of the circle'
  b. [$_{DP}$ der / ein [$_{NP}$ [$_{N}$ Freund] [$_{PP}$ von Anna]]
    'the / a friend of Anna'

We argue that the indefinite article is always blocked in the case of functional nouns, (23a), as the functional noun expresses uniqueness by its semantic interpretation. In the case of relational nouns, (23b), it is blocked just in case it is part of the common knowledge that there is only a single referent. There are also cases of relational nouns that are made functional nouns by adjectival modification. In this case, the indefinite article is blocked as well:

(23) [$_{DP}$ DET [$_{NP}$ N XP]]
  c. [$_{DP}$ der / #ein [$_{NP}$ [ältester [$_{N}$ Freund]] [$_{PP}$ von Anna]]
    'the / #an oldest friend of Anna'

How are these structures interpreted? We will sketch our proposal here and go into more detail in Section 7. It turns out that the proposal is best couched in a framework of dynamic interpretation, where the scope of indefinite and definite determiners extend to the right, reflecting that their variables are accessible. In a schematic way, the indefinite case receives the interpretation (24a), and the definite receives the interpretation (24b), where $\exists x$ stands for the existential quantifier, and $\exists !x$ stands for the existential quantifier with uniqueness, defined as $\exists !xP(x) \Leftrightarrow \exists x[P(x) \wedge \forall y[P(y) \rightarrow x=y]]$. The semicolon stands for dynamic conjunction. The dots stand for the verbal predicate, omitted here.

(24) a. $\exists x[\![N]\!]([\![XP]\!])(x)$; …
  b. $\exists !x[\![N]\!]([\![XP]\!])(x)$; …

The syntactic representation (23) and the interpretation (24) illustrate the treatment of relational nouns N (where functional nouns are a specific subcase where the noun denotes a right-unique relation). For regular nouns of the category NP that do not have a complement, we assume a modificational structure. Here we can distinguish between two distinct syntactic structures, which we illustrate with PPs, with the modifier at the NP level (25) or the DP level (26):

(25) $[_{DP}$ DET $[_{NP}$ NP XP]] $[_{DP}$ ein / der $[_{NP}$ $[_{NP}$ Punkt] $[_{PP}$ in der Mitte des Kreises]]]
(26) $[_{DP}$ $[_{DP}$ DET $[_{NP}$ NP]] XP] $[_{DP}$ $[_{DP}$ ein / der $[_{NP}$ Punkt]] $[_{PP}$ in der Mitte des Kreises]]

Let us first consider the interpretation of indefinite DPs, again in the dynamic framework sketched above. We have the following two interpretations for (25) and (26), respectively:

(27) a. $\exists x[[\![NP]\!](x) ; [\![XP]\!](x)] ; \ldots$
b. $\exists x[\![NP]\!](x) ; [\![XP]\!](x) ; \ldots$

In (27a), an x is introduced that has both the property expressed by NP and the property expressed by the modifier XP, which can be further modified by the verbal predicate and he subsequent text. In (27b) an x is introduced that has the property expressed by NP, which then is further modified by the XP predicate, and which can be further modified. One important observation at this point is: Even if the syntactic structures of (25) and (26) are different, the resulting truth-conditional meanings are exactly the same. This is because dynamic conjunction is associative, we have $[[\varphi ; \psi] ; \pi] = [\varphi ; \psi ; \pi]$.

Let us now consider the interpretation with the definite determiner. The two syntactic structures (25) and (26) allow for the following interpretations:

(28) a. $\exists!x[[\![NP]\!](x) ; [\![XP]\!](x)] ; \ldots$
b. $\exists!x[\![NP]\!](x) ; [\![XP]\!](x) ; \ldots$

In (28a) an x is introduced that is the unique x with the property of having both the meaning of NP and of XP; as in the case of indefinites, this x can be further specified by the verbal predicate and the subsequent text. In (28b), an x is introduced that is the unique x that has the NP property; it is further specified by also having the property XP, and by falling under the verbal predicate and whatever is said about x in the subsequent text. In this case, the interpretations (28a) and (b) are not the same. In particular, the uniqueness condition might be satisfied in (28a), which represents the low modifier attachment (25), but not in (28b), which represents the high modifier attachment (26).

What does this mean for the blocking effect? Let us assume that there is a unique x such that $[[\![NP]\!](x) ; [\![XP]\!](x)]$, but for $[\![NP]\!](x)$, x is not unique. For example, take *point exactly in the center of the circle*: there are many points, but only one point that is exactly in the center of the circle. If we want to refer to that point by a definite DP, we therefore have to choose the low-attachment structure $[_{DP}$ DEF $[_{NP}$ NP XP]], as in $[_{DP}$ *the* [$[_{NP}$ *point*] $[_{XP}$ *exactly in the center of the circle*]]]. This competes with the indefinite determiner in this syntactic structure, $[_{DP}$ IDEF $[_{NP}$ NP XP]], as in $[_{DP}$ *a* [$[_{NP}$ *point*] $[_{XP}$ *exactly in the center of the circle*]]], and blocks the indefinite. But it does not compete with, and hence does not block, the indefinite determiner in the high-attachment structure, [$_{DP}$ [$_{DP}$ IDEF NP] XP], as in [$_{DP}$ [$_{DP}$ *a point*] [$_{XP}$ *exactly in the center of the circle*]]. Hence this structure is not blocked. Now we have seen that in the indefinite case, the high-attachment structure has the same meaning as the low-attachment structure, cf. the discussion of (24). So we have, as end result, that the reading expressed by $\exists x[[\![NP]\!](x) ; [\![XP]\!](x) ; \ldots]$ is not blocked. The indefinite article can be used in the string *a point exactly in the center of the circle* even though the definite article as in *the point exactly in the center* would be justified as well. This is because the definite DP has the structure [*the* [*point exactly in the center of the circle*]] whereas the indefinite DP can have the structure [[*a point*] [*exactly at the center of the circle*]].

Recall that this is different with functional nouns, as for them there is only one structure available: [$_{DP}$ *the / a* [$_{NP}$ [$_{N}$ *centerpoint*] [$_{XP}$ *of the circle*]]]. This is because complements can only be attached at their syntactic heads; there is no high attachment (except for movements like extrapositions, which would have the same truth-conditional interpretation). Consequently, with functional nouns the definite article always blocks the indefinite one.

Our explanation why the indefinite article is available in spite of uniqueness assumes that blocking is sensitive to syntactic structure. If blocking would only be triggered on the level of the meaning of expressions, then the felicity of the definite DP would block the indefinite DP no matter under which syntactic structure, as the parses of the indefinite DP have the same meaning. There is independent evidence that the relevant alternatives are dependent on syntactic structure, and not just on the meaning, of expressions (cf. Katzir 2007). For example, the sentences *Mary talked to John or Bill* and *Mary talked to John or Bill or both* arguably have the same literal meaning, as disjunction is inclusive; however, only the first sentence triggers the implicature that Mary did not talk to both, which is clearly due to the formal difference that the second sentence mentions this alternative explicitly.

Our explanation of the availability of the indefinite article, despite uniqueness, applies to modifiers in general, in particular for PP modifiers as in [$_{DP}$ [$_{DP}$ *a point*] [$_{PP}$ *exactly in the center of the circle*]] and relative clause modifiers as in [$_{DP}$ [$_{DP}$ *a point*] [$_{RC}$ *that is exactly in the center of the circle*]]. This also holds for the German cases, which have a similar constituent order, and allow for high attachment, cf. (29) for PPs and (30) for RCs.

(29) [$_{DP}$ [$_{DP}$ ein [$_{NP}$ Punkt]] [$_{PP}$ genau in der Mitte des Kreises]]
‘a point exactly in the middle of the circle’
(30) [$_{DP}$ [$_{DP}$ ein [$_{NP}$ Punkt]] [$_{RC}$ der genau in der Mitte des Kreises liegt]]
‘a point which is exactly in the middle of the circle’

In this section we presented the core of our explanation why indefinites are sometimes not blocked by definites, in spite of uniqueness. The reason is that the clauses in which these indefinites occur allow for a parse in which they do not compete with the definites. In the following sections we will consider the case of participial modifiers, we will look at additional set of data that support the analysis, and we will provide an implementation for the compositional derivation of the meanings discussed in this section.

5. Participial modifiers and non-restrictive relative clauses

Our explanation for the acceptability of indefinite determiners requires that the modifiers that create uniqueness allow for high attachment to the DP, as in (26). This is fine for postposed modifiers that can attach to NP or DP when looking for an attachment site at [$_{DP}$ [$_{NP}$ … But this appears problematic for the case of PCs, participial attributes, as they precede the NP. We have the structure as in (31), for which only low attachment seems to be an option.

(31) [$_{DP}$ ein [$_{NP}$ [$_{PC}$ genau in der Mitte des Kreises liegender] [$_{NP}$ Punkt]]]
‘an [exactly in the middle of the circle lying] point’

We argued (without experimental support) that adjectives that lead to a unique interpretation of the head noun due to their superlative meaning, which like other adjectives always precede the noun in German, indeed block the indefinite determiner, as illustrated in (32) (where the adjective agrees in definiteness with the determiner).

(32) [$_{DP}$ der / #ein [$_{NP}$ [$_{AP}$ älteste(#r)] [$_{NP}$ [$_{N}$ Freund] [$_{PP}$ von Olga]]]]
‘the / #an oldest friend of Olga’

Why do participial constructions behave differently? We suspect that this may be due to the fact that they tend to express backgrounded material (cf. Fabricius-Hansen 2006) that are of the status of supplements (cf. Potts 2007). Evidence for that is that they can be prosodically marked as parentheticals, and they can contain discourse operators like *übrigens* ‘by the way’.

(33) ein – übrigens genau in der Mitte des Kreises liegender – Punkt
‘a – by the way exactly in the center of the circle being – point’

Hence in spite of their intermediate position, participial attributes can be interpreted externally, which corresponds to high attachment to the DP, as in the braced constituent in (34). We observed this already in (21) and Figure 4, with our finding that definite DPs with PCs are ranked significantly worse than definite DPs with RC modifiers, and also worse than FNs. We leave the precise nature of this interpretation open.

(34) a. [$_{DP}$ ein [$_{NP}$ {$_{PP}$ genau in der Mitte des Kreises liegender} [$_{NP}$ Punkt]]
b. [$_{DP}$ [$_{DP}$ ein [$_{NP}$ _ [$_{NP}$ Punkt]] {$_{PP}$ genau in der Mitte des Kreises liegender}]

This interpretation of the PC is similar to the non-restrictive interpretation of relative clauses, which also are interpreted under high attachment to the DP. From this, we predict that we should detect a difference when comparing restrictive vs. non-restrictive relative clauses. The situation in English is that both *that* relative clauses and *wh* relative clauses can be interpreted restrictively, while non-restrictive relative clauses are predominantly expressed by *wh* relative clauses, while *that* relative clauses can only marginally receive this interpretation (cf. Huddleston & Pullum 2002: 1059 on “integrated” vs. “supplementary” relative clauses). If relative clauses introduced by the complementizer *that* have a tendency towards low attachment, in contrast to *wh* relative clauses, we should find a distinction along these lines:

(35) a. the / #a point that is exactly in the middle of the circle
b. the / a point which is exactly in the middle of the circle

If *that* has a strong tendency to low attachment, even with indefinites, then the indefinite variant of (35a) should be affected by blocking by the definite article. If *which* is compatible with both low and high attachment, then we do not expect that the indefinite variant of (35b) is affected by blocking. AMS do not discuss this issue; they only discuss relative clauses in German and Spanish, but they use *wh*-relatives in their glosses. The prediction in (35a) vs. (b) remains to be tested experimentally.

6. Additional evidence: Coordinated DPs

In Section 4 we explained the occurrence of the indefinite article, despite of reference to an unique entity, with the help of an attachment ambiguity. We argued that in cases in which the definite article requires high attachment to a complex constituent consisting of a head noun together with the modifier to satisfy uniqueness, the indefinite article is admissible because it allows for low attachment to the head noun, resulting in a reading that is indistinguishable from the one with high attachment.

We can derive a prediction from this[2]: When low attachment is prevented for the definite determiner, the indefinite determiner should be blocked in case of reference to a unique entity. One test case for this prediction are NPs that consist of a conjunction of two NPs, each with their own determiners. Consider the following example:

(36) [$_{DP}$ [$_{DP}$ [$_{DP}$ the man] and [$_{DP}$ the woman]] [$_{RC}$ who know each other best]]

(36) requires high attachment, given its meaning. The compositional semantic interpretation of (36) is tricky: The uniqueness stemming from the superlative in the relative clause cannot be satisfied locally within the DPs *the man* and *the woman*, as (36) can be interpreted in a domain that has many men and women (cf. von Stechow 1980, Link 1984, and subsequent literature). Effectively, (36) is interpreted as the unique pair or sum of a man and a woman that stand in the relation of knowing each other better than any other pair. This suggests an interpretation of definiteness above the conjoined NPs, which is modified by the relative clause, as in the structure [*the* [[*man and woman*] [*that knew each other best*]].

If syntactic low attachment is blocked, we expect that changing the definite articles to indefinites in (36) leads to degraded results. Recall that it was precisely the possibility of low attachment, under the same meaning assignment, that allowed the indefinite article to escape blocking by the definite article in cases like (25)/(26).

We tested this prediction in a second experiment. We recruited 247 participants, again on the platform Clickworker, and tested the rating of sentences like (37) and (38). The test was part of a larger test, which included some items that we have reported already in Section 3 above. We tested the following two sentences, in two varieties each (with definite + definite and indefinite + indefinite) article.

[2] Thanks to Jonatan Bobalijk for pointing this out.

(37) Die Schüler mussten auf der Karte {das/ein} Dorf und {die/eine} Stadt, die am nächsten zueinander liegen, mit einer Linie verbinden.
‘The students had to connect with a line on the map {the/a} village and {the/a} city that are closest to each other.’

(38) Die Mitspieler sollten auf den Fotos {das/ein} Mädchen und {den/einen} Jungen, die sich am ähnlichsten sehen, bestimmen.
‘The players had to identify on the photographs {the/a} girl and {the/a} boy that looked most similar to each other.’

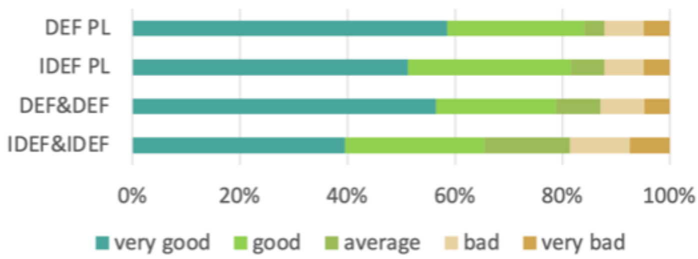
As a baseline, we also tested corresponding sentences with plural DPs, as in (39) and (40).

(39) Die Schüler mussten auf der Karte {die zwei / zwei} Städte, die am nächsten zueinander liegen, mit einer Linie verbinden.
‘The students had to connect with a line on the map {the two / two} cities that are closest to each other.’

(40) Die Mitspieler sollten auf den Fotos {die zwei / zwei} Personen, die sich am ähnlichsten sehen, bestimmen.
‘The players had to identify on the photographs {the two / two} persons that looked most similar to each other.’

The results are presented in Figure 5.

Fig. 5: Unique DPs with Relative Clause Modifier: non-conjunctive vs. conjunctive DP heads



	Mean [1…5]	Observed values v.good	else
D PL	1.74	42	40
ID PL	1.84	48	34
D&D	1.82	48	37
ID&ID	2.21	32	49

We see that the case of a conjunction of two indefinites, IDEF&IDEF, was judged slightly less good than the conjunction with two definites, DEF&DEF. This difference was significant when comparing the “very good” judgements with the “else”-judgements on a Chi-Square test ($p = 0.03$). In contrast, in the case of plural DPs, there was no significant difference between plural indefinites, IDEF PL, and plural definites, DEF PL when comparing “very good” with “else” judgements ($p = 0.34$). We take this to be a confirmation of our hypothesis: In cases in which indefinite article cannot have a low attachment, i.e. in the IDEF&IDEF, the definite article exerts a stronger blocking effect.

However, there is a clear difference in the rating of IDEF&IDEF cases in Figure 5 and the rating of functional noun (FN) cases in Figure 3, which were rated much worse. More specifically, when we take as effect size the difference between mean ratings, for IDEF&IDEF vs. DEF&DEF this is 2.21-1.82 = 0.39, whereas for FN vs. RC this is 2.96-1.71 = 1.25. This difference might be due to the way how sentences like (37) achieve their interpretation: The two definite articles may be reflections of a definiteness operator over the conjunct, as in [DEF [[$_{NP}$ (*the*) *man*] *and* [$_{NP}$ (*the*) *woman*]]], a structure that would allow for low attachment to the NP.

7. A formal implementation of low and high modification in DPs

We have sketched an interpretation in a dynamic framework to show that in the case of indefinite DPs, low attachment and high attachment lead to the same interpretation. In this section we will spell out this framework as far as necessary for our purposes.

The formal implementation for our proposal should allow for the following: There is a meaning difference between (a) low and (b) high attachment of modifiers in the case of definite DPs, but there is no such meaning difference in the case of indefinite DPs:

(41) a. [$_{DET}$ a / the [[$_{NP}$ point] [$_{PP}$ in the center of the circle]]
b. [$_{DET}$ [$_{DET}$ a / the [$_{NP}$ point]] [$_{PP}$ in the center of the circle]]

Among the versions of dynamic interpretation, the most suitable is Rooth (1987). In this framework, meanings are sets of tuples that contain an input assignment and an output assignment. These tuples are combined by construction-specific rules. For reasons of space, we just give the interpretations and only comment on underlying rules when necessary. We start with the low attachment (41) for the indefinite case, which is rendered in (42):

(42) a. $[\![[_{NP}\ \textit{point}]]\!] = \{\langle g,x,g\rangle \mid \text{point}(x)\}$
b. $[\![[_{PP}\ \textit{in the}_2\ \textit{center}]]\!] = \{\langle g,x,h\rangle \mid g<_2 h \wedge h_2 = \text{the.center} \wedge \text{in}(x,h_2)\}$
c. $[\![[_{NP}\ [_{NP}\ \textit{point}]\ [_{PP}\ \textit{in the center}]]]\!]$
$= \{\langle g,x,h\rangle \mid \exists k[g<k \wedge \langle g,x,k\rangle \in [\![[_{NP}\ \textit{point}]]\!] \wedge \langle k,x,h\rangle \in [\![[_{PP}\ \textit{in the}_2\ \textit{center}]]\!])$
$= \{\langle g,x,h\rangle \mid \text{point}(x) \wedge g<_2 h \wedge h_2 = \text{the center} \wedge \text{in}(x,h_2\}$
d. $[\![[_{DET}\ a_1\ ]]\!] = \lambda P\{\langle g,x,h\rangle \mid \exists k[g<_1 k \wedge k_1 = x \wedge \langle k,x,h\rangle \in P]\}$
e. $[\![[_{DP}\ a_1\ [_{NP}\ \textit{point in the center}]]]\!] = [\![\ a_1\ ]\!]([\![[_{NP}\ \textit{point in the}_2\ \textit{center}]]\!])$
$= \{\langle g,x,h\rangle \mid \exists k[g<_{1,2} h \wedge x = h_1 \wedge \text{point}(x) \wedge h_2 = \text{the.center} \wedge \text{in}(x,h_2)]\}$
f. $[\![[_{VP}\ \textit{is red}]]\!] = \{\langle g,x,g\rangle \mid \text{red}(x)\}$
g. $[\![[_S\ [_{DP}\ a\ [_{NP}\ \textit{point in the center}]]\ [_{VP}\ \textit{is red}]]]\!]$
$= \{\langle g,h\rangle \mid \exists x\exists k[\langle g,x,k\rangle \in [\![[_{DP}\ a\ [_{NP}\ \textit{point in the center}]]]\!] \wedge \langle k,x,h\rangle \in [\![[_{VP}\ \textit{is red}]]\!]]\}$
$= \{\langle g,h\rangle \mid g<_{1,2} h \wedge \text{point}(h_1) \wedge h_2 = \text{the.center} \wedge \text{in}(h_1,h_2) \wedge \text{red}(h_1)]\}$

We use g, h, k as partial functions from variables (numbers) to entities, and write $g<h$ / $g\leq h$ for 'h extends / extends or is equal to g', $g<_i h$ for 'h extends g by the variable i', and g_i for g(i). We interpret modification of a predicate by restriction, cf. (42c), application of the article by function application, cf. (e), and predication by restriction and existential binding, cf. (g).

Turning to high attachment modification, we notice that this is possible because the NP *point* and the indefinite DP *a point* have the same type. The result is the same as under low attachment:

(43) a. $[\![[_{DP}\ a_1\ [_{NP}\ point]]]\!] = \{\langle g,x,h\rangle \mid g{<_1}h \wedge x{=}h_1 \wedge \text{point}(x)]\}$

b. $[\![[_{DP}\ [_{DP}\ a_1\ [_{NP}\ point]]\ [_{PP}\ in\ the_2\ center]]]\!]$
$= \{\langle g,x,h\rangle \mid \exists k[g{<}k \wedge \langle g,x,k\rangle{\in}[\![[_{DP}\ a_1\ [_{NP}\ point]]]\!] \wedge \langle k,x,h\rangle{\in}[\![[_{PP}\ in\ the_2\ center]]\!]])$
$= \{\langle g,x,h\rangle \mid g{<_{1,2}}h \wedge x{=}h_1 \wedge \text{point}(x) \wedge h_2{=}\text{the.center} \wedge \text{in}(x,h_2)\}$

Definite DPs differ from indefinite ones by a uniqueness condition. Uniqueness can be relative to the variables accessible in the assignments (in the anaphoric use) or to the model itself; we focus here on the latter. We start again with low attachment:

(44) a. $[\![[_{DP}\ the_1\ ]]\!] = \lambda P\{\langle g,x,h\rangle \mid \exists k[g{<_1}k \wedge k_1{=}x \wedge \langle k,x,h\rangle{\in}P$
$\wedge\ \forall y\forall k\forall h[g{<_1}k \wedge k_1{=}y \wedge \langle k,y,h\rangle{\in}P \rightarrow y{=}x]]\}$

b. $[\![[_{DP}\ the_1\ [_{NP}\ [_{NP}\ point]\ [_{PP}\ in\ the_2\ center]]]\!]$
$= \{\langle g,x,h\rangle \mid g{<_{1,2}}h \wedge x{=}h_1 \wedge \text{point}(x) \wedge h_2{=}\text{the.center} \wedge \text{in}(x,h_2)$
$\wedge\ \forall y\forall h[[g{<_{1,2}}h \wedge h_1{=}y \wedge \text{point}(y) \wedge h_2{=}\ \text{the.center} \wedge \text{in}(y,k_2)] \rightarrow y{=}x]\}$

This extends g to h such that h maps 1 to x and x is the unique point in the center. In case uniqueness is not satisfied, we end up with the empty set, which reflects the presuppositional status of uniqueness. With high-attachment modification, we get the result (45b); it has different truth conditions from (44b), as it requires that there is a unique point in the model.

(45) a. $[\![[_{DP}\ the_1\ [_{NP}\ point]]]\!]$
$= \{\langle g,x,h\rangle \mid g{<_1}h \wedge x{=}h_1 \wedge \text{point}(x) \wedge \forall y[\text{point}(y) \rightarrow y{=}x]\}$

b. $[\![[_{DP}\ [_{DP}\ the_1\ [_{NP}\ point]]\ [_{PP}\ in\ the_2\ center]]]\!]$
$= \{\langle g,x,h\rangle \mid g{<_{1,2}}h \wedge x{=}h_1 \wedge \text{point}(x) \wedge \forall y[\text{point}(y) \rightarrow y{=}x] \wedge h_2{=}\text{the.center} \wedge \text{in}(x,h_2)\}$

We have seen that with indefinite DPs it does not matter whether the modifier is attached high or low, in contrast to definite DPs. With quantified DPs such as *every point* attachment matters as well: In the dynamic framework of Rooth (1987) it can only be low, to the NP, as quantified DPs are necessarily of a different type – for example, a functor that takes a VP meaning:

(46) a. $[\![[_{DP}\ every_1\ [_{NP}\ point]]]\!]$
$= \lambda P\{\langle g,g\rangle \mid \{\langle g,x,h\rangle \mid \exists k[g{<_1}k \wedge k_1{=}x \wedge k{\leq}h \wedge \langle g,x,h\rangle{\in}[\![[_{NP}\ point]]\!]\}$
$\subseteq \{\langle g,x,h\rangle \mid \exists k[g{\leq}k \wedge \langle k,x,h\rangle{\in}P]\}\}$

b. $[\![[_{S}\ [_{DP}\ every_1\ [_{NP}\ point]][_{VP}\ is\ red]]]\!] = [\![[_{DP}\ every_1\ [_{NP}\ point]]]\!]([\![[_{VP}\ is\ red]]\!])$
$= \{\langle g,g\rangle \mid \{\langle g,x,h\rangle \mid g{<_1}h \wedge h_1{=}x \wedge \text{point}(x)\} \subseteq \{\langle g,\ x,\ h\rangle \mid g{\leq}h \wedge \text{red}(x)\}\}$

For completeness we show how relational nouns with complements would be handled in the dynamic framework. In contrast to other nouns they must allow for output assignments that introduce new discourse referents. In (47), *of* is treated as a marker of nominal arguments.

(47) a. $[\![[_{N}\ centerpoint]]\!] = \lambda P\{\langle g,x,h\rangle \mid \exists y[\langle g,y,h\rangle{\in}P \wedge \text{centerpoint}(x,\ y)]\}$

b. $[\![[_{NP}\ centerpoint][_{PP}\ of\ the_2\ circle]]]\!]$
$= [\![[_{NP}\ centerpoint]]\!]([\![[_{PP}\ of\ the_2\ circle]]]\!])$
$= [\![[_{NP}\ centerpoint]]\!](\{\langle g,y,h\rangle \mid g{<_2}h \wedge h_2{=}y \wedge y{=}\text{the.circle}\}]\!])$
$= \{\langle g,x,h\rangle \mid \exists y[g{<_2}h \wedge h_2{=}\text{the.circle} \wedge \text{centerpoint}(x,\ y)]\}$

One might ask whether it is necessary to give this implementation of our explanation in Section 4 within a dynamic framework, or whether it could be done with static Generalized Quantifiers (Barwise & Cooper 1981). As Generalized Quantifiers, DPs like [$_{DP}$ *a point*] and [$_{DP}$ *the point*] denote second-order predicates, like $\lambda P[[\![point]\!] \cap P \neq \emptyset]$ and $\lambda p[\text{card}([\![point]\!]) = 1 \wedge [\![point]\!] \cap P \neq \emptyset]$, where we take $[\![point]\!]$ to be the set of points. We can define high attachment modifiers as type-lifted modifiers that take a second-order property and address its argument, as in $M^{lifted} = \lambda Q \lambda P[Q(M(P))]$, where M is the regular modifier meaning. In this way we also find that internal and external modification lead to the same result for indefinites but differ for definites. But M^{lifted} could also apply to universal quantifiers, like [$_{DP}$ *every point*], $\lambda P[[\![point]\!] \subseteq P]$, and then would give us non-available interpretation, e.g. for *every point in the circle is red* we would obtain 'every point is in the circle and is red'. There are attempts to deal with external modification in such cases as well (cf. e.g. von Stechow 1980), but these would lead to the same interpretation for high and low attachment in the case of DPs with definite article.

8. Conclusion

Let us recapitulate. We started with the observation by Alonso-Ovalle, Menéndez-Benito & Schwarz (2011), who showed that the indefinite article is not blocked by the definite article in cases of modifications by relative clauses that lead to a unique referent, as in *a man who is married to Ann.* This is in contrast to cases where uniqueness is due to functional nouns, as in *#a husband of Ann.*

We provided the first experimental evidence for this contrast, for German, not only for modifiers that consist of relative clauses but also for prepositional phrases and participial phrases. We also presented an analysis for this difference: Relational nouns with their complement allow only for a single parse, as in (48), and this leads to a blocking of the indefinite article in case the referent is unique. Non-relational nouns with modifiers allow for two structures, with low and high attachment of the modifier. The indefinite article is blocked under the low attachment of the modifier, as in (49a), which is the structure that leads to the uniqueness interpretation. It is not blocked under the high attachment of the modifier, as in (49b), as under this attachment the definite article is not appropriate, as uniqueness is not satisfied.

(48) [$_{DP}$ #a / the [$_{NP}$ [$_{N}$ husband [$_{PP}$ of Ann]]]]

(49) a. [$_{DET}$ #a / the [[$_{NP}$ man] [$_{RC}$ who is married to Ann]]
     b. [$_{DET}$ [$_{DET}$ a / #the [$_{NP}$ man]] [$_{PP}$ who is married to Ann]]

We also provided conceptual and experimental arguments against the account by AMS that was based on a difference between familiarity definites and uniqueness definites. In our account, familiarity does not play a role. We furthermore observed that participial modifiers are of particular interest: being preposed, they should allow only for low attachment (just like adjectives like *#a / the highest mountain*), but they are rather interpreted similar to high-attachment modifiers. We suspect that this is due to their backgrounded, suppositional nature.

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‘Czech’ the alternatives: A probe recognition study of focus and word order[1]

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Abstract. Comprehenders have been found to activate, select, and represent plausible alternatives to focused elements when processing incoming sentences (see Gotzner & Spalek, 2019 for an overview). This is consistent with Rooth’s (1992) theory of focus interpretation, which claims that the function of focus is to create an additional level of meaning consisting of a set of propositions derived by replacing the focused element with its contextually appropriate alternatives of the same semantic type. However, the psycholinguistic research on the processing of focus has mostly been done on a small sample of Germanic languages which mostly use prosody to mark focus. We tested whether the current results generalise to Czech, which can use word order to mark narrow focus. We report on a probe recognition study aiming to test whether Czech comprehenders represent alternatives to focused subjects. The results provide preliminary evidence in favour of this claim.

Keywords: focus, word order, Czech, comprehension, focus alternatives, probe recognition task

1. Introduction

1.1. Focus and semantic theory

Focus is said to be one of the chief ways in which speakers tailor the truth-conditional content of their utterances to their context. It is a part of information structure, the “packaging” that speakers apply to the literal meaning expressed (Chafe 1976). As a category within this structure, has been associated with the new or contrastive parts of utterances at least since the work of the Prague School (Sgall et al. 1973). An influential approach to focus claims that what the category essentially does is introduce alternative meanings into the discourse (Krifka 2008). This account pioneered by Rooth (1985) stipulates that this is done by means of focus creating a new level of interpretation in addition to the ordinary semantic value of a given sentence. This focus interpretation is said to be a set of propositions derived by means of a systematic replacement of the element in focus with its contextually appropriate alternatives of the same semantic type (Rooth 1992). Take the following example:

(1) $[\text{Jane}]_{\text{Focus}}$ played the sonata.

In sentence (1), the subject *Jane* is focused. Suppose we are in a world in which there are four individuals—Jane, Mary, Sally, and Fido the dog. According to the alternative semantics

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theory, the focus value of (1) would in this case be the set of propositions $\{\text{played}(x, \text{ the sonata}) \mid x \in E\}$. Here, E is the set of individuals of the same semantic type as the meaning of *Jane*, namely e. It can be written out as {Jane, Mary, Sally}. Notice that while also of type e, Fido cannot be in set E, since it is not contextually appropriate within (1), being a dog unable to perform sonatas.

However, the alternatives-based approach is not the only one taken by theorists to explain focus. Another strain of thought sees focus essentially in terms of the *newness* of the information provided by the focused element (Halliday 1967; Jackendoff 1972; Sgall et al. 1986). Another approach that we will discuss further sees focus essentially as a means of *noise reduction* (Schmitz 2008; Stevens 2016; Stevens and Roberts 2019). The so-called noisy channel theories in general see language as in effect a solution to the problem of communicating information in a situation where some of it may be lost or misperceived, in other words—across a noisy channel (Shannon and Weaver 1949). Within the Rational Speech Act (RSA) framework (Goodman and Frank 2016; Franke and Jäger 2016), there has been an attempt at combining the noisy channel approach to language with theories that postulate alternatives as a crucial part of what it means for a constituent to be focused (Bergen and Goodman 2015). In essence, the RSA framework is a way to model pragmatic inferences as an iterative Bayesian succession of social reasoning between speakers and listeners. The way to account for focus then is the following. As its starting point, the proposal of Bergen and Goodman (2015) takes the fact that focus status is associated with prosodic prominence in languages such as English (Gussenhoven 1999; Selkirk 1995). According to the above mentioned noisy channel approaches, speakers choose to give a particular element prosodic prominence in order to lower the probability of misperception on the part of the hearer. The way alternatives get in is by means of pragmatic inference. The hearer reasons that the speaker must have put prosodic prominence on a particular element in order to increase the probability that the hearer would correctly identify that particular element and not confuse it for another. This behaviour makes sense for the speaker if the speaker believes that they are in a situation where mistaking the focused element for one of its alternatives would be detrimental. This situation is for instance when the speaker believes these other alternatives to be false. The hearer then assumes that exactly such a process occurs in the mind of the speaker. Consequently, the hearer can derive an inference about these alternatives, namely that the propositions derived by replacing the focused element with them are false. As we can see, we arrive at precisely the specification of Roothian (1985; 1992) theories.

1.2. The processing of focus and its alternatives

Within psycholinguistic research, focus has been studied for its many processing effects. Firstly, Sturt et al. (2004) claimed that comprehenders processed focused information more deeply than they did backgrounded information. Anaphor integration (Sanford et al. 2009; Klin et al. 2004), attachment placement (Carlson et al. 2009; Carlson and Potter 2021, 2022), or ellipsis (Carlson 2015) processing have all been shown to be influenced by focus.

Over the past decade, a multitude of studies have shown that the formal theory of Rooth (1992) can be applied to the real-time comprehension of focus (see Gotzner and Spalek 2019 for an overview). Specifically, it has been found that the hypothesised focus alternatives are in fact routinely activated, selected, and represented in the course of comprehension.

Research has shown that focus alternatives receive improved memory encoding (Fraundorf et al. 2010; Norberg and Fraundorf 2021). But crucially for the current study, let us now turn to the investigation of immediate processing and the mechanisms enabling comprehenders to take advantage of focusing and to build the improved memory representations discussed above. Husband and Ferreira (2016), building on the pioneering work by Braun and Tagliapietra (2010), conducted two lexical decision experiments with English comprehenders aiming to answer the question of the time course of the activation of focus alternatives. They presented their participants with sentences such as the following:

(2) The museum thrilled the *sculptor* when they called about his work.

Their sentences were auditorily presented and the critical prime word *sculptor* was pronounced either with a contrastive (L+H*) or non-constrastive prosody. Following either 0ms (in Experiment 1) or 750ms (in Experiment 2) relative to the prime word, the participants saw a probe word on the screen. This probe was either a plausible focus alternative that could replace the focused word *sculptor* in the given context of (2), for example *painter*, a merely semantically associated word without the ability to replace the focused one—*statue* or an unrelated word serving as the baseline (*register*). What the researchers found was that while both alternatives and merely associated probes were primed and therefore activated at the earlier SOA of 0ms; at 750ms, this activation was maintained for plausible focus alternatives only. This was interpreted as evidence for a selection process that first activates a slew of related items that it then sifts through to come up with a final contextually appropriate set of only those elements that could replace the focused word in a given sentence.

In addition to the lexical decision task, which is said to target the level of immediate activation in the lexical-semantic network (Meyer and Schvaneveldt 1971), the probe recognition task has also been used to investigate focus alternatives in comprehension. In the task, participants are asked to evaluate whether a given probe appeared in some previously presented stimulus. As opposed to lexical decision, this method has been argued to tap into the mental model of the discourse and its representations (Gernsbacher and Jescheniak 1995). Using this method, it has been found that focus sensitive particles cause interference in the recognition of contextually mentioned alternatives and the rejection of unmentioned ones Gotzner et al. (2016). This interference effect was also found to be specific to plausible alternatives only with semantic associates being unaffected by focus particles like *only* (Gotzner and Spalek 2017).

While most of the research using the probe recognition task included contextually given alternatives in their stimuli, Jördens et al. (2020) conducted a study with only single sentences presented and no mentioned alternatives. Their German participants were exposed to sentences such as these (here in translation):

(3) The *farmer* has brought *straw* into the barn.

In their experiment, either the word *straw* (critical condition) or the word *farmer* received contrastive prosody. Then, either the word *cows* or the unrelated *lifts* was probed. In the case of the former, this was a plausible alternative when contrastive prosody was placed on *straw*. The word was merely associated when *farmer* received it, since it could not serve as the subject of the sentence. What they found was that the unrelated probe garnered the fastest responses, the condition where *cows* was playing the part of the merely associated word had the slowest rejections, and, crucially, that when the probe word was a plausible alternative, it patterned between the two in terms of response times.

The work on the processing of focus alternatives has been plentiful in the past decade, however, there are gaps in the literature. The first is that most of the research has been conducted on a small sample of Germanic languages (English, Dutch, and German). While there have been studies examining focus comprehension in other languages, cross-linguistic validation of the current results remains limited. Yan and Calhoun (2019) showed that focus alternatives were facilitated in a lexical decision task in Mandarin Chinese. As far as the memory representation of alternatives cross-linguistic research is concerned, Tjuka et al. (2020) report that the recall of plausible alternatives was supported by focus prosody in Vietnamese while noting that this effect was only present for female speakers.

One consequence of the dominance of Germanic languages in the literature on focus processing is that there is a bias towards the prosodic marking focus. However, languages can also use syntactic means as their primary way of focus marking (Zimmermann and Onea 2011). There have only been a few studies examining focus alternative processing in languages that primarily use syntactic means to mark focus. Studying Hungarian, Káldi et al. (2021) also examined the memory representation of the focused element and of alternatives and provided evidence suggesting that the recall of the focused element was facilitated. This was in line with the previous literature. This was the case in immediate, but not in delayed retrieval. As for focus alternatives however, their probe recognition study provided only indirect evidence in favour of focus alternative activation. Their first experiment, which employed an SOA of 0ms, found marginally significant effects of increased activation for alternatives. In their second experiment, there were six blocks between the presentation of stimuli and of the probe. The results of this delayed memory task showed that focused sentences lowered accuracy for all types of probes. The authors interpret this to be a consequence of semantic interference caused by the focus activation, selection and representation process. As far as response times were concerned, the authors report no effects of probe type or sentence type. Overall, the study of Káldi et al. (2021) suggests that the research on the improved memory representation of alternatives can be extended to languages with syntactically marked focus. However, their results are largely inconclusive.

Calhoun et al. (2022) have recently published new data on focus alternatives in Samoan. This language is claimed to use primarily syntactic means for the marking of focus. Calhoun (2015) reports that in an elicitation study, Samoan speakers produced non-canonical word orders when they intended to narrowly focus objects. They fronted the object and added the *'o* particle. She also notes that the initial sentential position is the default one for nuclear accent (L+H*), which has been associated with focus alternative effects in Germanic languages, as noted above (Husband and Ferreira 2016; Braun and Tagliapietra 2010). In their study, Calhoun et al. (2022) first conducted a probe recognition experiment based on the design of Gotzner et al. (2016). They found that mentioned alternatives to the object were correctly recognised more slowly when the object was narrowly focused by means of fronting and the *'o* particle. However, it must be noted that this effect was only marginally significant. No effect was found for contextually unmentioned alternatives. Their second experiment was a delayed recognition task, which was used to test whether focusing by means of word order manipulations improved recall for alternatives in Samoan. While they found no effect of focus marking on the accuracy of the recognition of alternatives, their response time data showed that Samoan comprehenders were faster to recognise mentioned alternatives when the object was focused. This research is the first piece of evidence suggesting that even in a language with mostly syntactic focus marking, focus alternatives are represented in online processing. However, no strong conclusions from the study of Calhoun et al. (2022) can be drawn given that the critical effects of interest were only reported to be marginally significant.

To our knowledge, no research has so far been conducted on the processing focus alternatives in Slavic languages. Given their features, studying focus processing in these languages would provide a needed addition to the literature. This is mainly due to the relationship between information structure and word order that is explored in the next section.

1.3. Focus in Czech

Let us move on to a discussion of how the information structure category of focus is realised in Czech. The language is a part of the Slavic branch of the Indo-European family and relies heavily on inflection (Short 1993). The language exhibits relatively free word order (Jasinskaja and Šimík forthcoming). While all possible combinations of subjects, verbs, and objects are allowed, these differ in their frequency. Siewierska and Uhlířová (1998) observe that in a corpus of over 6000 transitive sentences of Czech, the most dominant word order was SVO, which accounted for 63.1% of sentences. The next most frequent word order was OVS with 14.6% of the corpus. All the other possible word orders exhibited frequences of under 10%. However, not all of these word orders are felicitous in every context.

The study of Czech information structure goes all the way back to the Prague School of Linguistics (Mathesius 1936). Since then, it has been claimed that word order variation in the language is associated with different configurations of information structure (e.g. Mathesius, 1941; 1936; Firbas 1971, 1992; Sgall et al. 1986). Independently of the particular analytical framework, all researchers agree that elements in a Czech sentence are ordered sequentially from the most known and given elements to the new. This means that the final position in a sentence is associated with the newest and most unexpected element (from the point of the view of the hearer).

Given that in the hitherto-studied languages (such as English or German), prosody plays a crucial role in the marking of focus, we ought to ask what the relationship between it and information structure is in Czech. Daneš (1957; 1959) notes that in the language, there is a default position for sentential stress and that it is the final word of the sentence. At the same time, Czech requires stress to be placed within the focused constituent. Thus, it seems that there is a correspondence between where both focus and prosody fall–at the end of sentences.

This relationship between prosody and focus in Czech has been investigated by Šimík and his colleagues (Groeben et al. 2017; Šimík and Wierzba 2015, 2017). In their research, they ran several acceptability judgement experiments with native Czech speakers. Their participants were exposed to auditorily presented Czech sentences with varying word orders and prosodic structures. What they found was that both maintaining the canonical word order with moving the main sentential stress to, say, a focused subject and having a non-canonical word order with the subject in the last position which receives this stress by default was equally accepted by participants. The combination of non-canonical word orders and altered prosodic patterns however was judged to be less acceptable (unless it was the initial constituent that received stress).

What this means is that while focus is primarily marked by prosody in Czech, the speakers of the language can "make use" of the relatively free word order allowed for by the grammar (Junghanns 2001). They can place the element they wish to focus into the final position in the sentence in order for it to receive prosodic prominence by virtue of being in the default position for sentential stress. The results of the aforementioned studies also show that this is an either-or choice for the speakers of Czech—sentences with non-canonical word orders that also had shifted prosody were judged to be highly unacceptable.

These features make Czech a good candidate to test whether word order alone in the absence of realised prosody can induce comprehenders to create a set of focus alternatives in real-time processing. For if a Czech comprehender encounters a marked non-canonical word order, they ought to assign it a particular information structure configuration, namely one where the last element in the sentence is narrowly focused. What this allows a researcher to do is to present written stimuli manipulating the ordering of constituents and thus, presumably, guide participants towards particular set-ups of information structure.

1.4. The current study

In the current study, we aim at testing whether the previous psycholinguistic findings on Germanic languages regarding the processing reality of focus alternatives can be extended to Czech, a typologically different language that uses word order to mark different focus structures.

Furthermore, we wish to put to test the proposed tight connection between focus effects and prosody. As discussed above, the approach to focus taken by proponents of the RSA framework places the function of focus squarely into the domain of prosodic prominence. The theory claims that it is due to this attempted noise reduction (the probability of erroneous perception on the part of the hearer) that the mechanism of social reasoning is based on. Alternatives are considered, because of the speaker who who chooses to accentuate a particular constituent. Consequently, we may argue that this approach predicts that focus alternative effects, such as those discussed in the above section, would only be present when prosodic prominence is actualised. The flip side would then be that should stimuli be written only and no overt prosody present, no focus alternative effects ought to be observed. In other words, alternatives and focus are inherently tied to the prosodic realisation of sentences.

Thus, our main research questions are as follows—do Czech comprehenders represent focus alternatives to focused words in online processing? Are changes in word order sufficient to induce these effects? And finally—is realised prosodic prominence a necessary condition for focus alternative effects?

To answer these questions, we ran a web-based probe recognition task experiment with native Czech comprehenders, which employed rapid serial visual presentation (RSVP) as its mode of stimuli display. In it, we presented participants with sentences exhibiting non-canonical word orders. These were either subject final or verb final. In this way, we can manipulate which constituent in our stimuli is narrowly focused. Next, participants were to react to three different types of probes, which were all nouns. Being interested in the question whether Czech comprehenders represent alternatives to focused subjects, we judged the contrast between genuine plausible, albeit unmentioned, alternatives and merely associated words, which could not replace the focused element, crucial. We also included completely unrelated items in order to ascertain whether our comprehenders were processing the stimuli sentences fully and were affected by the semantic similarity of the probes at all.

We base our predictions on the study of Jördens et al. (2020), which is the closest to the design employed here. They also employed the probe recognition task with “out of the blue” sentences that were not preceded by any context containing mentioned alternatives (as in, for example, Gotzner et al. 2016). As discussed above, their findings show that plausible unmentioned alternatives are facilitated compared to merely associated words but that both of these types of probes are slower compared to unrelated words.

Let us now turn to the specification of our hypotheses. Based on the predictions of the Roothian-inspired (1992) processing approach, the research conducted on other languages, and the features of Czech described above, we hypothesise that Czech comprehenders represent focus alternatives to focused subjects when these are marked by means of word order only.

Therefore, under the hypothesis specified above, we predict that we ought to see a difference in the response times of correct rejections of probes between those that are plausible alternatives and merely associated words only in the condition where the subject is narrowly focused, i.e. where our alternative probes are actually concordant with the focused element in semantic type. When the subject is focused, the alternatives ought to be facilitated compared to merely associated words. When the verb is focused, no such difference ought to be observed. Given previous results, we also expect both types of associated probes to be rejected more slowly compared to unrelated words.

Here, we report a pre-registered (https://osf.io/tjw73) web-based probe recognition experiment with native Czech speakers. In it, our participants were tasked with responding to whether particular probes appeared in stimuli sentences presented in a word-by-word fashion (RSVP).

2. Probe recognition experiment

2.1. Method

2.1.1. Participants

Altogether, 180 Czech native speakers were recruited from a participant pool of the Institute of Czech Language and Theory of Communication at Charles University, Prague. They received course credit for their participation. There were 156 women, 21 men, 1 participant of other gender and 2 participants chose not to answer the gender question. The mean age of the participants was 22.51 (st.d. = 4.96).

2.1.2. Materials

We constructed Czech sentences with the intent to manipulate focus by means of word order. In order to narrowly focus the subject, we placed it last in the sentence. This was our critical condition—the Subject Focus condition. For our control condition—the Verb Focus condition, we placed the verb last, achieving narrow verbal focus. Each sentence started with a locative or a temporal phrase followed by a direct object. The following is an example item:

(4) Minulou sobotu sonátu zahrál [houslista]$_{\text{Focus}}$.
Last Saturday sonata played violinist
'Last Saturday, the [violinist]$_{\text{Focus}}$ played the sonata.'

(5) Minulou sobotu sonátu houslista [zahrál]$_{\text{Focus}}$.
Last Saturday sonata violinist played
'Last Saturday, the violinist [played]$_{\text{Focus}}$ the sonata.'

Both the critical Subject Focus condition and the control Verb Focus condition exhibit non-canonical word order, OVS and OSV respectively. We avoided using the canonical order of SVO for our control condition in order to prevent a frequency-based confound. Since both of the used structures are marked and rather infrequent, we expected comprehenders to have equal difficulty with either type of sentence appearing without supporting context.

In addition to the sentences, each item consisted of three probes. The Probe Type manipulation had three levels—Subject-Alternative, Subject-Associated, and Unrelated. In the current example item, the Subject-Alternative probe was *klavírista* (*pianist*), the Subject-Associated probe *symfonie* (*symphony*), and the Unrelated probe *obrubník* (*street curb*). These probes were matched for lemma frequency in the Czech National Corpus and for letter length (Křen et al. 2015).

We also conducted a rating study, in which native speakers of Czech (N = 33) were first asked to rate the perceived level of association between the subject of each item (here *violinist*) and the three types of probes on a Likert scale. Then their task was to judge the grammaticality of our sentence stimuli in the second half of the experiment. This way, we ensured that the Subject-Alternative and Subject-Associated probes were equal with regards to their association to the subject noun thus eliminating the risk of confounding. The grammaticality part of the rating study was added in order to make sure both of our Focus Status conditions were equally natural and acceptable for our participants. More information on the rating study can be found on the OSF platform (link above).

2.1.3. Procedure

Participants were given a link to a website with the experiment. Upon arriving, they read a consent form and indicated their consent by means of checking a box. Next, they filled out a brief demographic questionnaire and were given instructions for the experiment. This was followed by practice items.

In the experiment proper, each trial consisted of a Czech sentence presented in the rapid serial visual presentation (RSVP) mode with each word appearing in the middle of the screen for 300ms followed by 100ms of a blank screen. After the final word of each sentence, a probe word written in capital letters appeared. The stimulus-onset asynchrony with which the probe was displayed was kept at 2000ms measured from the subject noun in the experimental items. Thus, in the Verb Focus condition, the probe was placed on the screen 1600ms after the last word, whilst in the Subject Focus condition 2000ms elapsed, since the subject was always the final word in this condition. The participants were instructed to indicate as quickly as possible using their keyboard whether the given probe was present anywhere in the preceding sentence. They were told to press "j" for YES and "k" for NO. There was no feedback given and participants were under no time-out pressure. Each participant was exposed to 30 experimental items and 60 filler items. Each experimental item was followed by two filler ones. Latin Square design was used and the order of items was randomised. The answers participants gave (“YES” or “NO”) together with the associated response times (RTs) were measured.

2.1.4. Analysis

Our analysis was pre-registered on the Open Science Framework website (https://osf.io/tjw73). We fit the RTs of correct rejections of the probes in experimental items to a mixed-effects linear model. The RT data were entered as the dependent variable after log-transforming. The following factors were entered as fixed effects: centered Trial Order, Focus Status (Verb Focus and Subject Focus), Probe Type (Subject-Alternative, Subject-Associated, and Unrelated), and the interaction of the latter two. Since the factor of Probe Type had three levels, it was specified using Helmert Coding. The first contrast was set between the Subject-Alternative and Subject-Associated combined and the Unrelated condition. The second contrast compared the Subject-Alternative and the Subject-Associated condition. The factor of Focus Status was sum coded. As for our random effects structure, we followed Barr et al. (2013) and fit the maximal model that converged. The random effects structure of the final model included random intercepts for both participants and items and random slopes for participants.

2.2. Results

Mean response time per condition together with their standard errors are shown in Figure 1. The mixed effect model predicting log-transformed response times of correct rejections showed a significant main effect of Focus Status—probes in the Subject Focus condition were rejected quicker compared to those in the Verb Focus condition. Furthermore, a statistically significant main effect contrasting Subject-Alternative and Subject-Associated probes pooled to Unrelated ones was discovered. Finally, there was a significant main effect of centred trial with a negative effect estimate, meaning that participants got faster in responding to probes as the experiment unfolded. Contrary to our predictions, the model did not reveal a statistically significant interaction in the contrast between Subject-Associated and Subject-Alternative probes and the Focus Status condition. The full results of the model for our fixed effects can be found in Table 2.2.

Fixed effects	Estimate	SE	df	t-value	p-value
(Intercept)	7.1000	0.0284	232.3	310.803	<0.001 ***
Trial	−0.0028	0.0004	5037.0	−6.757	<0.001 ***
Focus status (FS)	−0.0161	0.0037	432.7	−4.297	<0.001 ***
Alternative (Al) v. Associated (As)	−0.0085	0.0051	191.1	1.656	0.099
Al+As v. Unrelated (Un)	0.0267	0.0027	335.0	−10.042	<0.001 ***
Al v. As : FS	0.0062	0.0047	220.2	1.328	0.185
Al+As v. Un : FS	0.0033	0.0026	215.9	1.252	0.212

Table 1: Fixed effects of a linear mixed effects model predicting log-RTs (full dataset)—Focus Status (FS) coded as -1 for Verb-Focus and 1 for Subject-Focus; Probe Type coded using Helmert contrasts, Subject-Alternative (Al), Subject-Associated (As) and Unrelated (Un)

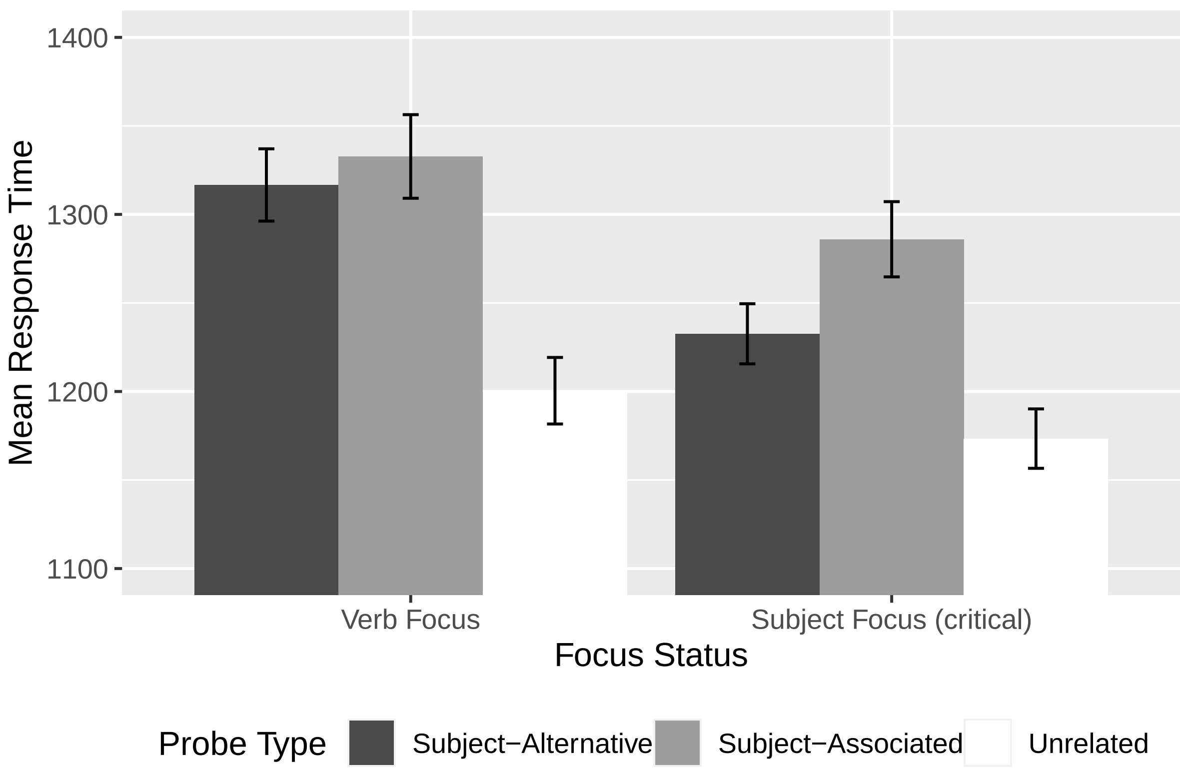

Figure 1: The means and SEMs of the trimmed RTs of correct rejections

3. Discussion

In the current study, we tested whether Czech comprehenders represent focus alternatives to subjects when their focus status is signalled through word order manipulations only. Our results remain inconclusive regarding this issue, since we did not find a significant interaction in the contrast between plausible alternatives to the subject and merely associated words and our word order manipulation of narrow focus on the subject noun or the finite verb respectively.

Our model showed us that there was a statistically significant difference between the two associated probe conditions and unrelated words, which were rejected faster. This is in line with our predictions set up based on the research of Jördens et al. (2020). The inhibition caused by semantic similarity of the associated probes with the subject in both conditions is evidence of our participants being influenced by our manipulations. It also suggests that they were paying attention to the content of the sentences presented to them.

Next, there is the observed main effect of Focus Status. The model shows us that probes in the Subject-Focus condition were rejected faster than those in the Verb-Focus one. This, we believe, could have two possible explanations. Firstly, there is the possibility of recency effects. Research has revealed that more recent information presented (e.g. presented closer to the point of probing) is privileged and is, for instance, better remembered (Bjork and Whitten 1974; Watkins et al. 1989). While we attempted to control for this by measuring our SOA from the point of the subject noun, which means that in the Verb-Focus condition, the probes appeared earlier after the last word of the sentence when compared to the Subject-Focus condition, it remains plausible that the effect of having intervening material (the finite verb) caused enough interference to be detectable in the task. The second explanation lies in the relative frequency and acceptability of the two word orders used. As discussed in the introduction, Siewierska and Uhlířová (1998) note that in Czech, the OVS word order appears to be the second most frequent. This was the word order used in our Subject-Focus condition. Our control condition, on the other hand, used the OSV order, which is much less frequent. It is therefore possible that our comprehenders found it more difficult to process the sentences in the Verb-Focus condition and were therefore, on average, slower in their responses to probes in this condition. In fact, we had attempted to preempt this issue before we conducted the main study by having native Czech speakers rate the acceptability of our stimuli sentences (the details of this study can be found on our OSF project page). When our participants rated our original set of 40 experimental items, they did indeed consider the sentences in the Verb focus condition to be less acceptable than those with subjects in the final position. We manually excluded those sentence pairs (items) where the verb-final sentences were judged to be substantially less acceptable compared to their subject-final counterparts. The final set of the 30 items we selected was judged equally acceptable in both conditions however. This mitigates the above-mentioned concern.

While our pre-registered analysis did not confirm the visually present pattern of predicted results, further investigations into the data revealed possible reasons for this. As can be seen in Figure 2, which shows our data divided into two halves by trial order for each participant, the predicted facilitation in the Subject-Focus condition is strongly present and one can see no difference between the two associated conditions in the Verb-Focus condition in the first half of trials. On the other hand, the pattern disappears in the second half. This suggests that, perhaps, our participants became accustomed to our stimuli or employed different strategies in the course of the experiments.

We conducted a post-hoc sub-set analysis that included only the data from each of the participant’s first half of trials. The fixed effects estimates together with the accompanying p-values can be seen in Table 2. The interaction of interest, i.e. the contrast between Subject-Associated and Subject-Alternative probes interacting with the Focus Status condition, is significant in this analysis. This confirms the pattern seen in Figure 2.

Fixed effects	Estimate	SE	df	t-value	p-value	
(Intercept)	7.1140	0.0244	256.5	291.905	<0.001	***
Trial	−0.0045	0.0012	2413	−3.876	<0.001	***
Focus status (FS)	−0.0204	0.0054	249.2	−3.796	<0.001	***
Alternative (Al) v. Associated (As)	−0.0019	0.0070	179.5	−0.269	0.788	
Al+As v. Unrelated (Un)	−0.0260	0.0037	305.7	−6.934	<0.001	***
Al v. As : FS	−0.0152	0.0068	178.1	−2.235	0.027	*
Al+As v. Un : FS	−0.0021	0.0037	467.6	−0.567	0.571	

Table 2: Fixed effects of a linear mixed effects model predicting log-RTs (block 1 only)—Focus Status (FS) coded as -1 for Verb-Focus and 1 for Subject-Focus; Probe Type coded using Helmert contrasts, Subject-Alternative (Al), Subject-Associated (As) and Unrelated (Un)

As for the explanations for the observed pattern of changes across the course of the experiment, we propose that the composition of the filler items used could be the reason. All of the probe

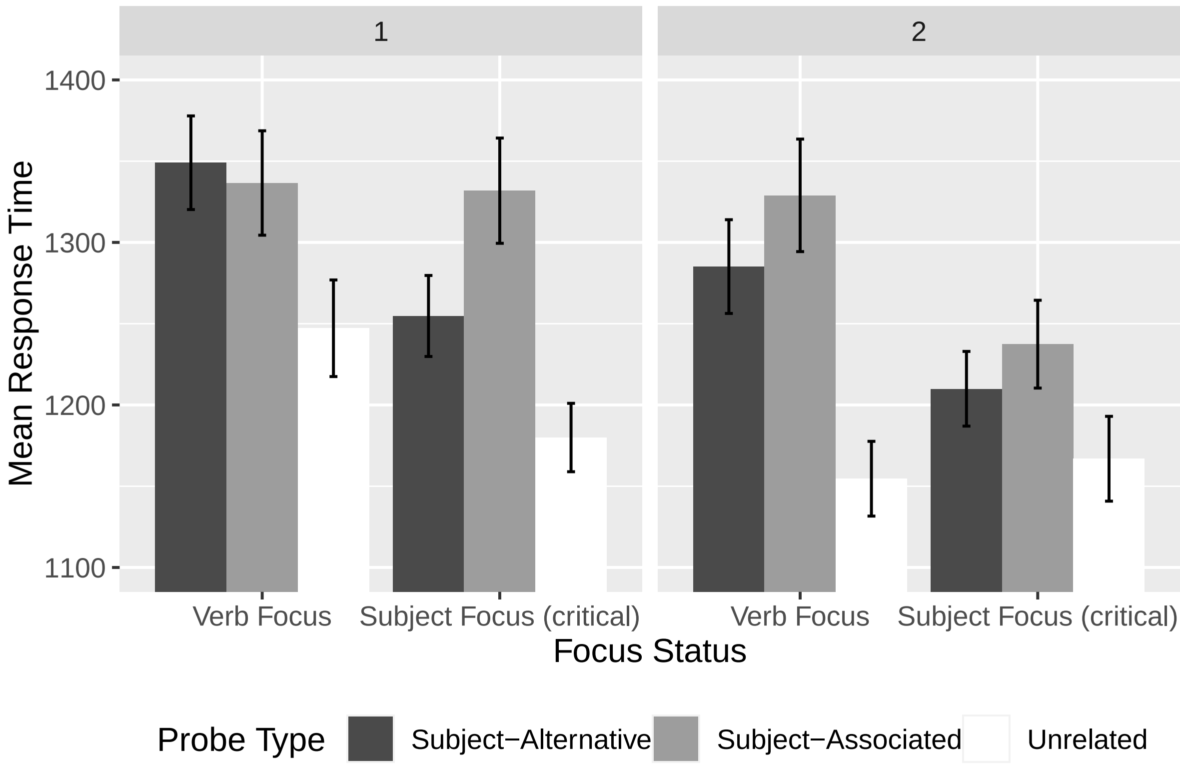

Figure 2: The means and SEMs of the trimmed RTs of correct rejections by block

words that participants were asked to respond to were in fact nouns. While we made sure the fillers employed were of varied structures and the probes to which participants were supposed to answer "yes" to were placed in different positions within the sentences presented, it remains plausible that given the fact that they were all nouns, our participants recognised this fact early on during the experimental session and learnt that in order to successfully complete the task, they did not in fact need to pay attention to any other word classes present in the sentences beside nouns.

This post-hoc analysis shows us that in the first half of trials, the predicted pattern holds. We observe the interaction in the difference between Subject-Alternative and Subject-Associated probes and the Focus Status manipulation. We argue here that this constitutes *preliminary evidence* in favour of the hypothesis that Czech comprehenders represent alternatives to focused subjects in cases where this element's focus status is marked purely by means of word order. Yet it must be stressed that while the pattern observed in the first half of trials and confirmed by the subset analysis is in line with our predictions and previous literature, it is suggestive only given that this analysis is exploratory in nature.

Taking the preliminary nature of this evidence into account, we can nevertheless say that the current study suggests that the previous results on the representation of focus alternatives have been replicated in Czech, a language which can use both prosody and word order to mark focus. It has been tentatively shown that Czech comprehenders are sensitive to changes in word order and treat the last position in sentences presented textually as conveying narrow focus. These comprehenders then seem to build representations of unmentioned alternatives that could plausibly replace the focused subject in the given context. They treat these alternatives differently to merely associated nouns that are not potential alternatives in the given context.

The implications of the fact that we only observed the predicted pattern in the first half of the experimental session ought also to be discussed. Firstly, it suggests that focus alternative effects can change depending on the amount of stimuli of similar structure presented. That the expected facilitation effects for alternatives can wane in later trials points to factors such as extra-linguistic factors such as attention or conscious task strategies of participants playing a role in modulating these effects. What this suggests is that the activation, selection, and eventual representation of alternatives may not be an automatic mandatory process within parsing as imagined for example by Fodor (1983). This would be in line with viewing focus and its function as essentially pragmatic in nature. Even when recognising focus marking, comprehenders could choose not to engage in the process of activating, selecting, and representing alternatives should the context of the utterance render this process moot in purpose.

With regards to the question of the necessity of realised prosody, which, arguably, is predicted by a narrow interpretation of RSA models based on noisy channel approaches, our study remains largely inconclusive. If prosodic realisation were necessary, we ought to have seen no differences between Subject-Alternative and Subject-Associated probes conditional upon the Focus Status manipulation. That we found no significant interaction in our pre-registered analysis is consistent with this prediction. This is, of course, interpreting a null result and therefore, it cannot be argued strongly that no difference was present. Additionally, our post-hoc analysis suggests that Czech comprehenders do in fact activate and represent alternatives to focused subjects even when they have no realised prosody aiding them in the marking of focus. One counterargument to this might be that our comprehenders engaged in implicit prosody (Fodor 2002). Further research contrasting written stimuli and auditory stimuli should be conducted to shed further light on the relative role of prosody (be it explicit or implicit) and word order in focus comprehension in Czech.

4. Conclusion

In the current research, we attempted to generalise previous results regarding the activation and representation of focus alternatives in real-time comprehension that have been attained in Germanic languages, which mostly use prosody to mark focus, to Czech, a language that can use word order to manipulate information structure. The results of our probe recognition experiment suggest give us preliminary evidence that Czech comprehenders do indeed represent focus alternatives to subjects, whose focus status was conferred by word order only. However, given that only a post-hoc analysis of the first block of trials supports this, our conclusion can only be tentative until more data is collected and the pattern replicated on a larger sample.

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‘Articleless’ languages are not created equal

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Abstract. We adopt a translation corpus approach based on the first chapter of *Harry Potter and the Philosopher’s Stone* to evaluate Dayal’s updated version of the neo-Carlsonian framework and the predictions it makes for bare nouns in Hindi, Russian and Mandarin (Dayal 2004). Our Hindi data turn out to be overall in line with Dayal’s predictions but the same does not hold for our Russian and Mandarin data, leading us to explore a number of extensions and modifications of Dayal’s analysis. For Mandarin, our data lead us to hypothesize a role for the numeral *yi* (‘one’) as an indefinite article and for demonstratives as definite articles. For our Hindi and Russian bare noun data, we argue that the only way to account for them is to reverse at least part of Dayal’s updates to the neo-Carlsonian framework and to hypothesize that Hindi – unlike Russian – is developing an indefinite article.

Keywords: definiteness, indefiniteness, bare nouns, Hindi, Russian, Mandarin.

1. Introduction

In his seminal paper on reference to kinds across languages, Chierchia defends the intuition that languages that do not have articles freely allow their bare nouns (henceforth BNs) to give rise to definite and indefinite interpretations (Chierchia 1998). On the basis of fine-grained data from Hindi, Russian and Mandarin, Dayal (2004) argues that this generalization holds for bare plurals (henceforth BPs) and for BNs in classifier languages, but not for bare singulars (henceforth BSs), the latter being restricted to definite interpretations. Dayal accounts for this new generalization in an updated version of Chierchia’s neo-Carlsonian framework.

In this paper, we retrace the data underlying Dayal’s argumentation and sketch the way she accounts for them (Section 2). Following up on problematic data from Russian, we propose a translation corpus study based on the first chapter of *Harry Potter and the Philosopher’s Stone* and its translations to the three languages studied by Dayal (2004) (Section 3). Our Hindi data turn out to be overall in line with Dayal’s predictions but the same does not hold for our Russian and Mandarin data (Section 4), leading us to explore a number of extensions and modifications of Dayal’s analysis (Sections 5 and 6). The overall conclusion we will arrive at is that BNs do not behave in the same way across so-called ‘articleless’ languages and that the explanation might lie in the fact that some of these languages are less articleless than the literature has suggested up till now.

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2. BNs in 'articleless' languages: from Hindi to Russian and Mandarin

Dayal (2004) argues that Hindi BNs display a singular/plural asymmetry. Whereas plural BNs (henceforth *bare plurals* or *BPs*) straightforwardly allow for narrow scope indefinite readings, singular BNs (henceforth *bare singulars* or *BSs*) turn out to be more restricted. We illustrate this asymmetry with the minimal pair in (1) (see Dayal 2004):

(1) a. #*caroN taraf* ***cuuha*** *hai*
everywhere mouse is
b. *caroN taraf* ***cuuhe*** *haiN*
everywhere mice are

The intended readings of *cuuha* (1a) and *cuuhe* (1b) are those in which they take scope under *caroN taraf*, leading to the assertion that there were mice everywhere. As Dayal points out, this reading is available for (1b) but not for (1a), the latter only leading to the pragmatically odd assertion that the same mouse was everywhere. With Dayal, we conclude that the opposition between (1a) and (1b) shows that Hindi BSs do not have the same range of indefinite readings as Hindi BPs.

Even though the contrast in (1) seems to bear on scope in the indefinite domain, Dayal (2004) gives it a definiteness twist, arguing that the data follow if we assume BPs allow for indefinite interpretations but BSs do not. In 2.2, we develop this intuition in more detail, sketch how Dayal derives it in an extended version of the neo-Carlsonian framework and explore the implications for Hindi, Russian and Mandarin. To properly frame the extensions Dayal proposes, we however start by taking another look at the original version of the neo-Carlsonian framework (Chierchia 1998) and the predictions it makes about Hindi BSs and BPs.

2.1. Chierchia's predictions for Hindi BSs and BPs

Chierchia (1998) does not explicitly treat Hindi, but we can generate the predictions he makes for its BSs and BPs. For presentation purposes, we work out the predictions under Dayal's assumption that Hindi is an articleless language, an assumption that Chierchia (1998) does not commit to.

For Hindi BSs, Chierchia's neo-Carlsonian framework presents two ways to derive indefinite readings. The first is a simple existential shift (∃): under Dayal's assumption that Hindi is an articleless language, BSs are predicted to be able to undergo a covert ∃-shift and end up with an indefinite interpretation. The second way is a more involved one, building on Chierchia's Derived Kind Predication (henceforth *DKP*) and the fact that Hindi BSs can refer to kinds, as illustrated in (2) (see Dayal 2004:402):

(2) ***kutta*** *aam janvar hai*
dog common animal is
'The dog is a common animal.'

DKP is an operation that kicks in when a kind combines with a predicate requiring reference to regular individuals (see Chierchia 1998:364):

(3) Derived Kind Predication (DKP):
If P applies to regular individuals and k denotes a kind, then
$P(k) = \exists x[{}^{U}k(x) \wedge P(x)]$

On its definition in (3), DKP leads to existential quantification over instantiations of a kind, effectively giving rise to a (derived) indefinite reading. With BSs referring to kinds in Hindi, Chierchia’s DKP thus constitutes a second path to indefinite readings for BSs.

Moving to Hindi BPs, Chierchia predicts them to give rise to indefinite readings on a par with Hindi BSs. The one difference with BSs resides in the fact that the latter have two paths that lead to indefinite readings – the existential and the DKP path – whereas BPs only have the DKP path at their disposal. The full derivation of the DKP path starts with a shift from predicates to their corresponding kinds (the *down*-shift,$^{\cap}$) and is followed by DKP. The reason BPs do not have the existential path at their disposal is that Chierchia ranks the shift from predicates to their corresponding kinds (the *down*-shift, $^{\cap}$) above the ∃- and the iota (ι)-shifts, and argues that the $^{\cap}$-shift is defined for plurals but not for singulars. Given that the $^{\cap}$-shift is defined for BPs, its ranking above the ∃-shift blocks the latter from applying and cuts off the existential route to indefinite readings for BPs. For BSs, the $^{\cap}$-shift is undefined, and its higher ranking has no effect on the availability of the ∃-shift, maintaining the latter as a path towards indefinite readings.

Summarizing Chierchia’s predictions for Hindi, we have worked out how BSs can get indefinite interpretations through the ∃-shift and DKP whereas BPs get indefinite readings through DKP alone. Importantly, though, the opposition in the availability of the ∃-shift has no bearing on the asymmetry we find in (1). Indeed, both the ∃-shift and DKP are expected to allow for narrow scope readings, leaving the unavailability of the narrow scope reading of the BS in (1a) and its asymmetry with the BP in (1b) unaccounted for.

2.2. Dayal’s account for Hindi and its predictions

Dayal’s extensions of Chierchia’s neo-Carlsonian framework are mainly targeting the singular paradigm. We present the underlying intuition and discuss the extensions Dayal proposes, focusing on BSs but also briefly looking into BPs. Dayal’s account is inspired by the intuition that Hindi BSs cannot get indefinite readings but only definite ones, straightforwardly explaining why *cuuha* in (1a) cannot but refer to a unique mouse and lead to the pragmatically odd assertion that the same mouse was everywhere. To derive this restriction to definite readings for BSs, Dayal introduces two extensions to Chierchia’s neo-Carlsonian framework. The first is to not only rank the $^{\cap}$-shift above the ∃-shift but to do the same for the ι-shift, leading to the ranking $^{\cap}$, ι>∃. The effect of this move is that the ∃-shift no longer constitutes a viable path to indefinite readings for Hindi BSs – independently of the fact that the $^{\cap}$-shift is not defined for them. The second extension Dayal proposes is to restrict the availability of DKP to kinds that have a 'semantically transparent relation to their instantiations' (Dayal 2004:430), a property that Dayal associates with kind reference of plural nouns but not of singular nouns. The effect of this second extension is that DKP is also cut off as a viable path to indefinite readings for Hindi BSs.

With the two extensions she proposes, Dayal makes sure that there are no paths to indefinite readings for Hindi BSs in her updated version of Chierchia's neo-Carlsonian framework. She thus guarantees that the only non-kind referring readings BSs can get in regular argument position are definite ones, deriving the pragmatically odd reading of *cuuha* in (1a). For BPs, Dayal's extensions have no impact on the availability of DKP-generated indefinite readings. The narrow scope indefinite reading Chierchia predicts for *cuuhe* in (1b) is thus maintained and the contrast with (1a) accounted for.

Dayal's extensions of Chierchia's neo-Carlsonian framework make a number of predictions. First, for Hindi BSs, the prediction is that they should never give rise to indefinite readings in regular argument position. Second, given that the extensions are defined at the level of type-shift rankings and DKP, they are intended to be language independent and the predictions for Hindi BSs should extend to BSs in any other articleless language. Finally, under the assumption that articleless languages without a grammaticalized singular/plural distinction in the nominal domain do not impose restrictions on the application of DKP (Dayal 2004:413), Dayal predicts them to differ from languages like Hindi and always allow for indefinite readings of their BNs. In what follows, we present Dayal's take on these predictions for Hindi, Russian and Mandarin and discuss how they have been received in the literature.

For Hindi, Dayal admits that there are cases in which BSs seem to get an indefinite reading (see Dayal 2011):

(4) *anu* ***kitaab*** *paRhegii*
Anu book read-FUT
'Anu will read a book.'

To account for cases like (4), Dayal argues that *kitaab* does not appear in regular argument position but rather in a pseudo-incorporated position. Crucially, pseudo-incorporated nouns can be argued not to type-shift, their apparent indefiniteness stemming from the construction they appear in. As such, examples like (4) do not need to pose a threat for Dayal's prediction that Hindi BSs in regular argument position only take on definite readings.

Dayal takes Russian to be a good example of another articleless language with a grammaticalized singular/plural distinction in the nominal domain and argues that Russian BSs align with their Hindi counterparts. (5) replicates the BS/BP asymmetry we saw in (1) (see Dayal 2004):

(5) a. #***Sobaka*** *byla vezde.*
dog was everywhere

b. ***Sobaki*** *byli vezde.*
dogs were everywhere

Whereas (5b) straightforwardly allows for the reading according to which there were dogs everywhere, the singular *sobaka* only leads to the same pragmatically odd reading as (1a), according to which the same dog was everywhere.

For articleless languages that allow for BNs but do not have a grammaticalized singular/plural distinction, Dayal discusses Mandarin and points out that Mandarin BNs are on a par with Hindi BPs rather than with Hindi BSs in allowing for narrow scope readings in contexts like (1) (see Dayal 2004):

(6) ***Gou*** *zai meigeren-de houyuan-li jiao.*
dog at everyone-DE backyard-inside bark

(6) is compatible with a reading in which different dogs are barking in different people’s backyards. This reading is similar to the one we get for Hindi BPs in (1b), in line with Dayal’s predictions.

In the formal semantics literature, Dayal’s account has been the predominant one for Hindi BNs and the literature on Mandarin has not called into question the predictions Dayal makes. For Russian, the story is different and multiple authors have argued that Russian BSs do not show any signs of inherent definiteness (e.g., Bronnikov 2006; Šimík & Demian 2020; Seres & Borik 2021). (7) illustrates this (see Seres & Borik 2021):

(7) V každom dome igral **rebënok**.
in every house played child.NOM

(7) straightforwardly allows for a reading according to which different children were playing in different houses, showing that the BS *rebënok* can take narrow scope under the universal *každom dome*. We concede that the structure of (7) is possibly different from the one in (5a) but this should not affect Dayal’s prediction, and we conclude that (7) constitutes a clear counterexample.

2.3. Towards a cross-linguistic re-assessment of Dayal’s account

Although the Russian facts have an immediate impact on the validity of Dayal’s analysis, we are not aware of any attempt at re-evaluating Dayal’s account for other languages than Russian. We assume that this is because the literature – up till recently – lacked the right tools to compare the distributions of BNs across languages and properly assess the empirical scope of counterexamples like (7). In this paper, we propose a translation corpus study and assess the predictions Dayal makes by analyzing translations of the same text to Hindi, Russian and Mandarin, allowing for a broad parallel evaluation of Dayal’s predictions for these three languages.

3. Methodology

Translation corpus research has recently been argued to constitute a valuable addition to the toolbox of semanticists who study cross-linguistic variation. The phenomena that have been studied include – among others – tense and aspect (Fuchs & Gonzalez 2022; van der Klis et al. 2022; Mulder et al. 2022; de Swart et al. 2022a; Tellings et al. 2021), negation (de Swart 2020) and reference (Bremmers et al. 2022). As for languages, the main focus has been on Romance and Germanic, but we also find extensions to a broader set of European languages (Gehrke 2022; de Swart et al. 2022b) as well as to Mandarin (Bogaards 2022; Bremmers et al. 2022; Mo 2022). Parallel to theory-oriented research, recent work is also covering the methodological side of translation corpus research from a semantics perspective (Le Bruyn et al. 2022; Le Bruyn et al. 2023; Le Bruyn & de Swart *submitted*).

The main advantage of translation corpora is that they present the same semantic content in a maximally similar way in different languages. For research into reference, this means that we can neatly trace the ways different languages deal with reference in the same (or maximally similar) contexts. By choosing a source language that makes a formal distinction between definiteness and indefiniteness, we can furthermore use this distinction as an independently motivated criterion to distinguish between definite and indefinite reference in languages that have been argued not to mark this distinction.

The source corpus we selected is the first chapter of *Harry Potter and the Philosopher's Stone*, a fairly recent novel that has been translated to Russian, Hindi, and Mandarin but also to an impressive array of other typologically diverse languages, allowing for the easy scaling up of the approach we pursue. We extracted all referential expressions from the English source text (N=1210) but for the current research, we focus on *a*(*n*) + N_{sg} (n=90), *the* + N_{sg} (n=140) and N_{pl} (n=52) and look into how they are rendered in the Russian, Hindi and Mandarin translations of the novel. The choice of these referential expressions is inspired by the dimensions that play a role in Dayal's analysis: number and (in)definiteness.

For *a*(*n*) + N_{sg}, Dayal predicts BS translations to be rare in Hindi and Russian and for BN translations to be perfectly fine in Mandarin. For Hindi, BSs should only be allowed to occur in pseudo-incorporation constructions (as in (4)) whereas, in other contexts, the Hindi translator is predicted to rely on overt determiners, the ∃-shift and DKP both being cut off as viable paths to indefiniteness for BSs. In line with the examples Dayal presents herself, the default way of rendering a singular indefinite in Hindi is to rely on *ek* ('one'):

(8) *bahut saal pahle, yehaaN* ****(ek) aurat*** *rahtii thii.*
many years ago here one woman lived
'Once upon a time, a woman used to live here.'

For Russian, we expect to find the same empirical picture as for Hindi, BSs being the minority option and determiners like *odin* ('one') being the default option for rendering singular indefinites.

Given that Dayal does not cut off the DKP path to indefiniteness for Mandarin BNs, she predicts the latter to be viable translations for singular indefinites.

For *the* + N_{sg} and for N_{pl}, Dayal predicts BNs/BSs/BPs to be the default options in all three languages. Given that she ranks the ι-shift at the same level as the $^{\cap}$-shift, each of the languages should straightforwardly allow its BSs/BNs to appear in singular definite contexts. Furthermore, given that Dayal takes DKP not only to be a viable path to indefiniteness for Mandarin BNs but also for Hindi and Russian BPs, we expect to find BPs/BNs as the default translations of N_{pl} in all three languages.

In Section 4, we organize the presentation of the results around the three types of contexts we have sketched above: singular indefinites, singular definites and plural indefinites. Because of this division of contexts, we can abstract away from number marking in Russian and Hindi, allowing us to resort to BNs as a general label and directly compare our Russian, Hindi, and Mandarin data. For each of the contexts, we compare the three languages and present descriptive and – where applicable – inferential statistics. The inferential statistic we will rely on is Fisher’s Exact Test, an alternative to the classic chi-square test that provides more reliable results for smaller datasets in which some expressions are far less frequent than others.

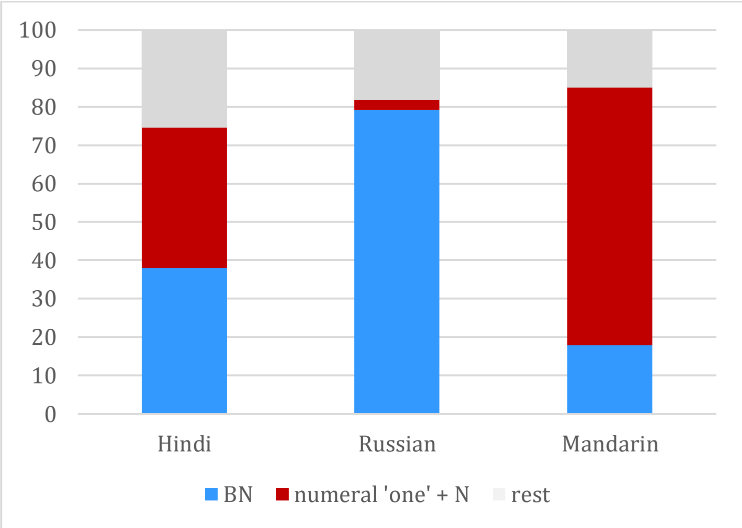
One final remark is in order before turning to the results. Even though translations render the same meaning as their original texts, it does happen that translators opt for different structures in which the referents of the original are not translated one-on-one. A concrete example from our corpus is ‘having a tantrum’ that is translated to Mandarin as *fā píqì* (litt. ‘lose temper’): the overall meaning is the same but there is no direct reference to a tantrum in the translation. We separately report on these cases but do not take them into account in our analyses.

4. Results

4.1. Singular indefinite contexts

For singular indefinite contexts (n=90), we found 23 cases of different constructions in Mandarin, 9 in Russian and 6 in Hindi. We report on three types of translations: (i) BNs, (ii) numeral ‘one’ + N, (iii) rest. For Hindi and Russian, BNs are restricted to BSs and for Mandarin, the numeral option includes a classifier. Graph *1* summarizes the data.

Graph *1* shows that there are big differences in how each language renders singular indefinites. Whereas Russian barely relies on the numeral, the latter is slightly more frequent than the BS in Hindi and is clearly the majority option in Mandarin. The differences in distribution of BNs and the numeral are also statistically significant (α=.05), Fisher’s Exact Tests leading to p-values smaller than 0.01 for the comparisons of the different language pairs. The rest category is varied in each of the languages but BNs and numeral ‘one’ + N clearly come out as the majority options for Hindi and Mandarin. In Russian, none of the rest options (proper names, pronouns, indefinite determiners, etc.) appear in more than two contexts.

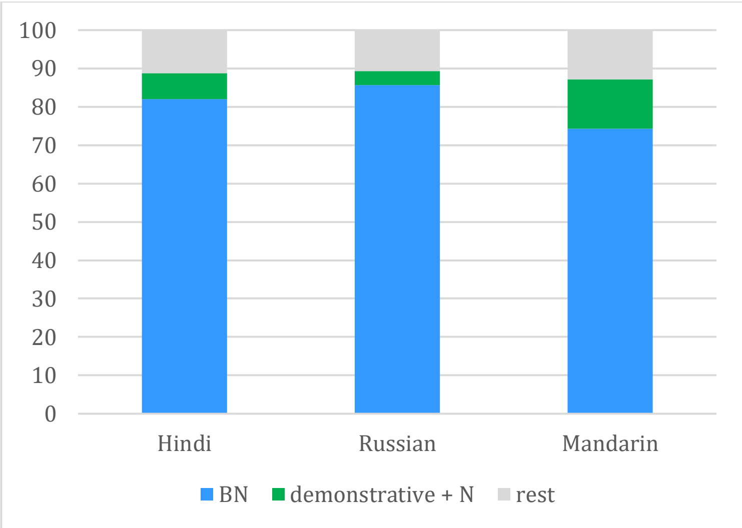


Graph 1: Relative frequencies of BN, numeral ‘one’ + N and rest translations of English indefinite singulars (*a*(*n*) + N_{sg}) in Hindi, Russian and Mandarin

4.2. Singular definite contexts

For singular definite contexts (n=140), we found 18 cases of different constructions in Russian, 12 in Mandarin and 5 in Hindi. Across the three languages, there was one construction that – despite remaining a distant second overall – stood out: the demonstrative. Even though Dayal makes no explicit predictions about the competition between BNs and demonstratives, our data do suggest that there is an interaction between the two and we consequently report on (i) BNs, (ii) demonstrative + N, (iii) rest. As for singular indefinites, BNs are restricted to BSs for Hindi and Russian. For Mandarin, the ‘demonstrative + N’ option typically contains a classifier. We summarize the data in Graph *2*.

Graph *2* shows that BNs are the majority option in all three languages. At the same time, we see that demonstratives are gaining ground, in particular in Mandarin. Pairwise comparisons between the languages show that the differences in distribution of BNs and demonstratives are significant for Russian-Mandarin ($p < 0.01$, Fisher’s Exact Test) but not for Russian-Hindi (p=0.15) nor for Hindi-Mandarin (p=0.14).



Graph 2: Relative frequencies of BN, demonstrative + N and rest translations of English definite singulars (*the* + N_{sg}) in Hindi, Russian and Mandarin

4.3. Plural indefinite contexts

For plural indefinite contexts (n=52), we found 5 cases of different constructions for Russian, 4 for Mandarin and 4 for Hindi. No constructions involving plural determiners appeared in more than two contexts in any of the languages, leaving us with no clear competitors to compare BNs to. In the absence of obvious competitors, we refrain from presenting graphs with relative frequencies and running inferential statistics. Our data show that BNs/BPs come out as the main category for translating plural indefinites in all of the languages (n=31 in Hindi, n=32 in Russian, n=39 in Mandarin).

5. Discussion

In Sections 2 and 3, we worked out the predictions Dayal makes for the translation of singular indefinites, singular definites and plural indefinites to Hindi, Russian and Mandarin. For singular definites and plural indefinites, we argued that Dayal predicts BNs/BSs/BPs to be the default options. For singular indefinites, however, Mandarin would have BNs as the default option whereas Hindi and Russian should both show a clear preference for nouns preceded by indefinite determiners like the numerals *ek* and *odin* (‘one’).

The picture that emerges from our results in Section 4 is different from the one predicted by Dayal. In this section, we zoom in on singular definite and singular indefinite contexts, discuss in how far our data are in line or at least compatible with Dayal’s predictions and explore extensions and modifications where relevant. Throughout, we will argue that Dayal’s analysis has to be extended and ultimately modified. The alternative analysis we move towards is one in which so-called 'articleless' languages do have articles that compete with BNs in varying ways. For reasons of space, we do not treat plural indefinite contexts separately. The general plural indefinite results are in line with Dayal's predictions and even though the data deserve to be unpacked further, we identified no tendencies that would go against Dayal's analysis.

5.1. Singular definite contexts

Our singular definite data are overall in line with Dayal's predictions in the sense that BSs/BNs clearly constitute the majority option in all three languages. The one surprise in our data is the special role of demonstratives that leads to a statistically traceable difference between Russian and Mandarin. Given that Hindi demonstratives do not lead to significant differences with Russian or Mandarin, we focus here on the Mandarin case.

The role of demonstratives in the referential system of Mandarin is not predicted by Dayal in her 2004 paper but has received attention in the more recent literature. Jenks (2018) argues that Mandarin demonstratives function as grammaticalized markers of familiarity and block BNs from marking this subtype of definiteness. In what follows, we argue that there is a division of labor between BNs and demonstratives, that it is different from the one proposed by Jenks and that it does not jeopardize the core of Dayal's analysis.

Our data show that demonstratives are used in familiarity contexts (10), but at the same time, we find that they are not obligatory in these contexts (9), *contra* Jenks (2018). Both (9) and (10) are part of a bigger context in which a cat is introduced and referred back to, (9) occurring before (10).

(9) **English**
Mr Dursley blinked and stared at **the cat**. It stared back.
Mandarin
Désīlǐ xiānshēng zhǎ. le zhǎ yǎn, dīng zhe ***māo*** *kàn*
Dursley Mr blink LE blink eye stare ASP cat look

(10) **English**
[…] he watched the cat in his mirror.
Mandarin
[…] *tā cóng hòushìjìng lǐ kànkàn* ***nà zhī māo***.
he from rear-view-mirror inside look that CL cat

Both *māo* in (9) and *nà zhī māo* in (10) refer back to the same cat that was introduced earlier. They thus count as familiar definites and show that Mandarin resorts both to BNs and to demonstratives in familiarity contexts. The exact division of labor between the two is an empirical puzzle that has been tackled in several recent papers (Bremmers et al. 2022; Dayal & Jiang 2021; Simpson & Wu 2022). The data in (9) and (10) are in line with Bremmers et al.'s (2022) proposal that Mandarin is sensitive to situation-level familiarity, allowing for familiar readings of BNs if they are introduced in the same situation as their antecedent and requiring the use of demonstratives to refer back to referents introduced in different situations. We refer the reader to Bremmers et al. (2022)

for further details but the intuition for (9) is that it is part of the same scene in which the cat is introduced through the eyes of Mr Dursley whereas (10) is part of another scene in which Mr Dursley drives off to work and looks back at the cat through his rear-view mirror. In line with Bremmers et al. (2022), we find that the BN can felicitously refer back to the cat within the same scene it was introduced in but that the translator resorts to the demonstrative when referring back to the cat in a separate scene.

Clearly, further research is needed to unpack the Mandarin data further and compare the different proposals on the division of labor between BNs and demonstratives. Crucially, though, our data suggest that such a division of labor exists and argue in favor of analyzing Mandarin demonstratives as article-like expressions that compete with BNs. Dayal does not foresee a role for definite articles in Mandarin but adding them does not impact on the core of her analysis: in neo-Carlsonian analyses, articles constitute an additional layer that is independent of the rankings of type-shifts and of number constraints on DKP. If we extend Dayal’s analysis with the assumption that Mandarin demonstratives function as definite articles, the prediction that follows is that BNs freely take on definite readings except for the subtype that demonstratives specialize in. This prediction is in line with our data, and we conclude that singular definite contexts do not pose a threat to Dayal’s analysis.

5.2. Singular indefinite contexts

Up till now, we have argued that our data in singular definite and plural indefinite contexts are in line or at least compatible with the predictions Dayal makes. The only additional hypothesis we have proposed is that Mandarin demonstratives function as a specific type of definite articles. Crucially, though, our singular definite and plural indefinite data have not led us to propose deep modifications of Dayal’s analysis. In this section, we discuss the singular indefinite contexts in our data and argue that they lead both to extensions and modifications.

We remind the reader that the prediction Dayal makes is that singular indefinites are straightforwardly translated as BNs in Mandarin and that Hindi and Russian should disallow BS translations, preferring nouns preceded by indefinite determiners like *ek* and *odin* (‘one’) instead. We argue that the empirical picture we get for Hindi is in line with this prediction but that the same does not hold for Mandarin and Russian. We go through the three languages in turn and use the translations of *a map* in (11) and of *a new word* in (12) as our running examples.

(11) **English**
It was on the corner of the street that he noticed the first sign of something peculiar - a cat reading **a map**.
Hindi
Sadak-ke mod par dursley ko pehli ajib chiz dikh-i – ek billi, jo ***naksha***
Street-GEN corner on Dursley to first strange thing.F see-PST.F a cat.F who map
padh rahi thi.
read PROG be.PST

Russian
Tol'ko na uglu ulicy mister Dursley nakonec zametil, čto proisxodit čto-to
only on corner street-GEN mister Dursley finally noticed that happens something
strannoe, – a zametil on košku, vnimatel'no izučavšuju ležaščuju pered nej
strange and noticed he cat-ACC attentively examining lying in.front.of her
kartu.
map-ACC
Mandarin
zài jiē.jiǎo shàng, tā kàn-dào-le dì-yī-gè yìcháng-de xìnhào
at street.corner on, he see-RVC-ASP ORD-one-CL peculiar-DE sign
yì-zhī-māo zài kàn ***dìtú***.
one-CL-cat PROG read map

(12) **English**
She told him over dinner all about Mrs Next Door 's problems with her daughter and how Dudley had learnt **a new word** ('Shan 't !') .
Hindi
Unho-ne dinner par apne pati ko bata-ya ki padosan ki apni beti ke.sath
She-ERG dinner on her husband to told-PFV that neighbor of own daughter with
kya samasyaye chal rahi hai aur Dudley-ne **ek naya vakya** sikh-a
what problems go PROG be.PRES and Dudley-ERG a new sentence learn-PFV
hai 'nahi karu-n-ga'.
be.PRES 'no do-FUT-M'
Russian
Za obedom ona oxotno spletničala, rasskazav misteru Dursley o tom, čto u
at lunch she gladly gossiped having.told mister-DAT Dursley about that that at
ix. sosedki ser'ëznye problemy s dočer'ju, i naposledok soobščiv,
their neighbour serious problems with daughter and finally having.informed
čto Dudley vyučil ***novoe slovo*** *"xačču!".*
that Dudley learnt new word I.wanna
Mandarin
Wǎnfàn zhuō shàng, désīlǐ tàitài xiàng tā jiǎngshùle línjū jiā de
Dinner table-on Durseley Mrs to he tell-ASP neighbour family DE
mǔ-nǚ máodùn, hái shuō dálì yòu xuéhuì ***yīgè xīncí***
mom-daughter conflict also say Dudley again learn-RVC one-CL new-word
("*jué bù*").
(never)

The translations of *a map* and *a new word* neatly illustrate the two major patterns that emerge from our data: one in which the Mandarin and Hindi translators both opt for a BN/BS (*a map*) and one in which they both opt for a construction with a numeral, Hindi *ek* and Mandarin *yi* 'one' (*a new word*), the Russian translator choosing a BS in both cases. We comment on the third pattern – one in which Hindi and Russian opt for a BS but Mandarin resorts to a construction with *yi* – in due course. The attentive reader will have noticed that the English original in (11) also contains a second indefinite singular – *a cat*. We leave it aside as the structures of its translations vary slightly.

5.2.1. Hindi

For Hindi, our singular indefinite data overall seem in line with Dayal’s predictions, especially if we compare the frequency of BNs as translations of singular definites (over 80%) to the frequency of BNs as translations of singular indefinites (below 40%). (11) and (12) nicely illustrate the alternation between BSs and nouns preceded by *ek* that we find in our singular indefinite data. To be fully in line with Dayal’s predictions, the argument should be that *naya vakya* occurs in regular argument position and therefore requires *ek*, but that *naksha* is pseudo-incorporated and can therefore occur without the numeral. Parallel to *kitaab* in (4), we assume that a pseudo-incorporation analysis for *naksha* is not implausible. We do note that the literature on pseudo-incorporation in Hindi does not give us any direct way to argue for it. In future work, we count on developing Le Bruyn et al. (2016)’s analysis of pseudo-incorporation and on exploiting the constraints it predicts on verb-noun combinations. According to Le Bruyn et al., pseudo-incorporation – in languages that allow for it – is possible in case the verb taps into the explicit or implicit relational semantics of the noun it combines with. This analysis gives us a handle on cases like *read book*, *read map* and *learn new word*. Indeed, whereas *book* and *map* both come with a telic role in their qualia structure (Pustejovsky 1995) and can thus be argued to come with an implicit use relation that can be picked up on by *read*, a noun like *word* arguably does not come with any explicit or implicit relational semantics that *learn* can pick up on. The prediction Le Bruyn et al.’s analysis makes then is that *read book* and *read map* allow for pseudo-incorporation and that *learn* (*new*) *word* does not. These predictions are in line with the data in (4), (11) and (12), *read book* and *read map* leading to BS translations and *learn new word* leading to a translation with *ek*. We submit that a full analysis of the Hindi data requires further theoretical and empirical work but conclude that on the basis of the Hindi singular indefinite data alone, we have no reason to believe that they are incompatible with Dayal’s analysis. We get back to this conclusion when we discuss the Russian indefinite singular data (Section 5.2.3.).

5.2.2. Mandarin

For Mandarin, Dayal’s prediction is that BNs should straightforwardly give rise to indefinite interpretations. With BNs occurring as translations of singular indefinites in fewer than twenty percent of the cases, this is arguably not the empirical picture we find. A counterargument one can entertain is that the low frequency of BNs in Mandarin does not say anything about the grammaticality of indefinite interpretations of BNs, but this argument makes little sense from Dayal’s perspective if the low frequency of BSs in Hindi is to be indicative of their ungrammaticality in regular argument position. We argue that our singular indefinite data are not in line with the predictions Dayal makes and that the analysis she proposes for Mandarin has to be adapted.

There are at least two options available to make sure that Mandarin BNs are not predicted to freely occur in singular indefinite contexts. One is to reconsider Dayal’s assumption that DKP is freely available for BNs in Mandarin. The disadvantage of this strategy is that it would make the prediction that BNs also have a hard time getting an indefinite interpretation in plural contexts, contrary to fact (see Section 4.2.). The other option is to assume that Mandarin is not only developing a definite article (see Section 5.1.) but also an indefinite one, specifically in the singular domain. Unlike the DKP strategy, the article strategy correctly targets the singular domain alone. It does raise the question what it means to be a developing indefinite article and how we can best formalize the division of labor between BNs and this indefinite article in synchrony. In this respect, a relevant tendency in our data is that there is only one case of a BN in Mandarin that is translated with the numeral in Hindi whereas there are fifteen cases of Hindi BSs that are translated with the numeral in Mandarin. What this tendency suggests is that Mandarin BNs are more restricted than Hindi BSs but that they do share a common set of contexts in which they appear. One route that deserves to be explored then is that Mandarin *dìtú* in (11) is pseudo-incorporated in the same way as Hindi *naksha* and that the division of labor between the Mandarin developing indefinite article and Mandarin BNs is to be formalized as a competition between the indefinite article and BNs in pseudo-incorporation constructions.

We conclude that our data point to the need to adapt Dayal's analysis for Mandarin and that extending it with the hypothesis that Mandarin is developing an indefinite article holds promise. We furthermore conclude that our data are suggestive of a scalar relation between contexts allowing for BSs in Hindi and BNs in Mandarin, arguing in favor of analyzing the division of labor between the Mandarin indefinite article and Mandarin BNs as a competition between the article and BNs in pseudo-incorporation constructions. Here too, we hope to develop Le Bruyn et al.'s (2016) analysis of pseudo-incorporation in our future work, as their analysis is explicitly set up in terms of a competition with singular indefinite articles.

5.2.3. Russian

For Russian, Dayal's predictions are similar to the ones for Hindi, BSs being clearly dispreferred and the translator opting for nouns preceded by an indefinite determiner like *odin* in the great majority of the cases. For Hindi, our data were overall in line with these predictions, but our Russian data show a completely different picture: unlike in Hindi, BSs are by far the predominant option to render singular indefinites in Russian. (11) and (12) are representative examples: where Hindi alternates BSs and nouns preceded by *ek*, Russian uniformly opts for BSs. We conclude that our Russian indefinite singular data are not in line with Dayal's predictions.

To accommodate our Mandarin singular indefinite data, it sufficed to extend Dayal's analysis with the hypothesis that Mandarin is developing an indefinite article. To accommodate our Russian data, we do not see how a simple extension could make do. The problem is that Dayal has meticulously closed off all routes to indefinite readings for regular BS arguments and those are exactly the ones we need. At the same time, it seems that we cannot re-open these routes without making the wrong predictions for Hindi. We are thus faced with a stalemate: either we get the Russian data right and the Hindi data wrong or *vice versa*.

To break the stalemate, we think it is instructive to zoom out and go back to the type of examples that originally motivated Dayal's analysis, viz. those in which Hindi BSs turn out to resist narrow scope indefinite interpretations (see (1a)). Crucially, we find the same resistance to narrow scope with unambiguously indefinite expressions like English *a* + N_{sg}:

(13) **A dog** was everywhere.

As noted by Carlson (1977), (13) only has the same bizarre reading as *cuuha* in (1a), viz. one in which the same animal is said to be everywhere. What this suggests is that the odd reading of (1a) is unlikely to be due to a definite interpretation of *cuuha* and that closing off the existential and the DKP route to indefinite readings for BSs is not offering a solution to the real puzzle (1a) raises, viz. one that is not concerned with the absence of indefinite interpretations of BSs but with missing narrow scope readings of indefinite singulars. Even though we will not try to attempt to solve the real puzzle, we submit that there are information-structural considerations at play, explaining why minor variations on the same sentence lead to different intuitions ((5a) vs. (7)).

Under the assumption that Dayal’s closing off of the existential and the DKP route is the wrong way to derive the odd reading of (1a), we argue that at least one of the routes should be reopened, either deciding that DKP can apply to singular kinds or returning to Chierchia’s original type-shift ranking. The upshot of this move is that – independently of our pick – our Russian data follow straightforwardly.

With the Russian data accounted for, the last step to be taken is to offer an alternative account for the fact that Hindi BSs in our corpus give rise to indefinite readings far less easily than in Russian. We hypothesize that Hindi, like Mandarin, is developing an indefinite singular article that competes with BNs in pseudo-incorporation constructions. Unlike the blocking of DKP for singular kinds and the re-ranking of type-shifts, the hypothesis of a developing indefinite article can be done at a language-specific level and – as such – allows us to account for the fact that BSs have a hard time getting indefinite readings in Hindi while at the same time making sure that they freely get these readings in Russian. We conclude that our article strategy allows us to break the stalemate we faced. The fact that articles can show different degrees of grammaticalization furthermore comes with the additional perk of creating the flexibility we need to account for the difference in distribution of Hindi and Mandarin numerals, another theoretical and empirical challenge we, however, have to leave for future work.

5.4. Recap

Throughout this section, we have argued that our data are compatible with many of Dayal’s predictions but that her analysis does go wrong on some crucial points, in particular for definite singular contexts in Mandarin (Section 5.1.) and for indefinite singular contexts in Mandarin and Russian (Sections 5.2.2. and 5.2.3.). To accommodate the Mandarin data, we argued that it suffices to extend Dayal’s analysis, and we hypothesized that Mandarin is developing an indefinite and a definite article. Accommodating the Russian data turned out to require a real modification of Dayal’s analysis, re-opening at least one of the two paths to indefinite readings for BSs that Dayal meticulously closed off. With the Mandarin and Russian data accounted for, we were left with the

Hindi data that originally motivated the closing off of the indefiniteness paths for BSs. Given that there was no way to accommodate the Russian data otherwise, we proposed an alternative analysis for Hindi, hypothesizing that – parallel to Mandarin – it is developing a singular indefinite article. Further theoretical and empirical work is needed but we do believe we have laid the necessary groundwork to build on in our future work.

The picture that has emerged throughout this section is that some so-called 'articleless' languages are less articleless than the literature has assumed up till now. We found that Hindi, Russian and Mandarin behave truly differently from each other and that capturing these differences requires us to abandon language-independent strategies to account for language-specific tendencies. By resorting to the hypothesis that Mandarin and Hindi are developing articles, we opted for a language-specific strategy that holds the promise of capturing the tendencies we found in our Mandarin and Hindi data without generating predictions that pose a problem for Russian, in which BSs really do turn out to freely allow for both definite and indefinite readings.

6. Conclusion

In this paper, we adopted a translation corpus approach based on the first chapter of *Harry Potter and the Philosopher's Stone* to come to a broad parallel evaluation of Dayal's seminal work on reference in Hindi and the predictions it makes for Russian and Mandarin. Dayal's core intuition is that Hindi BSs are different from Hindi BPs in that they do not allow for indefinite readings. In Section 2, we worked out how Dayal accounts for this intuition by closing off the two paths to indefinite readings that Chierchia's original version of the neo-Carlsonian framework left for BSs in articleless languages. In Sections 3 to 5, we worked out how Dayal's predictions can be operationalized for translation corpus research and argued that our Hindi data are overall compatible with them but that the same does not hold for our Mandarin and Russian data, leading us to explore a number of extensions and modifications of Dayal's analysis. For Mandarin, our data led us to hypothesize a role for the numeral as an indefinite article and for demonstratives as definite articles. For Hindi and Russian, we argued that the only way to account for the two languages was to re-open at least one of the two paths to indefinite readings Dayal closed off and to hypothesize that Hindi – unlike Russian – is developing an indefinite article. The overall conclusion we arrive at is that so-called 'articleless' languages are not created equal.

Along the way, we pointed out that there remains quite some theoretical and empirical work, in particular to properly pin down what it means for a language to be developing a definite and an indefinite article (see Liu et al. 2022 and Bremmers et al. 2022 for some first steps). Relevant follow-up empirical work also includes replication and triangulation of our results as well as extensions to a broader set of languages (see Borik et al. 2022). At a more general theoretical level, it is important to assess the impact of our data on the neo-Carlsonian framework, paying special attention to the desirability of reversing Dayal's extensions and how these would fare with later updates of the framework (see Liu et al. 2023 for discussion).

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A unified semantics for exceptive-additive *besides*[1]

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Abstract. Exceptive expressions like *except* and *but* are known to contribute an inference of exception when they occur with universal quantifiers and not to be compatible with non-universal quantifiers. Similarly to exceptives, exceptive-additive expressions like *besides* contribute an exceptive inference in universal statements. They, however, differ from exceptives in being able to co-occur with non-universal quantifiers. In such contexts they contribute an inference of addition. We propose a unified semantic treatment of exceptive-additives that derives their interaction with universal and non-universal quantifiers from independently motivated mechanisms. We extend the treatment of exceptives in terms of *Exh* (Gajewski 2013; Hirsch 2016; Crnič 2021) to exceptive-additives and propose that the difference between the two types of constructions lies in the way the alternatives are constructed. By reducing the set of alternatives, we can capture the additive inference of *besides* with *exactly n*-numerals. We extend this account to all other instances of modified numerals and existentials by adopting a decompositional approach to their semantics.

Keywords: *besides*, exceptives, exceptive-additive constructions, modified numerals, *Exh*, alternatives, quantification.

1. The puzzle

1.1. Parallels and differences between exceptive and exceptive-additive expressions

Combined with universal quantifiers such as in (1) and (2) the exceptive expressions *but*, *except*, and *besides* yield parallel inferences. For (1) this gives the following inferences: (i) a containment inference that Ann is a member of the restrictor set denoted by *girl*, (ii) a quantificational inference that the restrictor set minus Ann is a subset of the scope set denoted by *came*, and (iii) an exception inference that Ann is not a member of the scope set (Keenan and Stavi 1986; Hoeksema 1987; von Fintel 1993). Completely parallel inferences modulo the contribution of negation obtain for (2).

(1) Every girl *but/except/besides* Ann came.

⇝ Ann is a girl	containment
⇝ Every girl who is not Ann came	quantification
⇝ Ann didn't come	exception

(2) No girl *but/except/besides* Ann came.

⇝ Ann is a girl	containment
⇝ No girl who is not Ann came	quantification
⇝ Ann came	exception

Combined with non-universal quantifiers, as in examples (3) to (5), *but* and *except* result in

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ungrammaticality (Horn 1989; von Fintel 1993), whereas *besides* is grammatical. Interestingly, in all of these examples *besides* yields an additive interpretation. While the containment and quantification inferences remain as in the examples above, the exception inference changes to an additive inference to the effect that the predicate in the scope of the quantifier is true of Ann (von Fintel 1989; Sevi 2008; Vostrikova 2019a, b).[2]

(3) Some girl **but/*except/besides* Ann came.
$\rightsquigarrow$ Ann is a girl — containment
$\rightsquigarrow$ Some girl who is not Ann came — quantification
$\rightsquigarrow$ Ann came — addition

(4) At least/more than two girls **but/*except/besides* Ann came.
$\rightsquigarrow$ Ann is a girl — containment
$\rightsquigarrow$ At least/more than two girls who are not Ann came — quantification
$\rightsquigarrow$ Ann came — addition

(5) At most/fewer than two girls **but/*except/besides* Ann came.
$\rightsquigarrow$ Ann is a girl — containment
$\rightsquigarrow$ At most/fewer than two girls who are not Ann came — quantification
$\rightsquigarrow$ Ann came — addition

1.2. The standard approach to *but*-exceptives

The standard approach to the semantics of exceptives like *but* is due to von Fintel (1993, 1994). According to this approach, *but* does two things in (1) semantically: (i) it subtracts {Ann} from the restrictor set denoted by *girl*, and (ii) states that this is the minimal subtraction that is required to make the quantificational claim true. For (1) and (2) this can result in both truth and falsity, whereas for (3) to (5) it yields a contradiction.

More recent literature has tended to have (i) be contributed by *but* directly but lets (ii) be the contribution of an exhaustivity operator *Exh* strengthening the interpretation of its prejacent, i.e., the sentence without *Exh* (see Gajewski 2013; Hirsch 2016, also cf. Gajewski 2008). The LF for (1), for instance, would look as in (6).

(6) $[_{\text{IP}_2}$ Exh$_{\text{ALT}}$ $[_{\text{IP}_1}$ [every [girl [but Ann$_\text{F}$]]] came]]

The meaning for *but* is given in (7), following Hirsch (2016). *But* is looking to compose with a plural or atomic individual (denoted by the DP following *but*), then with a predicate of individuals (denoted by the restrictor of the quantifier). It introduces a presupposition that the predicate is true of this plural or atomic individual (thus, the containment inference is hard-wired into the lexical semantics of *but*). It outputs a new set of plural or atomic individuals such that the predicate is true of it and it does not overlap with the first plurality.

(7) a. $[\![but]\!]^{g,w} = \lambda x_e.\lambda f_{<et>}$: f(x). λy_e. f(y) & ¬OVERLAP(x)(y)
b. OVERLAP(x)(y) iff $\exists z\, [z \leq x\ \&\ z \leq y]$

Given this, the denotation of the restrictor of the quantifier in (6) is as shown in (8): this predicate of individuals picks girls who are not Ann; Ann is subtracted from the domain of the

[2]Notice that (2) similarly to (3)-(5) carries the inference that Ann came. We will come back to the question of whether the status of the inference in (2) and in (3)-(5) is the same.

quantifier.

(8) $[\![girl\ but\ Ann]\!]^{g,w} = \lambda y_e.$ y is a girl$_w$ & ¬OVERLAP(Ann)(y)
$[\![girl\ but\ Ann]\!]^{g,w}$ is defined only if Ann is a girl$_w$

Assuming there are four salient girls in the context (Ann, Bella, Carol, and Denise), the quantificational claim (the prejacent of *Exh*) is as follows.

(9) $[\![IP_1]\!]^{g,w}$ = T iff $\forall$x[x$\in$\{Bella, Carol, Denise\} $\rightarrow$ x came$_w$]

We adopt the standard denotation for *Exh*, given in (10). *Exh* asserts its prejacent and negates all innocently excludable alternatives (IE) (the alternatives that are in every maximal set of alternatives that can be negated together with the assertion of the prejacent without introducing a contradiction (Fox 2007)).[3]

(10) a. $[\![Exh_{ALT}\ \phi]\!]^{g,w} = [\![\phi]\!]^{g,w}$ & $\forall$q [q $\in$ IE(λw'.$[\![\phi]\!]^{g,w'}$, ALT) $\rightarrow$ ¬q(w)]
b. IE(p, ALT) = $\cap$\{ALT' $\subseteq$ALT: ALT' is a maximal subset of ALT s.t. ALT'$^{\neg}$ $\cup$ \{p\} is consistent\}
c. ALT'$^{\neg}$ = \{ ¬p' : p' $\in$ ALT'\}

This approach assumes the structural theory of focus alternatives (Katzir 2007; Fox and Katzir 2011). The alternatives used by *Exh* are determined by substituting the focused marked DP with other possible DPs of at most the same complexity.[4] The DP following *but* is marked with focus. The resuling set of alternatives is given in (11): in each of the alternative propositions a different individual is subtracted from the domain of *every*.

(11) $$\text{ALT} = \left\{ \begin{array}{l} \lambda w.[\![[[every\ [\ girl\ [but\ Ann]]]\ came]\ ]\!]^{g,w} \\ \lambda w.[\![[[\ every\ [\ girl\ [but\ Bella]]]\ came\ ]]\!]^{g,w} \\ \lambda w.[\![[[\ every\ [\ girl\ [but\ Carol]]]\ came\ ]]\!]^{g,w} \\ \lambda w.[\![[[\ every\ [\ girl\ [but\ Denise]]]\ came\ ]]\!]^{g,w} \end{array} \right\}$$

The first alternative is the prejacent. All other alternatives are innocently excludable, meaning their negation is consistent with the assertion of the prejacent. *Exh* negates all of them. The overall predicted truth conditions for the entire sentence are given in (12). The negation of the alternatives results in the inference that in every set differing from the original only in the individual that gets subtracted, not every girl came. Given the truth of the prejacent, the latter can only be the case if it is Ann who did not come. This derives the exception inference.

(12) $[\![(6)]\!]^{g,w}$ = T iff $\forall$x[x$\in$\{Bella, Carol, Denise\} $\rightarrow$ x came$_w$] &
¬$\forall$x[x$\in$\{Ann, Carol, Denise\} $\rightarrow$ x came$_w$] &
¬$\forall$x[x$\in$\{Ann, Bella, Denise\} $\rightarrow$ x came$_w$] &
¬$\forall$x[x$\in$\{Ann, Bella, Carol\} $\rightarrow$ x came$_w$]

[3]This can also be implemented with *Exh* that negates all alternatives that are not entailed by the prejacent (see Chierchia 2013). We follow Hirsch (2016) in employing Fox's 2007 version of *Exh* based on innocent inclusion. The relevant difference here is that the application of the innocent inclusion based *Exh* for (3) to (5) is predicted to be vacuous and is ruled out by the constraint that blocks a vacuous application of *Exh*, whereas the *Exh* not based on the innocent exclusion would directly lead to contradictions in such cases.

[4]Formally, this can be implemented by introducing the requirement that the set of alternatives *Exh* employs has to be a subset of propositions denoted by the sentences in the set of structural alternatives:

(i) a. $[\![Exh_{ALT}\ \phi]\!]^{g,w}$ is defined only if ALT$\subseteq$\{λw'.$[\![\phi']\!]^{g,w'}$: $\phi' \in$ ALT$_{\text{str}}(\phi)$\}
b. ALT$_{\text{str}}(\phi)$= \{ϕ': ϕ' is derived from ϕ by replacing the focus marked x by y such that y$\lesssim$x \}

1.3. Deriving co-occurrence restrictions for *but*-exceptives

The standard approach derives the unacceptability of (3) to (5) with both *but* and *except*.

The LF predicted for the existential claim in (3) is as shown in (13).

(13) $[_{IP_2}$ Exh_{ALT} $[_{IP_1}$ [some [girl [but Ann_F]]] came]]

The meaning of the prejacent of *Exh* is as shown in (14) and the alternatives other than the prejacent are given in (15).

(14) $[\![IP_1]\!]^{g,w}$ = T iff $\exists$x[x$\in$\{Bella, Carol, Denise\} & x $came_w$]

(15) a. λw.$\exists$x[x$\in$\{Ann, Carol, Denise\} & x $came_w$]
b. λw.$\exists$x[x$\in$\{Ann, Bella, Denise\} & x $came_w$]
c. λw.$\exists$x[x$\in$\{Ann, Bella, Carol\} & x $came_w$]

None of the alternatives in (15) is innocently excludable. Only one of them can be negated together with the assertion of the prejacent. For example, the negation of (15a) is compatible with the prejacent: this would mean that only Bella came. But the other two alternatives cannot be negated in this case, their negation would create a contradiction, as it is not compatible with Bella coming. The same goes for the second and the third alternative. Since none of the alternatives is innocently excludable, *Exh* has nothing to negate in this case. [5]

This LF is ruled out by the non-vacuity constraint (Spector 2013; Gajewski 2013; Fox and Spector 2018). Assuming that *but* obligatorily co-occurs with *Exh*, this is the the only possible LF for (3) with *but*. Considering that a sentence which is predicted to necessarily violate pragmatic constraints is perceived as ungrammatical, the ungrammaticality of (3) is explained.

(16) NON-VACUITY: *Exh[A]* is infelicitous if *Exh[A]* is equivalent to *A*.

Similar results obtain for the remaining examples in (4) and (5).[6] Let's consider *at most two* in (17) which is downward monotonic on its first argument.

(17) *At most two girls but Ann came.

The set of alternatives is given in (18). None of them is innocently excludable. Let's consider a situation where the negation of the second alternative is true, the situation where three girls came: Carol, Denise and Ann. This is compatible with the prejacent because there are two girls who came in the set {Bella, Carol, Denise} and not more. However, negating other alternatives cannot be done consistently with this, because in the sets {Ann, Bella, Denise} and {Ann, Bella, Carol} there will be exactly two girls who came. The same reasoning applies to other alternatives: the negation of at most one of them is compatible with the assertion of the prejacent.

[5] As shown in (Hirsch 2016), some additional assumptions have to be made about the case when there are exactly two salient individuals in the domain. In this case, the only alternative to the prejacent will be innocently excludable. If there are only two girls, say Ann and Bella, it is entirely possible that some girl in {Bella} came, but no girl in {Ann} came. This case is ruled out by the restriction on the use of an existential when it is known that there is exactly one individual satisfying the restrictor.
[6] Some of these cases also require some additional assumptions.

(18) $\left\{ \begin{array}{l} \lambda \text{w}.[\![[_{IP_1}\ [\ \textit{at most two}\ [\ \textit{girls [but Ann]]] came]}]\!]^{g,w} \\ \lambda \text{w}.[\![[_{IP_1}\ [\ \textit{at most two}\ [\ \textit{girls [but Bella]]] came]}]\!]^{g,w} \\ \lambda \text{w}.[\![[_{IP_1}\ [\ \textit{at most two}\ [\ \textit{girls [but Carol]]] came]}]\!]^{g,w} \\ \lambda \text{w}.[\![[_{IP_1}\ [\ \textit{at most two}\ [\ \textit{girls [but Denise]]] came]}]\!]^{g,w} \end{array} \right\}$

Since there are no innocently excludable alternatives in this case, the application of *Exh* is predicted to be vacuous. Thus, this sentence is predicted to be ungrammatical in the same way as the example with the existential considered above.

This approach could be straightforwardly carried over to *except*, as done by Crnič (2021) for at least some such constructions. That being said, Moltmann (1995) and Vostrikova (2021) draw attention to contrasts like (19a) and (19b). While *except* allows for multiple remnants and prepositional phrases following it, *but* does not do so.

(19) a. Every boy danced with every girl except Bill with Ann.
b. *Every boy danced with every girl but Bill with Ann.

Accordingly, Vostrikova (2019b, 2021), as well as Potsdam and Polinsky (2019), draw the conclusion that the *except* in (19a) syntactically coordinates two clauses. Vostrikova suggests a meaning for *except* that can be seen as a modification of von Fintel's 1993 one for *but* so as to be applicable at the clausal level. Thereby similar predictions regarding co-occurrence data are derived by the lexical meaning of *except*. Crnič (2021) explores the possibility that even in the clausal case, there is a place for strengthening through *Exh*.

1.4. The puzzle of *besides*

On the one hand, the standard recipe for *but* together with strengthening by *Exh* could be employed for *besides* as well. This would derive the facts in (1) and (2). Notice in this respect that, indeed, as far as syntax is concerned, *besides* appears to be phrasal just as much as *but*:

(20) *Every boy danced with every girl besides Bill with Ann.

On the other hand, extending this standard recipe to *besides*, all else being equal, would have undesirable consequences for (3) to (5). This is so because parallel to *but*, *besides* would be predicted to incur unacceptability through strengthening via *Exh* in these cases.

Notice that one cannot assume that *but* and *besides* are parallel in terms of subtraction but that only the former involves strengthening. While this would make *besides* acceptable with both universal and non-universal quantifiers, it would have the consequence that neither exceptive inferences would be drawn for the former nor additive inferences for the latter. Indeed, the exceptive or the additive inference seem to be non-removable and uncancellable parts of the meaning of sentences with *besides*. This is tested in (21a) and (21b) for (1) and (3) respectively. If the exceptive or additive inference were absent, it should be fine to precede the sentence with a sentence negating the supposed inference, but this is not the case. The sequences are degraded (Vostrikova 2019c).

(21) a. #Ann came. Every girl besides Ann came too.
b. #Ann didn't come. But some girl besides Ann came.

At this point, we can characterize the main semantic puzzle raised by exceptive-additive *besides* as follows:

(22) **Exceptive-additive puzzle (EAP):** *Besides* yields exceptive inferences precisely in those environments in which exceptive *but* is grammatical and yields additive inferences in precisely those environments in which exceptive *but* is not grammatical.

We need to ask why this should be the case. The EAP suggests that the behavior of *besides* is driven by factors of logicality. In this paper, we therefore adopt the following hypothesis to deal with the EAP:

(23) **Exceptive-additive hypothesis (EAH):** *Besides* yields additive inferences in those environments in which exceptive *but* is not grammatical in order to avoid ungrammaticality.

1.5. The previous treatments of *besides* and the plot

Previous approaches to the semantics of exceptive-additive *besides* provided an account for a subset of cases in (1)-(5).

Von Fintel (1989) proposed a unified treatment of *besides* with universal and negative quantifiers, as well as the non-monotonic quantifier *exactly n*. According to this analysis, *besides*, like any exceptive, contributes domain subtraction. Additionally, *besides* introduces the minimality condition, meaning that the subtracted set is the one with the minimal cardinality necessary for the quantificational claim to be true. The lexical entry proposed in (von Fintel 1989) is shown in (24): *besides* composes with a set denoted by the DP it introduces,[7] a set denoted by the restrictor, the determiner and the set denoted by the scopal argument. It subtracts the first set from the restrictor of the quantifier and adds the minimality condition (underlined in (24)).

(24) $$[\![besides]\!]^g = \lambda C_{<et>}.\lambda A_{<et>}.\lambda D_{<<et><et,t>>}.\lambda P_{<et>}.\ D(A\text{-}C)(P)\ \&\ \underline{\forall Y\ [|C|>|Y| \rightarrow \neg\ D(A\text{-}Y)(P)]}$$

The work of the minimality condition can be appreciated when we look at the specific example in (25a). Its predicted interpretation is in (25b). The first conjunct states that if we remove Ann from the domain it holds that exactly two girls came. The second conjunct says that if a set with the cardinality less than the cardinality of {Ann} is subtracted, the *exactly*-claim will not be true. There is only one set with a smaller cardinality than the singleton set {Ann} and that is the empty set. Subtracting an empty set equals to no subtraction at all. Accordingly, the minimality condition states that it is false that exactly two girls came overall. If it is true that exactly two girls came who are not Ann, but not exactly two girls came overall, Ann must be the girl who came, as adding Ann to the domain cannot reduce the number of girls who came. Thus, the additive inference is captured.

(25) a. Exactly two girls besides Ann came.

b. $$[\![(25a)]\!]^g = \text{T iff } |(\{z\text{: z is a girl}\} - \{\text{Ann}\}) \cap \{x\text{: x came}\}| = 2\ \&\ \underline{\forall Y[|\{\text{Ann}\}|>|Y| \rightarrow |(\{z\text{: z is a girl}\} - Y) \cap \{x\text{: x came}\}| \neq 2\ ]}$$

This treatment extends to cases with universal and negative quantifiers and accounts for the fact that in the first case the inference is negative, and in the second, it is positive. If every girl who is not Ann came, but not every girl came, Ann must be the girl who did not come. If no girl who is not Ann came, but some girl came, Ann must be the girl who came.

[7]Note that this approach assumes that the DP following an exceptive is a set denoting expression.

The problem with this approach observed by von Fintel (1989) is that it is not straightforwardly extendable to upward monotonic numerals like *at least two* in (4). It cannot be the case that at least two girls who are not Ann came, but not at least two girls came overall. For the same reason, it also does not extend to existentials in (3).

Vostrikova (2019a) proposes a unified compositional analysis of the additive uses of *besides* with existentials, *wh*-questions (like in (26a)), and in focus constructions (illustrated in (26b)). However, the proposed treatment considers *besides* as a pure additive element, and it does not account for the exceptive reading with universal quantifiers.

(26) a. Who besides Ann came?
b. Besides Ann, Bill danced with Mary_{F}

Vostrikova (2019c) proposes a unified treatment for the exceptive uses of *besides* with universal and negative quantifiers and the additive uses of *besides* with existentials, *wh*-questions and focus associates. Exceptive-additive flip is treated as a case of a structural ambiguity. This analysis, however, is not straightforwardly extendable to modified numerals and such cases are not discussed. In this paper we will not say anything about cases like (26) and will focus on quantificational cases and modified numerals.

The rest of the paper spells out a unified approach to the uses of *besides* in (1)-(5) relying on the standard mechanism introduced above. The work is distributed between *besides* contributing domain subtraction and *Exh* being responsible for the exceptive or the additive inference. We argue that the only difference from the exceptive *but* lies in the kind of alternatives used by *Exh*. This minimal change straightforwardly derives results von Fintel (1989) obtained for *exactly n* numerals. It is shown that this can be extended to other cases of non-universal quantifiers if they are allowed to be decomposed along the lines of what has been suggested in the literature for modified numerals (Hackl 2000; Heim 2000; Mayr and Meyer 2014; Buccola and Spector 2016), so that one part can scope below *Exh* and one above it.

2. The proposal

2.1. *Besides* and *every*

We'll assume *besides* is like *but*: it does domain subtraction and introduces the containment presupposition, as shown in (27). Like *but*, *besides* composes with a plural or atomic individual (denoted by the DP following *besides*), then takes a predicate of individuals (the restrictor of a quantifier) and outputs a new predicate of individuals. It introduces a presupposition that the restrictor predicate is true of the individual introduced by *besides*. The new predicate it outputs is true of atomic or plural individuals if they satisfy the restrictor predicate and do not overlap with the individual introduced by *besides*.

(27) a. $[\![\textit{besides}]\!]^{g,w} = \lambda x_e.\lambda f_{<et>}$: f(x). λy_e.f(y) & ¬OVERLAP(x)(y)
b. OVERLAP(x)(y) iff $\exists$z [z $\leq$ x & z $\leq$ y]
c. $[\![\textit{girl besides Ann}]\!]^{g,w} = \lambda y_e$. y is a girl_w & ¬OVERLAP(Ann)(y)
is defined only if Ann is a girl_w

We build on Gajewski (2008, 2013); Hirsch (2016); Crnič (2021), and propose that the exceptive-additive inference is contributed by *Exh*. Thus, the structure of a sentence with *besides* with a universal quantifier in (28a) is as shown in (28b).

(28) a. Every girl besides Ann came.
b. $[_{IP_2}$ Exh$_{ALT}$ $[_{IP_1}$ [every [girl [besides Ann]$_F$]] came]]

However, we suggest that the alternatives are not computed by substituting the element following *besides* with its alternatives, as proposed for *but* and discussed above. Instead, *besides* makes use of the structurally simpler alternatives. Thus, the focus is not on the element following *besides*, but on the entire *besides DP* phrase. In this case the set of alternatives is like shown in (29).

(29) $$\text{ALT} = \left\{ \begin{array}{l} \lambda w.[\![\textit{every girl besides Ann came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl came}]\!]^{g,w} \end{array} \right\}$$

Exh asserts the prejacent and negates the only alternative distinct from the prejacent. The result of this is shown in (30a), or equivalently (30b). The presupposition of containment contributed by *besides* is in (30c).

(30) a. $[\![\textit{(28b)}]\!]^{g,w}$ = T iff $\forall$x [(x is a girl $_w$ & $\neg$OVERLAP(Ann)(x)) $\rightarrow$ x came$_w$] & $\neg$ $\forall$y[y is a girl$_w$ $\rightarrow$ y came$_w$]
b. $[\![\textit{(28b)}]\!]^{g,w}$ = T iff $\forall$x [(x is a girl & $\neg$OVERLAP(Ann)(x) $\rightarrow$ x came$_w$] & $\exists$y [y is a girl$_w$ & $\neg$ y came$_w$]
c. $[\![\textit{(28b)}]\!]^{g,w}$ is defined only if Ann is a girl$_w$

The resulting interpretation correctly captures the negative inference (28a) comes with. If every girl who is not Ann came, but some girl did not come, then Ann is the girl who did not come.

So far we have considered the case where the DP following *besides* denotes an atomic individual. When *besides* introduces a plural DP, the negative inference has to apply to every individual in this plurality. This is captured by including the alternatives where the plurality is substituted by individuals denoting the plurality subparts as shown in (31).

(31) a. Every girl [besides Ann and Bella]$_F$ came.
b. $$\left\{ \begin{array}{l} \lambda w.[\![\textit{every girl besides Ann and Bella came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl besides Ann came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl besides Bella came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl came}]\!]^{g,w} \end{array} \right\}$$

Exh asserts the prejacent and negates all the other alternatives as they are all innocently excludable. The overall interpretation predicted for (31a) is in (32). Given the truth-conditional content in (32a), the fact that the negative inference applies to both Ann and Bella is captured: all girls who are not Ann and Bella came, but there is a girl who is not Ann who did not come (this must be Bella) and there is a girl who is not Bella who did not come (this must be Ann). The presupposition introduced by *besides* captures the containment inference for both Ann and Bella.

(32) a. $[\![\textit{(31a)}]\!]^{g,w}$ = T iff
$\forall$x[(x is a girl$_w$ & $\neg$OVERLAP(Ann+Bella)(x)) $\rightarrow$ x came$_w$] &
$\exists$y[(y is a girl$_w$ & $\neg$OVERLAP(Ann)(y)) & $\neg$y came$_w$] &
$\exists$z[(z is a girl$_w$ & $\neg$OVERLAP(Bella)(z)) & $\neg$z came$_w$] &
$\exists$x[x is a girl$_w$ & $\neg$x came$_w$]
b. $[\![\textit{(31a)}]\!]^{g,w}$ is defined only if Ann and Bella are girls$_w$

There is another way of constructing alternatives that would result in the same overall denotation for the sentence. Specifically, one could say that *besides* itself is focus-marked (as shown in (33a)) and the alternatives are formed by substitution of *besides* with its alternative *including*. Then, assuming that the subdomain alternatives for the plural are available, the list of alternatives is like it is shown in (33b).

(33) a. Every girl besides$_F$ Ann and Bella came.

b. $\left\{ \begin{array}{l} \lambda w.[\![\textit{every girl besides Ann and Bella came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl besides Ann came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl besides Bella came}]\!]^{g,w} \\ \lambda w.[\![\textit{every girl including Ann and Bella came}]\!]^{g,w} \end{array} \right\}$

As far as we can see, both options are open possibilities, and since they lead to the same resulting interpretation we remain agnostic about which one is the right way to go.

For simplicity of exposition, we will only consider cases where the individual introduced by *besides* is atomic from now on, but the treatment can always be extended to plural cases along the lines shown above.

2.2. *Besides* and *no*

Just like the standard approach to the semantics of exceptives, this approach applies to a universal and a negative quantifier in a unified way. The set of the alternatives for the prejacent of *Exh* in (34b) is as shown in (34c).

(34) a. No girl besides Ann came.

b. $[_{\mathrm{IP}_2}$ Exh$_{\mathrm{ALT}}$ $[_{\mathrm{IP}_1}$ [no [girl [besides Ann]$_{\mathrm{F}}$]] came]]

c. $\left\{ \begin{array}{l} \lambda w.[\![\textit{no girl besides Ann came}]\!]^{g,w} \\ \lambda w.[\![\textit{no girl came}]\!]^{g,w} \end{array} \right\}$

The predicted interpretation for the sentence is given in (35). The two conjuncts taken together entail that Ann is the girl who came. If no girl who is not Ann came, but some girl came (overall), this girl can only be Ann. This correctly captures the fact that (34a) comes with the positive inference that Ann came.

(35) a. $[\![\textit{(34b)}]\!]^{g,w}$ = T iff $\neg\exists$y [(y is a girl$_w$ & $\neg$OVERLAP(Ann)(y)) & y came$_w$]
& $\exists$x [x is a girl$_w$ & x came$_w$]

b. $[\![\textit{(34b)}]\!]^{g,w}$ is defined only if Ann is a girl$_w$

2.3. *Besides* and *exactly*

This approach is straightforwardly extendable to the non-monotonic quantifier *exactly n*. Like with the negative quantifier, we predict that *besides* gets the additive reading in such cases, which correctly captures the fact that (36a) comes with the positive inference that Ann came. (36b) provides the assumed LF for (36a). The alternatives used by *Exh* are given in (36c).

(36) a. Exactly one girl besides Ann came.

b. $[_{\mathrm{IP}_2}$ Exh$_{\mathrm{ALT}}$ $[_{\mathrm{IP}_1}$ [exactly one [girl [besides Ann]$_{\mathrm{F}}$]] came]]

c. $\left\{ \begin{array}{l} \lambda w.[\![\textit{exactly one girl besides Ann came}]\!]^{g,w} \\ \lambda w.[\![\textit{exactly one girl came}]\!]^{g,w} \end{array} \right\}$

For concreteness, we adopt the lexical entry for *exactly* given in (37). *Exactly* composes with a degree and two predicates of individuals and returns truth if and only if the degree is equal to the maximum cardinality for which a plurality satisfying both predicates exists. The definition for the metalanguage function *max*, which is employed in the denotation of *exactly*, is provided in (37b): this is a function that applies to a predicate of degrees and returns the unique largest degree for which the predicate holds, if such a degree exists; otherwise, it returns 0.[8]

(37) a. $[\![exactly]\!]^{g,w} = \lambda n_d.\lambda f_{<et>}.\lambda g_{<et>}.\max(\lambda d_d.\exists x[|x|=d \;\&\; f(x) \;\&\; g(x)]) = n$
b. $\max(P_{<dt>}) = \iota n[P(n) \;\&\; \forall m[P(m) \rightarrow m \leq n]]$ if $\exists d[P(d)]$, 0 otherwise

The prejacent of *Exh* gets the denotation in (38): it is true if and only if exactly one girl who is not Ann came.

(38) $[\![IP_1]\!]^{g,w}$=T iff $\max(\lambda d.\exists x[|x|=d \;\&\; x \text{ is a girl}_w \;\&\; \neg\text{OVERLAP(Ann)}(x) \;\&\; x \text{ came}_w])=1$

Exh asserts the prejacent and negates the only alternative in (36c) distinct from the prejacent. The result of this is in (39): the sentence is predicted to be true if and only if exactly one girl who is not Ann came, but not exactly one girl came overall. Since addition Ann to the domain could not have possibly made the number of girls who came smaller than it was without taking Ann into consideration, (39) can hold only if Ann came. The containment inference is captured by the presupposition introduced by *besides*.

(39) $[\![(36b)]\!]^{g,w}$=T iff
$\max(\lambda d.\exists x[|x|=d \;\&\; x \text{ is a girl}_w \;\&\; \neg\text{OVERLAP(Ann)}(x) \;\&\; x \text{ came}_w]) = 1 \;\&$
$\max(\lambda m.\exists y[|y|=m \;\&\; y \text{ is a girl}_w \;\&\; y \text{ came}_w]) \neq 1$
$[\![(36b)]\!]^{g,w}$ is defined only if Ann is a girl_w

The theory we have developed here essentially implements von Fintel's (1989) proposal for *besides* in terms of domain subtraction and *Exh*. This theory is also considered by Gajewski (2013) for exceptives like *but* but is rejected because it incorrectly predicts their compatibility with *exactly*.

In the treatment we propose the positive inference of *besides* observed with negative quantifiers and numerals has the same nature. Thus, in the approach we develop here there are no separate paths for the exceptive reading with *no* and the additive reading with *exactly*. In these cases, along with *every*, the inference is the result of conjoining a quantificational claim with domain subtraction and the negation of the claim without subtraction. Whether the inference is positive or negative depends on the properties of a quantifier. We propose that there is no exceptive-additive ambiguity, just like there is no ambiguity of exceptives with negative and universal quantifiers.

In what follows, we will extend this treatment to all modified numerals, including the upward entailing ones, which were previously considered a major challenge for this approach.

2.4. *Besides* and upward entailing quantifiers

An attempt to give a parallel LF to the *at least n* case in (40a) does not lead to a well-formed meaning. This is because the quantifier is upward monotonic and both alternatives in (40b) are entailed by the prejacent. This means that *Exh* cannot negate anything in this case and

[8]The latter condition is needed to deal with *exactly 0* when there is no individual satisfying both of the predicates.

its application is predicted to be vacuous. Thus, this LF is predicted to be ruled out by the same non-vacuity constraint that rules out the use of exceptive *but* with upward monotonic quantifiers.

(40) a. $[_{IP_2}$ Exh$_{ALT}$ $[_{IP_1}$ [at least one [girl [besides Ann]$_F$]] came]]
b. $\left\{ \begin{array}{l} \lambda w.[\![\textit{at least one girl besides Ann came}]\!]^{g,w} \\ \lambda w.[\![\textit{at least one girl came}]\!]^{g,w} \end{array} \right\}$

Our proposal is built on the idea that modified numerals are quantifiers over degrees and as such they must undergo quantifier raising to be interpreted (see Hackl 2000; Mayr and Meyer 2014; Buccola and Spector 2016 on extending the idea of quantificational treatment of degree constructions along the lines proposed in (Heim 2000) to modified numerals).

At least one has the meaning given in (41b), which is obtained by putting together the meanings of *at least* in (41a) and *one*. Like any degree quantifier, it is looking to compose with a predicate of degrees. It returns truth if and only if there exists a degree greater than or equal to 1 of which the predicate of degrees is true.

(41) a. $[\![\textit{at least}]\!]^{g,w} = \lambda n_d.\lambda f_{<dt>}.\ \exists d[d \geq n \ \&\ f(d)]$
b. $[\![\textit{at least one}]\!]^{g,w} = \lambda f_{<dt>}.\ \exists d[d \geq 1 \ \&\ f(d)]$

Given this semantics, *at least one* cannot be interpreted in its base position in (42a) because of the type mismatch. It undergoes quantifier raising and leaves a trace of type d. We propose that this trace is interpreted with a silent *exactly* below *at least one* left behind by QR, as shown in (42b). The numerical abstractor 1 is merged below the landing site of *at least one*.

(42) a. At least one girl came.
b. $[_{IP_2}$ at least one $[_{IP_1}$ 1 [exactly d_1 girl came]]]

Exactly has its standard denotation introduced in the previous section and repeated in (43) for convenience. It composes with the trace, then with the predicate denoted by *girl* and with the predicate denoted by *came*.

(43) $[\![\textit{exactly}]\!]^{g,w} = \lambda n_d.\lambda f_{<et>}.\lambda g_{<et>}.\max(\lambda d_d.\exists x[|x|=d \ \&\ f(x) \ \&\ g(x)])=n$

With these assumptions, the sister of *at least one* denotes the predicate of degrees shown in (44): this predicate is true of a degree if and only if exactly this many girls came.

(44) $[\![IP_1]\!]^{g,w} = \lambda n.\max(\lambda d_d.\ \exists x[|x|=d \ \&\ x \text{ is a girl}_w \ \&\ x \text{ came}_w) = n$

Given this, the overall predicted meaning for (42b) is as shown in (45). The sentence is predicted to be true if and only if there is a degree equal to 1 or larger such that exactly this many girls came. This captures the meaning of the sentence: one or more girls came.

(45) $[\![\textit{(42b)}]\!]^{g,w}$= T iff $\exists d[d \geq 1 \ \&\ \max(\lambda n.\exists x[|x|=n \ \&\ x \text{ is a girl}_w \ \&\ x \text{ came}_w)=d]$

Now, given that there is a constituent in the LF with the meaning of *exactly* and that we have an account of the interaction of *exactly* and *besides*, we can compute the additive inference of *besides* at the level of this constituent. The LF that we propose for (46a) is shown in (46b). As before, *besides* forms a constituent with the predicate denoted by the restrictor. *Exh* is merged below the abstraction over degrees and below the upward entailing quantifier *at least one*.

(46) a. At least one girl besides Ann came.

b. $[_{IP_3}$ at least one $[_{IP_2}$ 1 $[_{IP_1}$Exh$_{ALT}$ [exactly d_1 girl [besides Ann]$_F$ came]]]]

The predicted meaning of IP_1 is given in (47). It is true if and only if the degree denoted by g(1) is such that exactly this many girls came if Ann is not taken into account and not exactly this many girls came if Ann is included.

(47) $[\![IP_1]\!]^{g,w}$=T iff
$\max(\lambda d_d.\exists x[|x|=d$ & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=g(1) &
$\max(\lambda n_d.\exists y[|y|=n$ & y is a girl$_w$& y came$_w$])$\neq$g(1)

Accordingly, the sister of *at least one* is the predicate of degrees formed by abstraction over that degree, shown in (48).

(48) $[\![IP_2]\!]^{g,w}=\lambda n.\max(\lambda d_d.\exists x[|x|=d$ & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=n
& $\max(\lambda m_d.\exists y[|y|=m$ & y is a girl$_w$ & y came$_w$])$\neq$n

At least one composes with this predicate of degrees and states that a degree satisfying this predicate exists and it is equal to 1 or larger. The overall meaning predicted for (46b) is shown in (49). The sentence is predicted to be true iff there is a number such that if we do not count Ann exactly this many girls came and if we count Ann not exactly this many girls came and this number is equal to 1 or larger. This correctly captures the overall meaning of this sentence including its additive inference. Adding Ann to the domain while keeping everything else the same cannot result in a smaller number of girls in the domain who came. Thus, the only way (49) can hold is if Ann came.

(49) $[\![(46b)]\!]^{g,w}$= T iff
$\exists n[n \geq 1$ & $\max(\lambda d_d.\exists x[|x|=d$ & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=n
& $\max(\lambda m_d.\exists y[|y|=m$ & y is a girl$_w$ & y came$_w$])$\neq$n]
$[\![(46b)]\!]^{g,w}$ is defined only if Ann is a girl$_w$

The treatment we propose here crucially relies on the assumption that there is a constituent with the meaning *exactly* left behind by *at least one*. Now we will address the question of whether this assumption is well-grounded.

It is standardly assumed that degree quantifiers leave behind *many* and not *exactly* as shown in (50a) (Heim 2000; Hackl 2000). *Many* is an existential quantifier with the semantics given in (50b). As *many* is an upward monotonic quantifier, our approach predicts that *besides* is not able to operate on it.

(50) a. $[_{IP_2}$ at least one $[_{IP_1}$ 1 [many d_1 girl came]]]
b. $[\![many]\!]^{g,w} = \lambda n_d.\lambda f_{<et>}.\lambda g_{<et>}.\exists x[|x|=n$ & f(x) & g(x)]

However, the approach we propose here is compatible with the idea that a degree quantifier leaves behind *many*. *Many* can be turned into *exactly* by an operator that contributes maximality. This is evident from the denotation of *exactly* in (43) we employ here, which includes both the existential quantifier and maximality as its meaning ingredients.

The idea that the existential *many* can be turned into *exactly* by inserting an operator that contributes maximality was independently proposed by Buccola and Spector (2016) for modified numerals. In a nutshell, they propose that a modified numeral can undergo QR twice, as shown in (51a). First, it moves above the existential *many*, creating a degree predicate within its scope.

Then, it undergoes a second movement, generating another predicate of degrees. The trace left behind by the second movement undergoes type-shifting through the shifter *MAX* shown in (51b), which uses the same *max* function we employed in the denotation of *exactly*.

(51) a. $[_{IP_2}$ at least one [2 [d_{2MAX} $[_{IP_1}$ 1 [many d_1 girl came]]]]]
b. $[\![MAX]\!]^{g,w} = \lambda d_d.\lambda P_{<dt>}.\ \max(P)=d$

Alternatively, the same result can be achieved by inserting *Exh* as shown in (52) and forming the alternatives by substituting the trace by its focus alternatives, similar to how the meaning of *exactly* is derived for bare numerals like *one girl*.

(52) $[_{IP_2}$ at least one $[_{IP_1}$ 1 Exh [many d_{1F} girl came]]]

We propose that whenever *besides* appears to operate on an upward monotonic quantifier, it is actually operating on the silent *exactly* within the scope of this quantifier.

Besides with another type of upward monotonic numerals - *more than n* - can also be treated in a straightforward manner along the lines suggested for *at least one*. The proposed LF for (53a) is given in (53b).

(53) a. More than one girl besides Ann came.
b. $[_{IP_3}$ more than one $[_{IP_2}$ 1 $[_{IP_1}$Exh$_{ALT}$ [exactly d_1 girl [besides Ann]$_F$ came]]]]

The resulting interpretation is given in (54). The sentence is predicted to be true if and only if there is a number such that if we do not include Ann then exactly this many girls came and if we include her not exactly this many girls came and this number is larger than 1.

(54) $[\![(53b)]\!]^{g,w}$= T iff
$\exists n[n>1\ \&\ \max(\lambda d_d.\exists x[|x|=d\ \&\ x \text{ is a girl}_w\ \&\ \neg\text{OVERLAP(Ann)(x)}\ \&\ x\ \text{came}_w])=n$
$\&\ \max(\lambda m_d.\exists y[|y|=m\ \&\ y \text{ is a girl}_w\ \&\ y\ \text{came}_w])\neq n\ ]$
$[\![(53b)]\!]^{g,w}$ is defined only if Ann is a girl$_w$

We extend this approach to cases when *besides* seems to operate on an indefinite like in (55a). Thus, they get the LFs shown in (55b). We propose that *some* can be interpreted as *at least one*, as shown in (55c), when the NP predicate is singular, or as *more than one*, as shown in (55d), when the NP predicate is plural. Thus, we suggest that indefinites are degree quantifiers, they do not quantify over individuals like it is standardly assumed (or at least they can be degree quantifiers). We apply this treatment to *several* in (55e) as well: it gets the same interpretation as *more than one*. In all these cases, the semantic contribution of *besides* is computed on the constituent with the meaning *exactly*, thus correctly predicting the additive inference.

(55) a. Some girl(s) besides Ann came.
b. $[_{IP_3}$Some $[_{IP_2}$ 1 $[_{IP_1}$Exh$_{ALT}$ [exactly d_1 girl(s) [besides Ann]$_F$ came]]]]
c. $[\![some]\!]^{g,w} = \lambda f_{<dt>}.\ \exists d[d\geq 1\ \&\ f(d)]$
d. $[\![some']\!]^{g,w} = \lambda f_{<dt>}.\ \exists d[d>1\ \&\ f(d)]$
e. Several girls besides Ann came.

2.5. *Besides* and downward monotonic numerals

The account presented here extends straightforwardly to downward entailing modified numerals like *fewer than n* and *at most n*.

We follow (Buccola and Spector 2016) in treating them as existential quantifiers over degrees as shown in (56) and (57), similarly to *at least n* and *more than n*.

(56) a. $[\![\textit{fewer than}]\!]^{g,w} = \lambda n_d.\lambda f_{<dt>}.\ \exists m[m<n \ \&\ f(m)]$
b. $[\![\textit{fewer than two}]\!]^{g,w} = \lambda f_{<dt>}.\ \exists m[m<2 \ \&\ f(m)]$

(57) a. $[\![\textit{at most}]\!]^{g,w} = \lambda n_d.\lambda f_{<dt>}.\ \exists m[m\leq n \ \&\ f(m)]$
b. $[\![\textit{at most two}]\!]^{g,w} = \lambda f_{<dt>}.\ \exists m[m\leq 2 \ \&\ f(m)]$

Buccola and Spector (2016) show that if the sister of a degree quantifier has the maximality operator in it, the overall predicted interpretation of a sentence containing *fewer than n* or *at most n* with the semantics in (57) and (56) is equivalent to the interpretation resulting from applying the lexical entries in (58) (where they are treated as negative quantifiers) to a constituent without the maximality operator.

(58) a. $[\![\textit{fewer than two}]\!]^{g,w} = \lambda f_{<dt>}.\ \neg\exists m[m\geq 2 \ \&\ f(m)]$
b. $[\![\textit{at most two}]\!]^{g,w} = \lambda f_{<dt>}.\ \neg\exists m[m>2 \ \&\ f(m)]$

The truth conditions of (59a) can be expressed as (59b) or, equivalently, as (59c). Both entries make the correct prediction that the sentence is true if 0 or 1 girl came and it it false if 2 or more girls came. (59b) states that there is no degree equal to 2 or larger than 2 such that there is a plurality of girls who came with this cardinality. (59c) says that the cardinality of the maximal plurality of girls who came is 0 or 1. This amounts to the same thing.

(59) a. Fewer than two girls came.
b. $\neg\exists d[d\geq 2 \ \&\ \exists x[|x|=d \ \&\ x \text{ is a girl}_w \ \&\ x \text{ came}_w]]$
c. $\exists d[d<2 \ \&\ \max(\lambda n.\exists x[|x|=n \ \&\ x \text{ is a girl}_w \ \&\ x \text{ came}_w])=d]$

Given the discussion in the previous subsection, we propose that (60a) has the LF shown in (60b) (we are glossing over the internal composition *exactly* here).

(60) a. Fewer than two girls besides Ann came.
b. $[_{IP_3}$ fewer than two $[_{IP_2}$ 1 $[_{IP_1}$ Exh_{ALT} [exactly d_1 girl [besides Ann]$_F$ came]]]]

The sister of *fewer than two* has the denotation shown in (61). This is a predicate of degrees that is true of degrees for which it holds that exactly this many girls came without counting Ann and not this many girls came overall.

(61) $[\![IP_2]\!]^{g,w}=\lambda n.\max(\lambda d.\exists x[|x|=d \ \&\ x \text{ is a girl}_w \ \&\ \neg\text{OVERLAP(Ann)}(x) \ \&\ x \text{ came}_w])=n$
$\ \&\ \max(\lambda m.\exists y[|y|=m \ \&\ y \text{ is a girl}_w \ \&\ y \text{ came}_w])\neq n$

Fewer than two with the denotation in (56b) composes with this predicate and states that such degree exists and it is 0 or 1. The predicted truth conditions for (60b) are given in (62). The sentence is predicted to be true if and only if either exactly zero girls who are not Ann came and not exactly zero came if we take Ann into account or exactly one girl who is not Ann came and not exactly one if we count Ann. Adding Ann to the domain while keeping everything else the same cannot make the overall number of the girls who came smaller, it can only make this number larger. Thus, we correctly capture the fact that the sentence in (60a) comes with the positive inference that Ann came.

(62) $[\![\textit{(60b)}]\!]^{g,w}$=T iff

$\exists$n[n<2 & max(λd.$\exists$x[|x|=d & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=n & max(λm.$\exists$y[|y|=m & y is a girl$_w$ & y came$_w$])$\neq$n]

The same goes for the *at most two* case in (63a). It has a parallel LF shown in (63b). *At most two* composes with the same predicate of degrees shown in (61). *At most two* states that such a degree exists and it is equal to 0, 1 or 2. The predicted truth conditions are in (64). They capture the additive inference in exactly the same way.

(63) a. At most two girls besides Ann came.
b. [$_{\text{IP}_3}$ at most two [$_{\text{IP}_2}$ 1 [$_{\text{IP}_1}$ Exh$_{\text{ALT}}$ [exactly d$_1$ girl [besides Ann]$_\text{F}$ came]]]]

(64) $[\![$*(63b)* $]\!]^{g,w}$=T iff
$\exists$n[n$\leq$2 & max(λd.$\exists$x[|x|=d & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=n & max(λm.$\exists$y[|y|=m & y is a girl$_w$ & y came$_w$])$\neq$n]

Given our assumptions about the contribution of *besides* and *Exh*, the decomposition account of modified numerals is the only way to produce a well-formed meaning for an upward entailing quantifier. However, the situation is different with downward entailing modified numerals. The application of *Exh* is not predicted to be vacuous if the sentence with *fewer than two* in (60a) gets the LF shown in (65), where *Exh* scopes over the entire modified numeral.

(65) [$_{\text{IP}_3}$ Exh$_{\text{ALT}}$ [$_{\text{IP}_2}$ fewer than two [$_{\text{IP}_1}$ 1 [exactly d$_1$ girl [besides Ann]$_\text{F}$ came]]]]

The meaning resulting from interpreting of this LF is shown in (66). The sentence is predicted to be true if 0 or 1 is the maximal number of girls who are not Ann who came, but neither 0 nor 1 is the maximal number of girls who came overall. This is possible if Ann came and exactly one other girl came. This reading is strictly stronger than the reading resulting from the LF in (60b) and it is hard to empirically establish if this is also a possible LF for this sentence. It is definitely not the only available reading: the sentence does not require that exactly one girl who is not Ann came, it is compatible with Ann being the only girl who came.

(66) $[\![$*(65)*$]\!]^{g,w}$=T iff
$\exists$n[n<2 & max(λd.$\exists$x[|x|=d & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=n] & $\neg\exists$m[m<2 & max(λd'.$\exists$y[|y|=d' & y is a girl$_w$ & y came$_w$])=m]

Similarly, the application of *Exh* is not predicted to be vacuous if sentence with *at most* in (63a) gets the LF where *Exh* scopes over the entire modified numeral, as shown in (67).

(67) [$_{\text{IP}_3}$ Exh$_{\text{ALT}}$ [$_{\text{IP}_2}$ at most two girl [$_{\text{IP}_1}$ 1 [exactly d$_1$ girl [besides Ann]$_\text{F}$ came]]]]

The sentence is predicted to be true if and only if at most two girls came if we don't count Ann and not at most two girls came overall. This is possible if Ann came along with exactly two other girls. However, *at most n* numerals mandatorily come with the uncertainty inference (Geurts and Nouwen 2007; Nouwen 2010; Mayr and Meyer 2014) and the sentence in (68a) definitely cannot mean that exactly two girls who are not Ann came. This LF is ruled out due to its incompatibility with the uncertainty inference.

(68) $[\![$*(67)*$]\!]^{g,w}$=T iff
$\exists$n[n$\leq$2 & max(λd.$\exists$x[|x|=d & x is a girl$_w$ & $\neg$OVERLAP(Ann)(x) & x came$_w$])=n] & $\neg\exists$m[m$\leq$2 & max(λd'.$\exists$y[|y|=d' & y is a girl$_w$ & y came$_w$])=m]

2.6. The difference between exceptive and exceptive-additive constructions

The crucial difference between exceptives and exceptive-additives lies in the construction of alternatives. As discussed in Section 1, we adopt Hirsch's (2016) proposal for exceptives, where the alternatives are formed by substituting the DP following the exceptive by other DPs of at most equal complexity. Hirsch's approach correctly captures the fact that exceptives are incompatible with *exactly*, as illustrated in (69). The predicted LF for (69a) is shown in (69b).

(69) a. *Exactly two girls but/except Ann came.
b. $[_{\text{IP}_2}$ Exh_{ALT} $[_{\text{IP}_1}$ [exactly two girls but Ann_{F} came]]]

Assuming again that there are four salient girls (Ann, Bella, Carol, Denise), the alternatives for *Exh* in (69b) have the meanings shown in (70). The alternative in (70a) is the prejacent. None of the remaining alternatives is innocently excludable. We can negate maximally two of the alternatives together with the assertion of the prejacent. For example, the negations of (70b) and (70c) are compatible with the assertion of (70a) if only Bella and Carol came because in {Ann, Carol, Denise} and {Ann, Bella, Denise} there is only one girl who came and not two. But the alternative in (70d) cannot be negated as both girls who came (Bella and Carol) are in {Ann, Bella, Carol}. The same reasoning applies to other alternatives: none of them is in every maximal set of alternative propositions that can be negated together with the assertion of the prejacent. Consequently, the application of *Exh* is predicted to be vacuous, and this LF is ruled out by the non-vacuity constraint.

(70) a. λw.max(λd.$\exists$x[|x|=d & x$\in${Bella, Carol, Denise} & x came_w) = 2
b. λw.max(λd.$\exists$x[|x|=d & x$\in${Ann, Carol, Denise} & x came_w) = 2
c. λw.max(λd.$\exists$x[|x|=d & x$\in${Ann, Bella, Denise} & x came_w) = 2
d. λw.max(λd.$\exists$x[|x|=d & x$\in${Ann, Bella, Carol} & x came_w) = 2

3. For future research

In this paper we focused on *besides*-phrases occurring in the connected position (the position adjacent to the restrictor of a quantifier). This is not the only position *besides*-phrases can occupy in a sentence. There is an interesting pattern with *besides*-phrases occurring in the fronted position, as in (71). Sentence (71a) comes with the inferences discussed in this paper: Ann is a girl, Ann did not come and every other girl came. Something else is going on in (71b). Mark is not a girl but the sentence is acceptable and it comes with the additive inference: Mark came. The additive reading is not available for (71a) (assuming Ann is a girl) and the exceptive reading is not available in (71b) (Vostrikova 2019c). Vostrikova (2019c) proposes that in (71b) the *besides*-phrase does not operate on the domain of the quantifier *every girl*, but serves the same function as *besides* in (71c), where no quantificational determiner is present at all. We leave the question of the interaction of the fronted *besides*-phrase and *every* for future research, as well as the question of how the meaning of (71c) is derived. Our focus here is on *besides*-phrases in connected positions; the containment inference is mandatory in such cases (as shown in (71d)), as well as the negative inference and this is what our analysis captures.

(71) a. Besides Ann, every girl came.
b. Besides Mark, every girl came.
c. Besides Mark, John came.
d. #Every girl besides Mark came.

There is also an interesting pattern that fronted *besides*-phrases show with existentials: they come with an anti-containment inference as the contrast between (72a) and (72b) shows; the additive inference that Mark came is present in (72a). At this point we do not have a proposal about how the meaning of (72a) is derived and we do not have an explanation for the anti-containment inference in (72b). We leave the interaction of the fronted *besides* phrases with existentials for future research. We will only point out that the containment inference is mandatory with connected *besides*-phrases, as (72c) shows, which our analysis correctly captures.

(72) a. Besides Mark, some girls came.
b. #Besides Ann, some girls came.
c. #Some girls besides Mark came.

4. Conclusion

In this paper we proposed a unified compositional treatment to the exceptive and additive uses of *besides*. To our knowledge, this is the first approach to the semantics of *besides* that correctly captures the interaction of *besides* with the negative and universal quantifier and all cases of modified numerals. We proposed that the exceptive or the additive inference results from comparing the quantificational statement with domain subtraction done by *besides* and the statement without this subtraction. Our starting point is the unified treatment of *besides* with the universal and negative quantifier and the non-monotonic *exactly n*. The resulting positive or negative inference depends on the properties of the quantifier: with the universal quantifier the inference is predicted to be negative, with the negative and non-monotonic quantifier it is predicted to be positive. We extended this approach to all cases of modified numerals by adopting a decompositional account of them assuming that there is a constituent in the scope of the numeral with the meaning equivalent to *exactly* and by showing that the additive inference can be computed on that constituent. The advantage of the approach proposed here is that it captures the exceptive and the additive uses of *besides* using the theoretical mechanisms familiar from the discussion of other empirical phenomena in the literature: focus marking, structural alternatives, and an exhaustivity operator (*Exh*).

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Future orientation & free choice[1]

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Abstract. Epistemic necessity modals cannot be future-oriented. Previous attempts to explain this ban tie the constraint directly to speakers' intuitions about the metaphysics of the future. As a result, they fail to predict the range of cross-linguistic variation attested in the domain of temporal orientation. This paper defends a fully grammatical approach to the phenomenon. I assume, with much of the recent literature on temporal orientation, that future orientation stems from a covert temporal morpheme. Then, I proceed to show that in English and in Brazilian Portuguese there is substantial overlap between the distribution of this morpheme and the distribution of Universal Free Choice Items (∀-FCIs), like *any* in some of its uses. Based on these similarities, I sketch an account of temporal orientation that employs tools from the literature on polarity sensitivity.

Keywords: future orientation, modality, mood, polarity sensitivity.

1. Introduction

This paper sheds new light on a well-known gap in the temporal orientation of modal verbs: epistemic necessity modals cannot be future-oriented. Simply put, epistemic modals are used to make inferences based on a body of evidence, so there is no obvious reason why a speaker who sees dark clouds in the sky cannot utter (1c) to make a prediction about the weather. Besides its temporal dimension, this constraint is also relative to modal force and modal flavor: epistemic *possibility* modals (2a) and *root* necessity modals can be future-oriented.

(1) a. It must$_{\text{epis}}$ have rained.
b. It must$_{\text{epis}}$ be raining.
c. *It must$_{\text{epis}}$ rain.

(2) a. It may$_{\text{epis}}$ rain.
b. John must$_{\text{deon}}$ pay a fine.

A successful account of the unacceptability of (1c) must meet at least two desiderata: it needs to account for the force asymmetry between (1c) and (2a), and for the flavor asymmetry between (1c) and (2b):

(3) **The constraint on future orientation**

a. **The force asymmetry**
Epistemic *necessity* modals cannot be future-oriented.
Epistemic *possibility* modals can.

b. **The flavor asymmetry**
Epistemic necessity modals cannot be future-oriented.
Root necessity modals can.

[1]This project has benefited from discussions with Valentine Hacquard, Paolo Santorio, Fabrizio Cariani and Alexander Williams. I am also thankful to the audience at SuB27 and to three anonymous reviewers for their suggestions. All errors are my own.

Many existing accounts have reduced the ban on future orientation to either a force-based or a flavor-based constraint. Klecha (2016) claims that *may* in (2a) is not truly epistemic, which dissolves the force asymmetry. I will show that this view is challenged by the interaction between possibility modals and negation: in its predictive use, like (2a), *may* outscopes negation, a behavior that is typical of epistemic modals. Williamson (2021), on the other hand, claims that future reference can only be licensed in a diverse modal context. Epistemic *must* is, in a sense, stronger than root *must*: it quantifies over a homogeneous modal base, which prevents it from being future-oriented. That circumvents the flavor asymmetry, but it comes at the cost of making problematic typological predictions.

In this paper, I argue that constraints on future orientation can be reduced to the more well-known puzzle of polarity sensitivity, which opens doors for a more principled and predictive account of the phenomenon.

The paper is organized as follows: In §2, I suggest that we should approach the puzzle on future orientation as a puzzle about futurity, not as a puzzle about modality. In §3 I show that there is substantial overlap between environments that license future orientation, and those that license a certain class of polarity sensitive items. In §4, I investigate the source of futurity in modal sentences. In §5, I develop an account of future orientation building on Crnič's (2017) theory of polarity sensitivity. In §6, I discuss challenges for previous accounts of future orientation. In §7, I conclude and suggest directions for future research.

2. Refining the puzzle

Much of the literature on temporal orientation has focused on the paradigm in (1). A consequence of this approach is that the constraint on future orientation is often seen as a puzzle about modals. I would like to argue that, instead, we should approach it as a puzzle about future-oriented clauses. The motivation for this change in perspective comes from the fact that, in matrix clauses, future reference without overt future morphology is also disallowed (4). I take this as evidence that *must*, in (1c), is not blocking an otherwise-available future reading. Instead, the modals in (2a) and (2b) are rescuing an otherwise-unavailable reading.

(4) *It rains (soon).

I adopt the common view that future orientation comes from a forward-shifting morpheme, which is silent in English (Kratzer 2011; Matthewson 2012; Klecha 2016; Williamson 2021). In order to remain neutral on the nature of this morpheme, I will refer to it as simply FUT. From now on, we can recast the puzzle on future orientation as a puzzle about the licensing of FUT: What are the environments that license FUT? Why does FUT need to be licensed? In the next section, I tackle the first of these questions.

3. Polarity sensitivity in future reference: the empirical landscape

In this section, I show that in Brazilian Portuguese (BP) and English, there is substantial overlap between the environments that license FUT and those that license a certain class of polarity sensitive items (PSIs), namely, universal free choice items (∀-FCIs). To make this point, I focus on two aspects of the distribution of ∀-FCIs that set them apart from other PSIs: their interaction with modals, and their behavior in the restrictor of universal quantifiers, in conditional antecedents, and under negation.

Interaction with modals A lot of attention has been given to the interaction of ∀-FCIs and modals (Aloni 2007; Menéndez-Benito 2010; Chierchia 2013; Dayal 2013; Crnič 2017; Xiang 2020, among many others), but there is still some disagreement about the empirical facts and their proper derivation. The most stable generalization is that ∀-FCIs are generally unacceptable in episodic contexts and with necessity modals, but can be rescued by possibility modals. This phenomenon is sometimes called *modal obviation* (Xiang 2020).

(5) *John read any book.

(6) a. John may$_{\text{deon}}$ read any book.
b. John may$_{\text{epis}}$ be in any room in the house.

(7) a. *John must$_{\text{epis}}$ be in any room in the house.
b. *John must$_{\text{deon}}$ read any book.

As we saw, the interaction of FUT with modals is more nuanced: in addition to the obviating effect of possibility modals, FUT is also acceptable with root necessity:

(8) a. John may$_{\text{deon}}$ go to the party.
b. John might$_{\text{epis}}$ get sick.

(9) a. John must$_{\text{deon}}$ pay a fine.
b. *John must$_{\text{epis}}$ get sick.

While this disanalogy might seem to jeopardize the unification I'm pursuing, in §5 I'll show that the flavor asymmetry follows naturally from plausible assumptions about the syntax of modals and the temporal operator I take to be the source of future orientation.

Restrictor of *every* and conditional antecedents Another hallmark of the distribution of ∀-FCIs is that they are licensed in the restrictor of universal quantifiers, but not of existentials—compare (10a) and (10b)—and in conditional antecedents, but not consequents—compare (11a) and (11b):[2]

[2] I only bring data from BP in this section because, unlike *qualquer*, *any* also has NPI uses—that is, it's licensed under negation.

(10) a. Todo aluno que leu **qualquer** artigo tirou A na prova
every student that read QUALQUER article got A in the test
'Every student who read any article got an A in the test.'

b. *Algum aluno que leu **qualquer** artigo tirou A na prova
some student that read QUALQUER article got A in the test
Intended: 'Some student who read some article or another got an A in the test.'

(11) a. Se você já fez **qualquer** curso de semântica, você vai ir bem
if you already taken QUALQUER course of semantics, you will go well
nesse seminário.
in this seminar
'If you've taken any semantics courses, you'll do well in this seminar.'

b. *Se o João se formou em linguística, ele já fez **qualquer**
if the John REFL majored in linguistics, he already taken QUALQUER
curso de semântica.
course of semantics
Intended: 'If John majored in linguistics, he has taken some course or another in semantics.'

The distribution of FUT follows the same pattern. As described by Crouch (1994), a future orientation is possible in conditional antecedents, even in the absence of any overt future marker (12a). Conditional consequents, on the other hand, require an overt marker, like *will*, to acquire a future orientation—compare (12b) and (12c). Under the assumptions made in this paper, that means that conditional antecedents, but not consequents, license FUT.

(12) a. If I smile when I get out, the interview went well. [(5) in Crouch (1994)]
b. *If my next interview goes well, I smile when I get out.
c. If my next interview goes well, I will smile when I get out.

On a similar vein, Williamson (2021), observed that the restrictor of *every*, but not of *some*, licenses FUT. The author illustrates this point with the Crouch-inspired minimal pair below, slightly adapted to favor an episodic reading:

(13) a. Every student who comes out of this room smiling did well.
b. *Some student who comes out of this room smiling did well.
[adapted from (319) in Williamson]

These facts suggest that the licensing of ∀-FCIs and of FUT is tied to the monotonicity of the environment: ∀-FCIs and FUT are licensed in conditional antecedents and in the restrictor of *every* because they are downward-entailing (or, at least, not upward-entailing) environments. Sentential negation, however, seems to provide a counterexample to this generalization:

(14) *Eu não li **qualquer** livro.
I NEG read QUALQUER book
Intended: 'I didn't read any book.'

(15) *It doesn't rain (soon).

The fact that some polarity sensitive items are not licensed under sentential negation is a recurring pattern cross-linguistically. Chierchia (2013) reports similar facts for Italian, and Pereltsvaig (2000) for Russian. This pattern also shows in the licensing of ∀-FCIs and FUT under negated modals. Pure ∀-FCIs, like *qualquer*, are disallowed under negated possibility modals, regardless of flavor:[3]

(16) a. *O João não pode$_{\text{root}}$ ler **qualquer** livro.
the John NEG can read QUALQUER book
Intended: 'John can't read any book.'

b. *O João não pode$_{\text{epis}}$ ter lido **qualquer** livro.
the John NEG can have read QUALQUER book
Intended: 'John can't have read any book.'

FUT behaves similarly, but we again see an effect of modal flavor. Only with negated epistemic modals is FUT disallowed:

(17) a. John can't$_{\text{root}}$ leave.
b. *It can't$_{\text{epis}}$ rain (soon).

One might wonder if the ban of pure ∀-FCIs under negated modals is due to the resulting modal force of the assertion. Since $\neg\Diamond \equiv \Box\neg$, it could be that *qualquer* is banned in (16) because these sentences are logically necessity statements. I don't believe this is the case. In (18), the necessity modal *ter que* scopes under negation, which means that the resulting modal force of the assertion is existential. If *qualquer* was disallowed in (16) because of its resulting force, we would predict it to be licensed in (18), which is not the case.

(18) *O João não tem que$_{\text{root}}$ ler **qualquer** livro.
the John NEG have to read QUALQUER book
Intended: 'John doesn't have to read any book.'

I therefore conclude that the facts in (16), (17), and (18) are related to the more general pattern of anti-licensing by negation that some ∀-FCIs are subject to.[4]

3.1. Further evidence of polarity sensitivity in future reference

Before I conclude this section, I would like to present some cross-linguistic evidence that further supports the view that constraints on future orientation boil down to polarity sensitivity.

[3]Examples (14) and (16) could be rescued in the right conversational context if *qualquer* was focused. When focused, *qualquer* acquires a 'just any' reading: (16) would convey that John didn't read just any book, he read a special/remarkable book. It's not clear how this 'just any' reading comes about, or why it has special licensing conditions. I leave an investigation of these facts for future work.

[4]I am unable to replicate the pattern in (18) with epistemic necessity modals because it's unclear that they can ever scope under negation. In examples like 'It must not have rained', the only interpretation available seems to be $\Box\neg$.

	∀-FCIs	FUT
Root $\Diamond$	✓	✓
Epistemic $\Diamond$	✓	✓
Root $\Box$	*	✓
Epistemic $\Box$	*	*
Conditional antecedents	✓	✓
Restrictor of $\forall$	✓	✓
Restrictor of $\exists$	*	*
Episodic contexts	*	*
Sentential negation	*	*

Table 1: Overlap in the distribution of ∀-FCIs and FUT

A growing body of research shows that future morphemes are subject to cross-linguistic variation in their licensing conditions. Mucha (2016) proposes that, in Medumba (Grassfields Bantu), a covert forward-shifting morpheme is licensed under negation, in questions, conditional antecedents and modal complements, among other environments. Bochnak (2016), on the other hand, shows that graded future markers in Washo (language isolate) are licensed in modal complements, conditional antecedents, attitude verbs, and questions, but not under negation.[5]

This brief overview shows that, while constraints on future reference are subject to cross-linguistic variation, this variation is systematic. In Medumba, FUT displays the behavior of an NPI/FCI hybrid (like *any*), being licensed also by sentential negation. In Washo, future markers, are also licensed in questions, an environment that is often hospitable for PSIs.

Importantly, these facts also cast doubt on any theory of future orientation that builds on the idea that the future is uncertain or open: If constraints on future orientation were tied to the inherent uncertainty of future affairs, why would FUT be licensed under negation in Medumba? Conversely, why would FUT *not* be licensed in questions in English?

3.2. Taking stock

In this section, I have shown that the distribution of FUT closely resembles the distribution of ∀-FCIs. These facts are summarized in table 1. I take this as evidence that the puzzle on future orientation can be reduced to the more familiar puzzle of polarity sensitivity. This conclusion raises two important questions: (i) if FUT is really a polarity sensitive item, why is it subject to a robust flavor asymmetry, in a way that other PSIs are not? (ii) why would a forward-shifting morpheme be sensitive to the monotonicity of the environment? I believe an investigation of the nature of FUT can shed light on both issues.

[5] See Bochnak (2019) for a more thorough discussion of these facts.

4. What is FUT?

So far, I have been using the theory-neutral label FUT to refer to the source of futurity in all environments surveyed in §3. But what is the nature of this morpheme? The received wisdom is that FUT is an aspectual morpheme (Kratzer 2011; Matthewson 2012; Klecha 2016; Williamson 2021),[6] whose lexical entry is roughly the one in (19). This semantics is inspired by an analogy with the perfect aspect, but direct evidence that this is the correct treatment of FUT is quite elusive.

(19) $[\![\text{FUT}]\!] = \lambda P_{\langle i,st\rangle}.\lambda t_i.\lambda w_s.\exists t'[t' \succ t \wedge P(t')(w)]$

I would like to propose an alternative view: at least in some environments, future orientation comes from a subjunctive future. This is supported by evidence from Brazilian Portuguese, which is, to my knowledge, the only Romance language with a productive and dedicated subjunctive future (henceforth, SF):[7]

(20) a. Se o João **for** à festa, a Maria pode ir também.
if the John **go.SUBJ.FUT** to.the party, the Mary might go too
'If John goes to the party, Mary might go too.'

b. Todos os candidatos que **forem** eleitos vão ser empossados em 1 de Janeiro.
all the candidates who **be.SUBJ.FUT** elected will be sworn into office on 1 of January
'Every candidate who is elected will be sworn into office on January 1st.'

What do we gain by switching to the view that future orientation comes from a subjunctive morpheme? For starters, subjunctives cross-linguistically have a tendency to display polarity sensitive behavior. So-called *polarity subjunctives* have been observed in several languages with overt indicative/subjunctive moods (Rivero 1971; Farkas 1992; Giannakidou 2011; Quer 2000: a.m.o). That makes the polarity-sensitive nature of FUT much less surprising. Furthermore, subjunctives are usually taken to attach high in the clause, either at T or C.[8] The fact that BP has both a past and a future subjunctive supports this view—it's likely that these two forms can be decomposed into a subjunctive morpheme and a combination of tense and aspect. It's also well-known that epistemic and root modals have complements of different sizes, so that gives us an initial clue of why FUT displays a flavor asymmetry.

[6]I should clarify that, with the exception of Williamson (2021), all the other authors listed here focused on temporal orientation in non-finite clauses. That is, they didn't claim that the future orientation of conditional antecedents and relative clauses also comes from an aspectual marker.

[7]SF morphology appears only in a subset of the environments that license future readings, namely, conditional antecedents and the restrictor of some quantifiers. Modals, on the other hand, always have infinitival morphology, regardless of their flavor or temporal orientation. In §5 I'll show that the surface form of modal sentences is not particularly informative about their morphological makeup, therefore, I believe it would be a hasty decision to assume that no modals embed the SF.

[8]See (Quer 2006: §4) for an overview of existing proposals for the syntax of subjunctive moods.

5. Proposal

5.1. Explaining the flavor asymmetry

Let's recall the basic pattern that motivated this paper. Root modals can always be future-oriented, regardless of force, but only epistemic *possibility* modals can:

(21) a. John might$_{\text{epis}}$ leave.
b. *John must$_{\text{epis}}$ leave.

(22) a. John may$_{\text{deon}}$ leave.
b. John must$_{\text{deon}}$ leave.

This pattern closely resembles the pattern of modal obviation displayed by nominal ∀-FCIs, with the exception that nominal ∀-FCIs are not susceptible to such a robust flavor asymmetry. How can we capture this disanalogy? In her seminal work, Kratzer (1981, 1991) proposed that modals only lexicalize their force, but not their flavor, which is retrieved from the context of utterance. This proposal is based on the fact that, cross-linguistically, the same modals are compatible with different readings, which speaks against an ambiguity-based theory. An account of temporal orientation should preserve this attractive feature of the Kratzerian framework and derive the flavor asymmetry without stipulating different lexical entries for root and epistemic modals. I would like to suggest that instead of relying on semantic differences, we should rely on syntactic differences between the two classes of modals.

It's widely believed that epistemic and root modals combine with complements of different sizes (see Picallo 1990; Brennan 1993; Butler 2003; Hacquard 2006; among many others).[9] Evidence for this syntactic split comes mainly from the interaction of modals with tense. For instance, consider how the past tense on *have to* seems to have a different interpretive effect depending on how the modal is construed:

(23) a. John had to$_{\text{deon}}$ go to bed early when he was a child.
b. $[\![23\text{a}]\!] = 1$ iff $\forall w'.w'$ is compatible with the rules in w_0 **in the past** $\rightarrow$ John goes to bed early in w'

(24) a. A: Do you know where John was last night?
B: He had to$_{\text{epis}}$ be home. He never goes out on the weekends.
b. $[\![24\text{a}]\!] = 1$ iff $\forall w'.w'$ is compatible with the evidence in w_0 **at speech time** $\rightarrow$ John **was** home in w'

In (23a), *have to* is interpreted deontically; the modal refers to a past obligation. That is: past tense is setting the time of modal evaluation. In the epistemic example (24a), on the other hand, past seems to be setting the running time of the eventuality denoted by the prejacent. These facts suggest that epistemic modals scope above tense, while root modals scope below:

[9] This is the majority view in the literature, but see Rullmann and Matthewson (2018) for counter-evidence.

(25) $[_{\text{MODP}}$ **Mod**$_{\textbf{epis}}$ $[_{\text{TP}}$ T $[_{\text{MODP}}$ **Mod**$_{\textbf{root}}$ $\ldots$

How can these different LFs lead to the flavor asymmetry? I have argued that FUT, which is often taken to be an aspectual head, sometimes is a subjunctive mood. Root modals have smaller complements, which are unlikely to host a mood morpheme. Based on this, I would like to suggest that the future orientation of epistemic and root modals comes from different sources: only epistemic modals embed a subjunctive morpheme, which, as a polarity sensitive item, has a limited distribution. That explains why root modals are not subject to the same constraints on future orientation. While I will remain mostly neutral on the source of future orientation for root modals, one possibility is that they combine with the temporal marker in (19), which, being aspectual in nature, attaches lower in the clausal spine.

If this is on the right track, the distribution of FUT now looks less messy than initially thought: if only epistemics embed a SF morpheme, then the SF is uniformly banned under necessity modals, just like ∀-FCIs are usually taken to be.[10] In the next section, I provide an account of this force asymmetry couched in alternative semantics.

5.2. Explaining the force asymmetry

Having sharpened the empirical picture, we can now account for the distribution of the subjunctive future using tools from the literature on polarity sensitivity. I begin by proposing the following entry for the subjunctive future:

(26) $[\![\text{SUBJ FUT}]\!]^{w,t} = \lambda P_{\langle i,st\rangle}.\exists w' \in \text{HIST}(w,t)[\exists t' : t' \succ t \wedge P(t')(w')]$

In addition to temporal displacement, I assume the subjunctive future also introduces modal displacement.[11] This move is justified by the interpretation of the subjunctive in relative clauses. Consider the Crouch-inspired example below. Notice that (27) does not presuppose that any student *will* ace the test. Instead, (27) seems to allow for the possibility of different students acing the test in different historical alternatives[12] to the world of evaluation, $w_@$.

(27) Every student who aces this test cheated.

I also propose the modal force of the subjunctive is existential. This is in line with the widespread assumption that ∀-FCIs are underlyingly existentials, and any hint of a universal force comes via exhaustification. The basic truth conditions of future oriented sentences with epistemic modals are given below:

[10] See §7 for some exceptions to this view.

[11] As I said earlier, in addition to a subjunctive future, Brazilian Portuguese also has a subjunctive past. These facts suggest that both forms share a common core that combines with different of tenses and aspects. Presumably, this shared morpheme contributes the layer of modality in (26), while temporal displacement comes from tense and aspect. Here, I opt for a syncategorematic entry for the sake of simplicity, given that the present paper focuses on the subjunctive future only.

[12] Two worlds are *historical alternatives* to each other at an interval t if they are identical up to (and including) t, even if they are distinct at a later interval (Thomason 1970, 1984).

(28) John may$_{\text{epis}}$ leave.

a. LF: [may [SUBJ FUT [John leave

b. $[\![(28)]\!](w_0)(t_0) = 1$ *iff* $\exists w' : w'$ is compatible with the evidence in w_0 at t_0 $[\exists w'' : w''$ is a historical alternative to w' at $t_0[\exists t' : t' \succ t_0$ s.t. John leaves$(w'')(t')]]$

(29) *John must$_{\text{epis}}$ leave.

a. LF: [must [SUBJ FUT [John leave

b. $[\![(29)]\!](w_0)(t_0) = 1$ *iff* $\forall w' : w'$ is compatible with the evidence in w_0 at t_0 $[\exists w'' : w''$ is a historical alternative to w' at $t_0[\exists t' : t' \succ t_0$ s.t. John leaves$(w'')(t')]]$

That sets the stage to derive the polarity sensitivity of the subjunctive future. For concreteness, I adopt the theory of polarity sensitivity from Crnič (2017).[13]

The crux of Crnič's theory is the idea that some polarity sensitive items are associated with a covert operator, EVEN$_\varnothing$.[14] Like its overt counterpart, EVEN$_\varnothing$ has a scalar presupposition requiring that its prejacent, $P(D)$, be stronger than its alternatives, $P(D')$.

(30) $[\![\text{EVEN}_\varnothing]\!]^{g,c}(D)(P)$ is defined only if $\forall D' \subset D : P(D) \neq P(D') \rightarrow P(D) \subset P(D')$.
If defined, $[\![\text{EVEN}_\varnothing]\!]^{g,c}(D)(P)(w) = \lambda w.P(D)(w) = 1$

What are the alternatives to a sentence with the subjunctive future? Following a long-standing tradition in the polarity sensitivity literature, I assume the alternatives to a quantifier are obtained by replacing the original domain of the quantifier with subsets of it. Assuming a toy model containing only two historical alternatives, the alternative set to (28) is given in (31). The alternative set to (29) would look identical, except for modal force.[15]

(31) $$Alt(28) = \left\{\begin{array}{l} \Diamond[\text{John leaves in } w_1 \vee \text{John leaves in } w_2], \\ \Diamond[\text{John leaves in } w_1], \\ \Diamond[\text{John leaves in } w_2] \end{array}\right\}$$

When the subjunctive future is in matrix clauses, the presupposition of EVEN is not satisfied: if John will leave in some accessible world, that doesn't entail he will leave in any particular world.

(32) *[EVEN$_\varnothing$[John leaves$_{\{w_1,w_2\}}$]]

a. $\not\models$ John leaves$_{\{w_1\}}$.

b. $\not\models$ John leaves$_{\{w_2\}}$.

However, when the subjunctive future is in a downward-entailing environment, like the restrictor of *every*, all alternatives are entailed and the presupposition of EVEN$_\varnothing$ is satisfied:

[13] This presentation follows closely the one in (Crnič 2017: §2.1) and Francis (2020). I should emphasize that Crnič's theory was developed specifically for *any*.

[14] This part of Crnič's proposal is based on Lahiri's (1998) influential analysis of Hindi NPIs, which can be overtly decomposed into *even*+an indefinite.

[15] Crnič (2017) assumes that, in addition to these alternatives, polarity sensitive items also project a conjunctive alternative, which can be pruned from the alternative set. In the case at hand, the conjunctive alternative would be ($\Diamond$[John leaves in $w_1 \wedge$ John leaves in w_2]), but I'll omit it to avoid clutter.

(33) [EVEN$_{\varnothing}$[Every student who comes out smiling$_{\{w_1,w_2\}}$ did well]]
   a. $\vDash$ Every student who comes out smiling$_{\{w_1\}}$ did well.
   b. $\vDash$ Every student who comes out smiling$_{\{w_2\}}$ did well.

Now, we incorrectly predict that the subjunctive future should be licensed under negation. Crnič's account was meant to capture the distribution of *any*, which has both NPI and FCI uses. However, as we saw in §3, the subjunctive future is part of a class of polarity sensitive items that are banned under clause-mate negation. Pereltsvaig (2000) proposes an explanation to this ban based on morphological blocking. The idea is that, under negation, some NPIs would compete with, and be blocked by, negative concord items. An extension of this account is unlikely to work for the subjunctive future, that doesn't have any natural competitors in the English or Portuguese lexicon.

Supplementing Crnič's account with morphological blocking would also be insufficient to explain the distribution of the ∀-FCI *qualquer*. In addition to being banned under sentential negation, *qualquer* is also disallowed in other environments that license *any*, like the scope of *only* and the scope of *few*.[16] Neither of these two environments licenses negative concord items. This points to a more general problem: no existing theory is able to fully capture the distribution of ∀-FCIs, which is more intricate than that of NPIs. Developing a theory that is better suited for ∀-FCIs is out of the scope of this paper.

For existential modals, things are not as straightforward. Existential modals do not create a downward-entailing environment, so, as things stand, Crnič's account would incorrectly predict *any* to be disallowed. To integrate modals into his account, Crnič builds on a well-established difference between the interpretation of *any* in modalized and episodic sentences. In downward-entailing environments, *any* is naturally interpreted as a negated existential. However, in modalized sentences, *any* seems to acquire the force of a wide-scope universal: 'John may read any book' does not convey simply that John may read *a* book. It conveys that every book is a permissible option—hence the label 'free choice'.

Crnič (2017) takes this interpretive difference as evidence that, when under a modal, *any* gives rise to a free choice implicature. This implicature is generated by the application of a covert operator, EXH, whose meaning is akin to *only*. The particular denotation of EXH I adopt is the one from Bar-Lev (2018) and Bar-Lev and Fox (2020):[17]

(34) $[\![\text{EXH}]\!](C)(p)(w) = \forall q \in IE(p,C)[\neg q(w)] \wedge \forall r \in II(p,C)[r(w)]$
   a. $IE(p,C)$ = Innocently Excludable alternatives to p in C
   b. $II(p,C)$ = Innocently Includable alternatives to p in C

The algorithm to calculate the **IE alternatives** to a prejacent p is the following: First, we look at the maximal sets of alternatives that can be negated consistently with p. Then, we select only the alternatives that are members of all these sets. These alternatives are IE. The calculation of **II alternatives** is analogous: First, we look at the maximal sets of alternatives that can be assigned true consistently with the prejacent *and* the negation of all IE alternatives. Then, we

[16] The same observations apply to the subjunctive future. I omit the relevant examples due to space limitations.
[17] This version of EXH has the benefit of deriving free choice implicatures in one single application. Adopting the denotation of EXH in Fox (2007) and applying it recursively would yield the same results.

select only the alternatives that are members of all these sets. These alternatives are II. EXH excludes (i.e. assigns false) to the former and includes (i.e. assigns true) to the latter.

To see how this mechanism works, consider (35), ignoring the role of EVEN$_\varnothing$ for now. The alternatives under consideration are given in (35b). Two sets of alternatives can be negated consistently with the prejacent, namely, the set in (ii) and the set in (iii). The intersection of (ii) and (iii) is the empty set. Therefore, none of the alternatives is IE. The set formed by the union of (ii) and (iii) can be assigned true consistently with the prejacent, so both (ii) and (iii) are II. The enriched meaning of (35) is given in (35c). (35c) says that John will leave in a historical alternative to some epistemically-accessible world, while expressing indifference about which historical alternative that will be.

(35) John may$_{\text{epis}}$ leave$_{\{w_1,w_2\}}$.

a. $[\,\text{EXH}_C\,[\Diamond\,[\text{ John leaves}_{\{w_1,w_2\}}]]]$

b. $C = \left\{\begin{array}{l}\text{(i) } \Diamond(\text{John leaves}_{\{w_1\}} \vee \text{John leaves}_{\{w_2\}}),\\ \text{(ii) } \Diamond(\text{John leaves}_{\{w_1\}}),\\ \text{(iii) } \Diamond(\text{John leaves}_{\{w_2\}})\end{array}\right\}$

c. $\Diamond(\text{John leaves}_{\{w_1\}} \vee \text{John leaves}_{\{w_2\}}) \wedge \Diamond(\text{John leaves}_{\{w_1\}}) \wedge \Diamond(\text{John leaves}_{\{w_2\}})$

Now, let's put EVEN$_\varnothing$ back into the picture. The prejacent of EVEN$_\varnothing$ is no longer the basic existential meaning of (35), but rather, its strengthened meaning, in (35c). EVEN$_\varnothing$ tests whether its prejacent entails all of its alternatives, which are the ones in (ii) and (iii). Since the prejacent of EVEN$_\varnothing$ now contains the conjunction of all its alternatives, the subjunctive future passes the test.

(36) $[\,\text{EVEN}_{\varnothing C'}\,[\,\text{EXH}_C\,[\Diamond\,[\text{ John leaves}_{\{w_1,w_2\}}]]]]$

a. $C' = \left\{\begin{array}{l}\text{(i) } \Diamond(\text{John leaves}_{\{w_1\}} \vee \text{John leaves}_{\{w_2\}}) \wedge\\ \qquad \Diamond(\text{John leaves}_{\{w_1\}}) \wedge \Diamond(\text{John leaves}_{\{w_2\}}),\\ \text{(ii) } \Diamond(\text{John leaves}_{\{w_1\}}),\\ \text{(iii) } \Diamond(\text{John leaves}_{\{w_2\}})\end{array}\right\}$

Let's briefly consider what happens when the subjunctive future is under the scope of a necessity modal. Now, there's only one maximal set of alternatives that can be excluded consistently with the prejacent. This is the set formed by the union of (ii) and (iii). It follows that both alternatives are IE. The only II alternative is the prejacent itself.

(37) *John must$_{\text{epis}}$ leave$_{\{w_1,w_2\}}$.

a. $[\,\text{EVEN}_{\varnothing C'}\,[\,\text{EXH}_C\,[\Box\,[\text{ John leaves}_{\{w_1,w_2\}}]]]]$

b. $C = \left\{\begin{array}{l}\text{(i) } \Box(\text{John leaves}_{\{w_1\}} \vee \text{John leaves}_{\{w_2\}}),\\ \text{(ii) } \Box(\text{John leaves}_{\{w_1\}}),\\ \text{(iii) } \Box(\text{John leaves}_{\{w_2\}})\end{array}\right\}$

Because the alternatives in (ii) and (ii) were not included, the prejacent of EVEN$_\varnothing$ does not contain the conjunction of its alternatives. As a result, it does not entail (ii) and (iii), and the presupposition of $\text{EVEN}_{\varnothing}$ is not satisfied, which explains why the subjunctive future is disallowed with necessity modals.

$$(38)\quad C' = \left\{ \begin{array}{l} \text{(i) } \Box(\text{John leaves}_{\{w_1\}} \vee \text{John leaves}_{\{w_2\}}) \wedge \\ \quad \neg\Box(\text{John leaves}_{\{w_1\}}) \wedge \neg\Box(\text{John leaves}_{\{w_2\}}), \\ \text{(ii) } \Box(\text{John leaves}_{\{w_1\}}), \\ \text{(iii) } \Box(\text{John leaves}_{\{w_2\}}) \end{array} \right\}$$

6. Challenges for previous accounts

As I said earlier, many existing proposals have reduced the constraint on future orientation to either the flavor asymmetry or the force asymmetry. In this section, I discuss one recent representative of each approach: Klecha (2016), who defends a flavor-based approach, and Williamson (2021), who defends a force-based approach.[18]

6.1. Klecha (2016)

The most explicit flavor-based account is due to Klecha (2016), who hard-wires constraints on temporal orientation directly into modal bases. In his system, modal bases are represented as covert pronouns that, after combining with modal verbs, can impose restrictions on the temporal interpretation of the complements of these verbs. Epistemic (or doxastic) modal bases repel future-oriented prejacents, while circumstantial modal bases demand them. Presenting the details of Klecha's proposal would lead us too far afield; what is crucial for this discussion is his empirical claim: root modals are always future-oriented; epistemic modals are never future-oriented.

Let's start with his claim about the temporal orientation of root modals. While it is true that root modals are *typically* future-oriented, it is unlikely that this tendency is purely linguistic. Root modals are often used performatively, to give orders or permissions, which are inherently future-oriented—giving someone an order to have done something would be decidedly odd.[19] Once we provide enough contextual support to suppress the performative tendency of root modals, present- (39) and past-oriented (40) readings become available.[20]

[18]Both Klecha and Williamson assume that future orientation comes from a covert future operator, an assumption that is shared with the present work. Some earlier theories, like Werner (2003; 2006) and Lekakou and Nilsen (2009), assumed that modal sentences are almost completely unspecified with respect to temporal orientation. According to this view, temporal orientation is determined by the interplay of pragmatic principles governing the interpretation of modalized utterances. However, there is cross-linguistic evidence that future orientation stems from an aspectual morpheme (Matthewson 2012), so a purely pragmatic explanation of the facts discussed in this paper seems unlikely.

[19]See Williamson (2021) for a formal proposal that links performativity to temporal orientation.

[20]More could be said against the thesis that root modals are always future-oriented, but I would like to keep this discussion short for the sake of focus. I refer the reader to Harr (2019), ch.7, for a more thorough case against the obligatoriness of future orientations for root modals.

(39) a. John has to run every day to stay fit.
b. I'm only here because I have to be.[21]

(40) All students must have received their booster shot before returning to campus.

When it comes to Klecha's claim about epistemic modals, the burden of proof lies not in showing that *might* or *may* can be used to make predictions, but rather in showing that these uses are epistemic. Klecha argues that the modality expressed in sentences like *it might rain tomorrow* is better understood as metaphysical, rather than epistemic. Since metaphysical modals are taken to be a subset of root modals, these predictive uses of *may* and *might* are not counterexamples to his generalization.

Teasing apart epistemic and metaphysical readings is not a trivial task, as Klecha himself points out. I will offer instead, a simple syntactic argument to support the view that predictive *may* and *might* are epistemic. In its root readings, *may* scopes below negation, while epistemic *may* scopes above. This difference in behavior most likely stems from the different heights of interpretation of the two classes of modals.

(41) a. You may_{root} not leave. $\neg\Diamond$
b. John may_{epis} not be home. $\Diamond\neg$

If predictive uses of *may* and *might* exemplify metaphysical modality, they should pattern like root *may* with respect to negation—after all, Klecha takes metaphysical modals to be a subset of root modals. This is not the case: predictive *may* and *might* scope above negation.

(42) a. It may not rain. $\Diamond\neg$
b. It might not rain. $\Diamond\neg$

I take this behavior as evidence that the puzzle about temporal orientation cannot be reduced to modal flavor: predictive *may* and *might* are epistemic. I now turn to Williamson (2021), and show that the puzzle cannot be reduced to modal force either.

6.2. Williamson (2021)

For Williamson (2021), the puzzle of future orientation is a puzzle about the distribution of FUT, which he models as roughly the mirror image of the perfect. Williamson argues that FUT has a presupposition that requires it to be under the scope of an operator that meets certain criteria. Informally, FUT is only defined if its *modal context*[22] contains p-worlds and $\neg p$-worlds:

[21] Attributed by Klecha to Kai von Fintel.

[22] The term *modal context* was introduced by Portner (1997) to account for mood selection. A modal context can be understood as the modal base of a certain operator $\mathscr{O}$ that is accessible to other operators embedded under $\mathscr{O}$.

(43) $[\![\text{FUT } p]\!]^{g,s}(w_1)(t_1)$

a. is defined only if $\exists\langle w_2,t_2\rangle \in s : \exists t_3 \succ t_2 : [\![p]\!]^{w,g,s}(w_2)(t_3) = 1 \wedge$
$\exists\langle w_3,t_4\rangle \in s : \neg\exists t_5 \succ t_4 : [\![p]\!]^{w,g,s}(w_3)(t_5) = 1$

b. if defined, $= 1$ iff $\exists t_6 \succ t_1 : [\![p]\!]^{w,g,s}(w_1)(t_6) = 1$

Root *must*, according to Williamson, quantifies over a diverse modal base; $\neg p$ worlds are removed from this modal base by a Kratzerian ordering source. That guarantees that the presupposition of FUT is satisfied. Epistemic *must*, on the other hand, quantifies over a homogeneous modal base, which dooms FUT to systematic presupposition failure, thus leading to ungrammaticality.

Within English, Williamson himself recognizes a potential problem for his analysis. Semi-modals, like *be bound to*, *be certain to*, and *be sure to* all express epistemic necessity. Under Williamson's assumptions, they should be incompatible with future-shifted prejacents, a prediction that's not borne out:

(44) John is {sure / certain / bound} to win the match.

One simple way to integrate these semi-modals into the account presented in this paper is by capitalizing on the size of their complements: unlike other epistemic operators, *be sure/certain/bound* take complements smaller than a TP; so like root modals, they might not be able to host a subjunctive mood.

6.3. Discussion

Most accounts of temporal orientation build directly on the idea that the distribution of future morphemes is constrained because the future is (perceived as being) open. Although Klecha's and Williamson's proposals are compositional at their core, this notion is also lurking behind their accounts. According to Klecha, the generalizations he states evolved from 'pragmatic pressures' that the English lexicon is subject to. Williamson, on the other hand, claims that a homogeneous modal base 'conveys a degree of certainty about future states of affairs which cannot be warranted' (Williamson 2021: pp. 11). While both proposals are language-specific, their view strongly implies that there should not be much cross-linguistic variation in the licensing of future markers. Why would the lexicon of different languages be subject to different pragmatic pressures? Why would speakers of different languages be more confident about future affairs? As we saw in §3, however, languages vary with respect to which environments license future markers, and the range of variation attested closely resembles the kind of variation seen in the licensing of polarity sensitive items.

7. Conclusion and loose ends

This paper provides a fresh perspective on the debate about the temporal orientation of modal auxiliaries. There are two cornerstones to my proposal, both of which are very general, and therefore compatible with a number of different implementations. First, I argued that constraints on future orientation are simply instances of polarity sensitivity. Tying future orientation to polarity sensitivity makes my account more flexible and predictive than previous works. Then, I proposed that the flavor asymmetry is likely to follow from syntactic differences between epistemic and root modals: root modals are immune to the constraint on future orientation because their complements are too small to embed a subjunctive future. This is a principled way to refine the empirical picture and explain why future orientation has a more nuanced distribution than other cases of polarity sensitivity.

I would like to point out that, if we're willing to grant that root modals *do* embed the subjunctive future, in principle, there should still be ways to account for the flavor asymmetry while preserving the spirit of my proposal. Although ∀-FCIs are typically assumed to not be licensed under necessity modals, there are several exceptions to this generalization. For instance, so-called supplementary *any* is both compatible with necessity modals *and* subject to a flavor asymmetry (Fălăuş 2014):

(45) a. *John must$_{\text{epis}}$ be with a friend, any friend. [=(90) in Fălăuş (2014)]

b. John must$_{\text{root}}$ come with a friend, any friend.

A fully-developed theory of polarity sensitivity clearly has to be able to explain why certain syntactic configurations allow necessity modals to license ∀-FCIs. When available, such a theory might be able to also explain the flavor asymmetry without relying on the assumption that root modals do not embed subjunctives.

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Missing words and missing worlds[1]

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Abstract. In this paper, we discuss how a non-lexical account of neg-raising can be extended to explain a lexical gap in the domain of modals.

Keywords: modals, lexical gap, strong and weak modal.

1. Introduction: the problem

Traditionally, universal modal auxiliaries have been divided into two categories: *strong necessity* and *weak necessity modals*. They are called like that as strong necessity modals (such as *must* or *have to*) are semantically stronger than weak necessity modals (such as *should* or *ought to*), as the following examples show:

(1) a. You should/ought to leave but you don't have to leave.
 b. You should/ought to leave; in fact you have to leave.

Such a distinction cannot be made for existential modals. Despite morphological similarities, modals like *might/ could* do not stand in a similar strength relation with *may/can*:

(2) a. # You could/might leave but you can't/may not leave.
 b. # She might/could be in her office; in fact, she may/can be in her office.

In this paper, we argue that *might/could* pattern with *may/can* (outside of X-marked contexts). That is, they behave as existential duals of strong necessity modals and tend to yield a strong possibility reading. English appears to lack weak possibility modals. This is not a coincidence. Hardly any language seems to lexically distinguish between weak and strong possibility modals. Naturally, the question is why is that the case?

In addition, we argue that this question is related to another question, namely why weak necessity modals, when negated, can give rise to so-called Neg-raising (NR) readings, but strong necessity modals cannot do so.

Even though both *must* and *should* generally outscope negation (*Mary mustn't leave* means that it must be the case that Mary leaves, and *Mary shouldn't leave* means that it should be the case that Mary leaves, cf. Iatridou and Zeijlstra (2013); Homer (2015)), when embedded under a negated neg-raising predicate, only the latter but not the former is able to outscope the matrix negation:

(3) a. I don't think that John should marry Susan. (✓*should* > *not*)
 b. I don't think that John must marry Susan. (# *must* > *not*)
 (Homer 2015)

This shows that *should* is a neg-raiser but *must* is not. Similar observations can be made for

[1]We would like to thank the audience at SuB27, the Workshop on Modality at Creteling Summer school, and the HU-Workshop on Multiple Modality. We are especially grateful to Cleo Condoravdi, Jacopo Romoli, Brian Buccola and Manfred Sailer for providing valuable feedback in different stages of this project.

other strong and weak necessity modals: weak necessity modals are neg-raisers, strong necessity modals are not.

In this paper, we aim to provide a strengthening account for neg-raising that explains why certain predicates may and others may not given rise to neg-raising readings. Moreover, we show how this approach can distinguish strong necessity and possibility modals from weak necessity modals and neg-raising predicates (NRPs). We then explain why weak possibility modals generally need to undergo strengthening, which makes them hard to detect.

2. Neg-raising

2.1. Existing approaches to NR and some challenges to them

Current standard approaches to NR, formulated in pragma-semantic terms, take NR readings to be the result of an excluded middle inference that is a special lexical property of NRPs (see Bartsch 1973; Horn 1989; Gajewski 2005a; Romoli 2013; Homer 2015, and Zeijlstra 2018, among others).[2] This approach has two versions:

(4) a. *The presuppositional approach* (Gajewski 2005b, 2007): NRPs come with an excluded middle *presupposition*.
  b. *The implicature approach* (Romoli 2012, 2013): NRPs have excluded middle *alternatives*.

The presuppositional approach (Gajewski 2005b, 2007) takes NRPs to carry an excluded middle presupposition. That is, the speaker is presupposed to be opinionated about the truth or falsity of the embedded proposition. The NR reading is then a logical consequence of this presupposition and the literal meaning of the sentence, as shown in (5).

(5) not [NRP [S]]
Assertion: $\neg$ NRP (S)
Presupposition: NRP (S) $\vee$ NRP $\neg$(S)
$\therefore$ NRP $\neg$(S) (Gajewski 2005a; p.14)

Under this account, the NR reading (6b) of (6a) follows straightforwardly.

(6) a. John doesn't think that Bill left.
  b. John thinks that Bill didn't leave.

With the excluded middle presupposition that the speaker thinks that either Bill left or Bill didn't leave, (6a) entails (6b):

(7) Assertion: It's not the case that John thinks Bill left.
Presupposition: John thinks Bill left $\vee$ John thinks Bill didn't leave.
$\therefore$ John thinks Bill didn't leave.

However, the universal projection of an excluded middle presupposition from the scope of negative indefinites turns out to be too strong in many contexts, as shown in the example below.

[2] There are also a syntactic approach to NR on the market, most notably Collins and Postal (2014). However, this syntactic approach suffers from several problems that have been addressed in the literature (Romoli 2013; Zeijlstra 2018; Mirrazi and Zeijlstra 2021), which is why we do not discuss it here. See the aforementioned references for more discussion.

For the NR reading in (8) to be true, not only should everybody have an acquaintance relation with the addressee but they should also have an opinion about whether or not the addressee is stupid:

(8) *It's the first day of school. Before entering the school your mom tells you:*
Remember, nobody here thinks you're stupid.

Apart from this, it is problematic for presuppositional approaches to NR that the NR reading does not always surface, as shown below (Homer 2015):

(9) a. Unlike many people nowadays, my great-grandparents didn't want to spend a lot of time on the internet.
b. $\not\rightsquigarrow$My great-grandparents wanted not to spend all their spare time on the internet.

(10) A*t a job interview:*
a. I don't want to make a lot of money, you know.
b. $\not\rightsquigarrow$I want not to make a lot of money.

For Gajewski this has lead to arguing that the NR inferences must count as so-called *soft presuppositions* after Abusch (1993).

Instead of assuming that the excluded middle inference is a (soft) presupposition, Romoli (2012, 2013) proposes that NRPs take the excluded middle as a lexical alternative. A NRP like *think*, then, has ($\textbf{think}_x$p $\vee$ $\textbf{think}_x\neg$p) as its lexical alternative, as shown in (11).

(11) $Alt(\textbf{think}\ \mathrm{p}(x))=\{\ \textbf{think}_x\mathrm{p}, \textbf{think}_x\mathrm{p} \vee \textbf{think}_x\neg\mathrm{p}\ \}$

The set of alternatives of (12) is given in (13a). Exhaustification of these alternatives will result in the strengthened NR reading (13b).

(12) John doesn't think that it is raining = $\neg\textbf{think}_j\ \mathrm{p}$

(13) a. $Alt(\neg\textbf{think}_j\ \mathrm{p})=\{\ \neg\textbf{think}_j\ \mathrm{p}, \neg(\textbf{think}_j\ \mathrm{p} \vee \textbf{think}_j\neg\mathrm{p})\ \}$
b. $[\![\textsc{exh}]\!](\neg\textbf{think}_j\ \mathrm{p})= \neg\textbf{think}_j\ \mathrm{p} \wedge \neg\neg(\textbf{think}_j\ \mathrm{p} \vee \textbf{think}_j\neg\mathrm{p}) =$
$\neg\textbf{think}_j\ \mathrm{p} \wedge (\textbf{think}_j\ \mathrm{p} \vee \textbf{think}_j\neg\mathrm{p}) = \textbf{think}_j\neg\mathrm{p}$

The scalar implicature account of NR has the advantage of not running into the projection problems of the presuppositional account. Moreover, as the generation of scalar implicatures depends on the contextual relevance of particular alternatives, the second problem addressed concerning the alleged presupposition failures does not arise either.

At the same time, Romoli's implementation of the implicature calculation is based on the assumption that NRPs have *lexical* alternatives, which are hardly pronounceable and are not attested elsewhere (Križ 2015).

A perhaps more pressing problem for both types of lexical approaches is that in certain contexts non-NRPs nevertheless get a NR reading, as illustrated below (where the lawyer must know what is constitutionally possible).

(14) Trump: I can overturn the result of the election.
Constitutional lawyer: I'm not sure that's constitutionally possible, sir.

(15) Anthony: you know why?
Uncle Junior: I don't know that I give a f***. (Sopranos, S1.E6)

Summing up, the discussion above shows that these semantic-pragmatic approaches to NR face particular non-trivial problems. One of the reasons is that the property that some predicate is a NRP must be lexically encoded (either as a (soft) presupposition or as part of its alternatives).

2.2. Proposal

For these reasons, we present a semantic-pragmatic account of NR that is non-lexical in nature. As it turns out, not only do the problems mentioned before for the lexical approaches disappear under our approach, but it also predicts a number of novel facts that can be observed in this domain.

Inspired by the recent implicature approaches to Free Choice inferences (Bar-Lev and Fox 2017), and Homogeneity (Bassi and Bar-Lev 2018; Magri 2014; Bar-Lev 2020), there has been new attempts to derive the neg-raising reading using the machinery of exhaustification (EXH) (Mirrazi and Zeijlstra 2021; Staniszweski 2021; Jeretič 2021). Below, we spell out the details of our own proposal presented earlier in (Mirrazi and Zeijlstra 2021), indicating where it differs from other exhaustification-based accounts as well.

The first ingredient of our analysis is that operations that apply to the LF of a particular utterance may also apply LFs that are strictly equivalent to the original LF, where strict equivalence is defined as follows:

(16) a. p is strict equivalent to q (p $\Leftrightarrow_{strict}$ q) iff p strictly entails q (p $\Rightarrow_{strict}$ q) and q strictly entails p (q $\Rightarrow_{strict}$ p)
b. p strictly entails q (p $\Rightarrow_{strict}$ q) iff in every world where p is true, q is true as well[3]

The reason for this is that LF operations apply to the meaning of an utterance p, i.e. the set of worlds where p holds, and should be blind to the way this meaning was originally structured. Pragmatic reasoning or any other operation that applies to LFs cannot distinguish between strictly equivalent LFs.

Strict LF-equivalence also requires presupposition conservation. We cash this out in a trivalent system, where the possible truth-values are 1,0 and #, where presupposition failure is marked by the third truth-value. Given the rules of strict duality, operations like EXH can apply to the dual of a negated universal modal, $\neg\forall w$: p(w), which is $\exists w$: $\neg$p(w), if and only if the two are strictly equivalent. This is indeed the case for non-factive epistemic modals, such as *think*. By (16), $\neg\forall w\in W$:p(w) $\Leftrightarrow_{strict}$ $\exists w\in W$:$\neg$p(w). The meaning of negated NR predicates is thus strictly equivalent to $\exists w\in W$:$\neg$p(w).

In what follows, we show that this existential LF, unlike the strictly equivalent negated universal counterpart, yields a strengthened NR reading under exhaustification. One of the major reasons to apply EXH to the existential dual $\exists w\in W$:$\neg$p(w) is that existential quantifiers, unlike universal quantifiers, can take singleton sets as their restrictor. This is important, as exhaustification over a set of domain alternatives that lacks singleton alternatives, as we will see later, will not be able to yield the strengthened NR reading. Thus, strict duality has a major advantage over

[3]We are grateful to Amir Anvari for his insightful comments that led us to adopt this notion of equivalence.

proposals that directly exhaustify LFs containing a negated universal quantifier over possible worlds (such as Jeretič (2021)).

Another advantage of strict duality is that it rules out certain predicates for being neg-raisers.[4] If strict duality does not apply, no NR reading can be yielded. Consequently, when some negated universal predicate does not have a strict existential dual, such a predicate cannot be a neg-raiser. This way, modals that carry presuppositions that block duality are excluded from NR. Factive *know* is a good example. Assume that $\Diamond K_p$ is the existential dual of the knowledge operator $\Box K_p$. When $\Diamond K_p$ also carries the factivity presupposition that the embedded p is true, strict LF-equivalence does not hold. While the negated universal version of know presupposes that its prejacent is true; the existential dual that outscopes negation presupposes that the same prejacent is false:

(17) $\underline{p(w) = 1}.\neg\Box K\ \underline{p(w)} \Leftrightarrow_{strict} \underline{\neg p(w) = 1}.\Diamond K\ \underline{\neg p(w)}$

Note that even when $\Diamond K_p$ doesn't carry any presupposition, strict LF-equivalence is still not valid. In a world where the factivity presupposition is not satisfied, $\neg\Box K\ p(w)$ is #, but $\Diamond K\ \neg p(w)$ is true:

(18) $\underline{p(w) = 1}.\neg\Box K\ \underline{p(w)} \Leftrightarrow_{\text{STRICT}} \Diamond K\ \neg p(w)$

As $\Diamond K\ \neg p(w)$ is not strictly equivalent to $\neg\Box K\ p(w)$, EXH cannot apply to $\Diamond K\ \neg p(w)$. Given that, as we will see later on, a strengthened NR reading can only be derived when the existential LF-equivalent is exhaustified, such a strengthened reading cannot be derived for factives like *know*. This means that it is not NRPs that are special in allowing NR inferences; it is rather strictly *non-*NRP*s* that are special in not allowing them. Strict non-NRPs, i.e. predicates that never yield NR readings, may carry a presupposition that is incompatible with their dual form. Then no *existential* reading can be derived that can be further strengthened.

Our second ingredient finds a parallel in the implicature account of Free Choice (Fox 2007; Bar-Lev and Fox 2017), and Homogeneity (Bassi and Bar-Lev 2018; Magri 2014; Bar-Lev 2020). In line with this approach, we take strengthened readings to be the result of the application of an exhaustivity operator at LF. Modals trigger subdomain alternatives (Zeijlstra 2011; Bassi and Bar-Lev 2018; Staniszewski 2021). Thus, in the exhaustification of modals, we will only make use of domain alternatives and not scalar alternatives. We adopt the definition of the exhaustivity operator (EXH) by Bar-Lev and Fox (2017).[5]

(19) Innocent Exclusion + Innocent Inclusionbased exhaustivity operator:
$[\![\text{EXH}]\!]^{IE+II}(C)(p)(w) \Leftrightarrow \forall q \in \text{IE}(p,C)[\neg q(w) \land \forall \in \text{II}(p,C)[r(w)]$

(20) Given a sentence p and a set of alternatives C:

[4]Note that without adding more, the assumption that exhaustification applies to the LF after applying DeMorgan laws (per Jeretič's suggestion) overgenerates neg-raising for all negated universal modals. To get the right result, one would need to further assume that DeMorgan laws do not work for certain modals. To motivate this assumption, a notion similar to strict equivalence would have to be employed again.

[5]We would like to clarify that we use the exhaustification mechanism without necessarily committing to its grammatical status. For our purpose, strengthening is a pragmatic phenomenon that can be triggered via the general principle of the Strongest Meaning Hypothesis (Dalrymple et al. 1998; Winter 2001; Yoon 1996). However, we think that the Innocent Exclusion + Innocent Inclusion–based exhaustification mechanism proposed by Bar-Lev and Fox (2020) provides a useful tool to formally talk about how the strengthening proceeds.

a. $\textsc{ie}(p,C) = \bigcap\{C' \subseteq C : C'$ is a maximal subset of C, s.t.
$\{\neg q : q \in C'\} \cup \{p\}$ is consistent }

b. $\textsc{ii}(p,C) = \bigcap\{$C" $\subseteq$ C : C" is a maximal subset of C, s.t.
$\{r : r \in$ C"$\}\cup\{p\}\cup$ $\{\neg q : q \in \textsc{ie}(p,C)\}$ is consistent }

According to the definition above, EXH takes a proposition (p), and a set of alternatives (C) as arguments, and returns the conjunction of all of the negated innocently excludable (IE) alternatives, and all of the asserted (assigned *true*) innocently includable (II) alternatives. The IE alternatives are all those that can be assigned *false* consistently with the prejacent. The II alternatives are those that can be assigned *true* consistently with the prejacent and the falsity of all IE alternatives. The NR reading is then derived via application of EXH, starting with the LF corresponding to the basic existential reading ($\exists w \in W$: $\neg$p(w)).

Let's assume the speaker's belief worlds consists of three worlds w_1, w_2 and w_3.

The alternatives generated from replacing the domain variable with its subsets in the existential reading are given in (21).

(21) $\exists w \in \{w_1, w_2, w_3\}$: $\neg$p(w), $\exists w \in \{w_1, w_2\}$: $\neg$p(w), $\exists w \in \{w_1, w_3\}$: $\neg$p(w), $\exists w \in \{w_2, w_3\}$: $\neg$p(w), $\exists w \in \{w_1\}$: $\neg$p(w), $\exists w \in \{w_2\}$: $\neg$p(w), $\exists w \in \{w_3\}$: $\neg$p(w)

No alternatives are IE. All alternatives are II.

Upon exhaustification, we will have (22), which is equivalent to the NR reading.

(22) $\textsc{exh}^{IE+II}$(Alt($\exists w \in \{w_1, w_2, w_3\}$: $\neg$p(w))) ($\exists w \in \{w_1, w_2, w_3\}$: $\neg$p(w)) =
$\exists w \in \{w_1, w_2, w_3\}$: $\neg$p(w) $\wedge$ $\exists w \in \{w_1, w_2\}$: $\neg$p(w) $\wedge$ $\exists w \in \{w_1, w_3\}$: $\neg$p(w) $\wedge$
$\exists w \in \{w_2, w_3\}$: $\neg$p(w) $\wedge$ $\exists w \in \{w_1\}$: $\neg$p(w) $\wedge$ $\exists w \in \{w_2\}$: $\neg$p(w) $\wedge$ $\exists w \in \{w_3\}$: $\neg$p(w)
= $\forall \boldsymbol{w} \in \{\boldsymbol{w}_1, \boldsymbol{w}_2, \boldsymbol{w}_3\}$: $\neg$p($\boldsymbol{w}$)

Note though, that not every non-NRP have particular presuppositions that render existential LF-equivalents impossible. For instance, strong modals like *must* or *need* do not do so. Hence, at this stage our approach may still overgeneralize. However, as we will see in the next section, the same reason why exhaustifying negated universals does not lead to strengthened NR readings, also will turn out to apply to the existential LF-equivalents of such modals.

The reader may wonder why EXH applies do the existential dual and not the the original negated LF containing the negated universal (as proposed in Jeretič (2021)). After all, $\exists\neg$p is strictly equivalent to $\neg\forall$p in the NR examples provided. The reason is that a universal quantifiers, unlike existentials, cannot take a domain of quantification that is a singleton set as their first argument[6] (witness the oddity of sentences like *Every current pope lives in Rome*). Hence, the set of alternatives of a negated universal does not contain any singleton alternatives, as shown in (23). Consequently, exhaustifiyng $\neg\forall$p(w) will not lead to the NR reading (24).

(23) $\neg\forall$p$w \in \{w_1, w_2, w_3\}$: p(w), $\neg\forall w \in \{w_1, w_2\}$: p($w$), $\neg\forall w \in \{w_1, w_3\}$: p($w$), $\neg\forall w \in \{w_2, w_3\}$: p($w$)

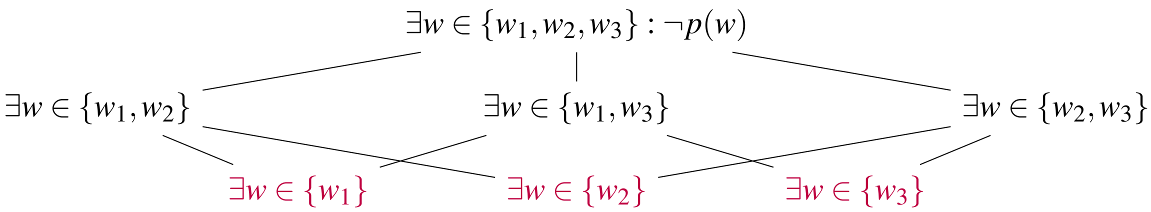
[6]The exhaustification procedure that Jeretič (2021) proposes involves alternatives of the form $\neg\Box_{\{w_1\}}p$, as shown below.

(i) Alt(S') = $\{$EXH[Alt(S)][$\neg\Box_{\{w_1,w_2\}}p$], EXH[Alt(S)][$\neg\Box_{\{w_1\}}p$], EXH[Alt(S)][$\neg\Box_{\{w_2\}}p$]$\}$
= $\{\neg\Box_{\{w_1,w_2\}}p, \neg\Box_{\{w_1\}}p \wedge \Box_{\{w_2\}}p, \neg\Box_{\{w_2\}}p \wedge \Box_{\{w_1\}}p\}$

(24) $\text{EXH}^{IE+II}(\text{Alt}(\neg\forall w{\in}\{w_1, w_2, w_3\}\text{: } (w)))(\neg\forall w{\in}\{w_1, w_2, w_3\}\text{: } \text{p}(w)) = \neg\forall w{\in}\{w_1, w_2, w_3\}\text{: } \text{p}(w) \wedge \neg\forall w{\in}\{w_1, w_2\}\text{: } (w) \wedge \neg\forall w{\in}\{w_1, w_3\}\text{: } \text{p}(w) \wedge \neg\forall w{\in}\{w_2, w_3\}\text{: } \text{p}(w)) \neq \boldsymbol{\forall w{\in}\{w_1, w_2, w_3\}\text{: } \neg\text{p}(w)}$

Our approach solves one of the main issues with the existing pragmatic-semantic approach to NR, namely that non-NRPs may yield NR readings too. As long as strict duality is obeyed every predicate in the right context may give rise to a NR reading, including the examples, such as the examples in (14).

But, as addressed before, another challenge to these approaches is that the alleged excluded middle presuppositions can actually be violated. The NR reading does not emerge obligatory. This, for us, does not follow from having the exhaustifier apply optionally as that would render its inclusion arbitrary, but rather from the systematic *pruning* of alternatives. Concretely, we follow again Bar-Lev's (2018; 2020) account of non-maximal readings of definite plurals, where we take the non-NR reading to be the result of pruning all the subdomain alternatives which are singleton sets (i.e. $\{w_1\}$, $\{w_2\}$, $\{w_3\}$).



By applying EXH to the set of alternatives in (25), like in the case of exhastified negated universals discussed above, we get the weak non-NR reading, as shown in (26).

(25) $\exists w \in\{w_1, w_2, w_3\}\text{: } \neg\text{p}(w)$, $\exists w \in\{w_1, w_2\}\text{: } \neg\text{p}(w)$, $\exists w \in\{w_1, w_3\}\text{: } \neg\text{p}(w)$, $\exists w \in\{w_2, w_3\}\text{: } \neg\text{p}(w)$

(26) $\text{EXH}^{IE+II}(\text{Alt}(\exists w \in\{w_1, w_2, w_3\}\text{: } \neg\text{p}(w))) = \exists w \in\{w_1, w_2, w_3\}\text{: } \neg\text{p}(w) \wedge \exists w \in\{w_1, w_2\}\text{: } \neg\text{p}(w) \wedge \exists w \in\{w_1, w_3\}\text{: } \neg\text{p}(w) \wedge \exists w \in\{w_2, w_3\}\text{: } \neg\text{p}(w)$

Pruning is a mechanism to reduce the set of alternatives to only those that are plausible and relevant in a given context, and it is governed by the following principles.

(27)
a. **Maxim of Relevance:** Every utterance must be relevant to Q.
b. **Weakening:** Pruning can only weaken the meaning (Crnič et al. 2015).
c. **Minimal pruning:** Don't prune more than necessary to satisfy (Bar-Lev 2020).

We saw that pruning the singleton worlds from the set of domain alternatives provides us with the right result, but under what conditions does pruning take place?

Following Kratzer (1989, 2012), we argue that singleton propositions predicated of the actual world are too specific to be cognitively viable. A plausible necessary condition for a cognitively viable proposition is that it should be possible for an actual human to believe it. Assuming that the person's beliefs are consistent, it follows that she has to be omniscient in a rather strong sense. Her beliefs have to be so specific that they are able to distinguish the actual world from all other possible worlds—including all of its perfect duplicates. We propose that the domain of alternatives can include singleton propositions if the actual world does not have to be among the set of worlds in the quantification domain of a modal. That is, when believing in a singleton proposition does not require strong omniscience. Therefore, strengthened NR readings are predicted to be only possible for such modals. In such cases, consideration of a broader domain of alternatives leads to a stronger statement.[7]

Under this view, the (un)availability of strengthened NR readings for duality-allowing universal modals depends on which set of alternatives EXH applies over. When EXH applies over the whole set of subdomain alternatives, we get the strengthened reading. When EXH applies over the subset remained after pruning singleton sets, we get the weak reading. Reference to the actual world in the domain of quantification triggers the difference here. Singleton set alternatives are necessarily pruned when the quantification domain of modals includes the actual world. This is indeed the case with strong modals like *must* or *have to* and modals that expresses objectivity or evidentiality. The actual world is unique and its inclusion in the quantification domain of modal renders a non-homogeneous set. Distinguishing the actual world from all other possible worlds is not cognitively viable (Kratzer 2012). The question is to what extent this constraint on singleton alternatives can be extended to strong modals in general. In the rest of this paper, we will pursue this idea.

3. Modality and Anchor Semantics

In the previous section, we introduced a pruning system that is sensitive to the kind of worlds in the quantification domain of modals. A corollary of this proposal is that modals differ in whether or not their domain includes the actual world. In this section, we argue that this is what is behind the intuition about the weakness of *should* and *ought* (see also Silk (2016, 2018, 2022)). We follow Mirrazi (2022) who implements this insight about the semantics of weak necessity modals in the framework of Anchor Semantics (Arregui 2009; Kratzer 2013; Kratzer et al. 2014; Kratzer 2020). Before explaining the details of our proposal, we first need to lay out our assumption about the semantics of modals.

3.1. An Anchor Semantics for modals

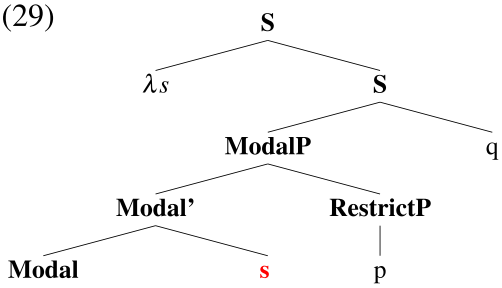
In the standard Kratzerian framework, modals differ in two dimension: (i) the type of quantification over possible worlds (modal force), and (ii) the worlds included in their domain of quantification (modal base). The former is typically lexically encoded in the semantics of modals, but the latter is determined by an interplay of contextual factors, at least in most European languages.

We adopt the *Anchor semantics* for modals proposed by (Kratzer 2013), according to which the modal base is constructed out of two ingredients: a modal anchor which projects the initial domain, and a modal restriction that determines the final domain. The quantificational domain of modals is initially determined by taking a situation from the actual world (the *anchor situation*), and considering the set of possible worlds that have an exact match of that situation (Kratzer 2020). This conjecture, dubbed *factual domain projection*, is defined below.

[7] Note that we are not suggesting that the reasoner (i.e. the hearer) has to decide on the truth or falsity of every singleton proposition separately. They can assign true to all singleton propositions when a set of worlds are all of a particular kind. The reasoning process breaks when the worlds are taken (by the reasoner/hearer) to be candidates for the actual world. A quantification domain that includes the actual world is not a homogeneous set as one (and only one) world necessarily differs from other worlds in being the actual world.

(28) **Factual Domain Projection (Kratzer 2020)**
For any part of a (maximal) situation s, $f_{act}(s)$ is the set of possible (maximal) situations that have an *exact match* of s.

Philips and Kratzer (2022) take this basic capacity of considering possible extensions of an actual anchor situation as a common component of many, apparently different, types of modal cognition. Moreover, the factual domain projection captures the intuitive idea that even in our modal claims, we are concerned with worlds that we take to be candidates for the actual world. It is clear that the initial domain of unembedded modals includes the actual world as it has the exact match of a piece of itself (unless the modal domain is projected from a particular individual's mental state that might be in conflict with the actual world (see Kratzer (2020) and Philips and Kratzer (2022) for examples of epistemicky anchors). Following Mirrazi (2022), we take the anchor situation to be the first argument of a modal, as shown below.

(29)


(Mirrazi 2022)

Like other variables, the value of the anchor situation depends on its place in the structure. In an unembedded sentence, the anchor situation takes its value from the evaluation situation.

(30) **Modal Anchor Impact (Kratzer 2020)**
The anchor situation of a modal is identical to the evaluation situation of the smallest constituent that contains the modal and its scope.

The choice of anchor situations is subject to the *Diversity Condition* that states that the anchor must be chosen such that the projected domain has both worlds where the modal's prejacent is true and worlds where it is false (see also Condoravdi 2002; Werner 2003; Giannakidou and Mari 2016). The initial modal domain projected from the anchor is further restricted by contextually supplied modal restrictions that allow for certain worlds in the projected domain to be ignored. Kratzer (2020) proposes that *contextual restrictions have to be provided from the prospective common ground*, which is the common ground as it stands after the claim in question has been made and negotiated (Stalnaker 2014; Mandelkern 2020).

(31) **Prospective Contextual Modal Restrictions**
Modal restrictions have to be provided from the *prospective common ground* (Kratzer 2020), which is the common ground as it stands after the claim in question has been made and negotiated (Stalnaker 2014; Mandelkern 2020).

Kratzer (2020) argues that since a Stalnakerian notion of common ground can have false presuppositions in it, the proposal, as it stands, predicts weak truth-conditions for strong modal claims with *must*. She proposes a constraint to allow strong modal claims to be false even when they would follow from speakers' false presuppositions. The constraint states that the world of anchor must be in the context set ($w_s \in C$). Mirrazi (2022) points out that this constraint together with *Prospective Contextual Modal Restrictions* entails that the modal restrictions of strong necessity modals should be compatible with a factive common ground ($p \cap C \neq \emptyset$). Therefore, the actual world remains in the final quantification domain of strong modals. The denotation of a strong universal modal such as *must* is given below.[8]

(32) $$[\![\Box_{strong}]\!] = \lambda s.\ \lambda p : \underline{p \cap C \neq \emptyset}.\ \lambda q.\ (\underline{w_s \in C}\ \wedge\ \forall w(w \in f_{act}(s) \cap p \rightarrow \exists s' \exists s''(s' \leq w\ \wedge\ s'' \leq w\ \wedge\ Match(s', s)\ \wedge\ R(s'', s')\ \wedge\ q(s''))))$$
(Mirrazi 2022)

R represents a contextually supplied relation that maps the match of the anchor situation to a situation where the modal's prejacent is evaluated. The truth-conditions state that in all the worlds projected from the anchor situation ($\forall w(w \in f_{act}(s_0))$ and in which the modal restriction p holds ($\cap p$), the match of the anchor situation bears the contextual relation R to a situation in which the prejacent q is true. The constraint that the context (C) includes the world of anchor (w_s), together with the condition that modal restrictions should come from prospective Common Ground, keeps the truth-conditions of the modal claim strong.

3.2. Weak necessity modals

Traditionally, universal modals have been divided in two categories: strong necessity and weak necessity modals. They are called like that as statements containing strong necessity modals (such as *must* or *have to*) entail a corresponding claim with a weak necessity modal (such as *should* or *ought to*), but not vice versa. The following examples illustrate the entailment relation between strong and weak necessity modals.[9]

(33) a. You should/ought to leave but you don't have to leave / it's not that you must leave.
b. You have to/must leave, # but you shouldn't/ought not to leave.

(34) a. You should/ought to leave; in fact you have to/must leave.
b. You have to/must leave; # in fact you shouldn't/ought not to leave.

von Fintel and Iatridou (2008) and von Fintel and Iatridou (2020) observe that many languages morphologically use the same morphological strategy they use to mark the difference between X-marked and O-marked conditionals to distinguish between weak and strong universal modals. For instance, the strong necessity modal *must* in Hungarian can take the X-marker *-nA*, and express the meaning of weak necessity.

(35) Péter-nek el kell-**ene** mosogat-ni-a az edény-ek-et, de senki nem
Peter-DAT PRT must-**nA** was-INF-3SG the dish-PL-ACC but noone not

[8] Following von Fintel and Gillies (2010, 2021); Kratzer (2020); Silk (2016, 2018, 2022), among others, we take *must* to be a strong modal, but see Giannakidou and Mari (2016) and Lassiter (2016) for counter examples to this view, and Kratzer (2020) for an account of these apparently conflicting data.

[9] There are different approaches in the literature to explain the difference between the weak and strong necessity modals that we will not discuss here (see Rubinstein (2020) for an overview). Our aim here is to show that our proposal about the defining role of the actual world in the (un)availability of strengthening, which is in line with Silk's account of the distinction between weak and strong necessity modals, make correct predictions about the cross-linguistic picture of modals' strength.

követeli meg tőlle.
require-3SG.SUBJ-3.OBJ part 3.SG.ABL
'Peter ought to do the dishes, he is not obliged to.'

Without *-nA* on the strong necessity modal, the sentence will be a contradiction.

(36) #Péter-nek el kell mosogat-ni-a az edény-ek-et, de senki nem
Peter-DAT PRT must was-INF-3SG the dish-PL-ACC but noone not
követeli meg tőlle.
require-3SG.SUBJ-3.OBJ part 3.SG.ABL
'Peter has to do the dishes, he is not obliged to.

A somewhat similar pattern can be seen in English which uses its past tense morphology in X-marked contexts. Past form of modals *would* (for *will*) and *should* (for *shall*), which can appear in X-marked conditionals, imply weakness. Strong modals *must* and *have to* never appear in X-marked conditionals, as shown in (37). von Fintel and Iatridou (2020) argue that a common denominator of X-marking meaning in all of its occurrences is to indicate a departure from the default.

(37) a. If she had taken the train yesterday, she would/should have arrived by now.
b. *If she had taken the train yesterday, she must/had to have arrived by now.

Silk (2022) proposes that the difference between weak and strong modals is whether or not they predicate the necessity of their prejacent of "the actual world". While the truth of $\Box_{strong}\phi$ depends on the value of ϕ at the evaluation world, $\Box_{weak}\phi$ brackets away whether the necessity claim is verified in the actual world. Adopting the general insight that X-marking signals that the worlds being talked about needn't be candidates for actuality, Silk (2022) derives the apparent weakness of weak necessity modals from the meaning contribution of X-marking, i.e. canceling a presupposition that the set of worlds in a modal's domain of quantification is a subset of the context set. He frames this idea in a past-as-modal approach to X-marking. Here, we follow Mirrazi (2022) who implements this general insight in the framework of Anchor Semantics with a past-as-past approach to X-marking.[10]

Following Arregui (2009), Mirrazi (2022) takes the role of the past tense in X-marked modals to determine the temporal specification of the anchor situation. She proposes that the pastness of the anchor situation affects the semantics and pragmatics of X-marked modals. Unlike the anchor situations of strong modals, they do not invoke the condition that the world of the anchor has to be in the context set. This allows for the modal restrictions to be incompatible with the presuppositions of factive common ground[11], which in turn can lead to the exclusion of the actual world from the final quantification domain of these modals. According to this view, X-marked weak necessity modals contribute the same assertoric information as strong modals but yield weaker truth conditions because they lack the presupposition ($w_s \in C$) that strong modals carry. Compare the denotation of weak necessity modals given below with that of strong modals in (32).

[10]We are using a past-as-past approach, which is compatible with the Anchor Semantics, but the general point we are trying to make here (defining the strength of modals in terms of the inclusion of the actual world) is independent of the role of past tense morphology in X-marking.
[11]Philips and Kratzer (2022) also take the weak necessity *should* to indicate the presence of restrictions that depart from the default.

(38) $[\![\Box_{weak}]\!] = \lambda s.\ \lambda p.\ \lambda q.\ \forall w(w \in f_{act}(s) \cap p \rightarrow \exists s' \exists s''(s' \leq w\ \wedge\ s'' \leq w\ \wedge$ $Match(s', s)\ \wedge\ R(s'', s')\ \wedge\ q(s'')))$ <u>where s is a past situation.</u>

(Mirrazi 2022)

Note that weak modals are semantically compatible with a strong reading. The actual world is not necessarily excluded from the domain. If there's a stronger alternative available, the use of weak modal generates an implicature that either the restrictions or prejacent of the modal are not compatible with the factive context set. Strong modals, on the other hand, are predicted to be infelicitous when the modal restrictions are not compatible with the factive context set.

Let us take stock here. In the previous section, we postulated that pruning mechanism is sensitive to whether or not the actual world is part of the quantification of modals. We have shown that the importance of the actual world in defining the properties of modals is not an ad hoc assumption, and has been independently proposed by Silk (2022); Mirrazi (2022) who aim to systematically derive the difference between weak and strong modals from the contribution of X-marking, as well as by Philips and Kratzer (2022) who are concerned with a more fundamental question about humans' cognitive capacity for modal thought. In this light, we propose that the nature of worlds in the domain of modals, in addition to the modal force, contribute to the strength of modals. We dub this notion of strength as *Actuality Strength*.[12]

(39) **Actuality Strength**
  a. The final quantification domain of strong modals includes the actual world.
  b. The final quantification domain of weak modals may or may not include the actual world.

4. Weak possibility modals

In principle, this distinction must be extendable to possibility modals. This way, four types of modals should expected to be attested across languages: strong and weak necessity modals, and strong and weak possibility modals. This seems to be a correct prediction when we look at X-marked contexts. Similar to what we observed about the contrast between weak and strong necessity modals in (37), only past form possibility modals *might* and *could* appear in X-marked, as shown below.

(40) a. If I had looked in my pocket, I might/could have found a penny.
  b. *If I had looked in my pocket, I may/can have found a penny.

However, these X-marked possibility modals, unlike X-marked necessity modals, do not yield a weak reading outside of X-marked contexts. *Could* and *might* are not perceived as weaker alternatives to *can* and *may*. No entailment relationship holds between these two groups of possibility modals.[13]

[12]Not all languages morphologically distinguish between weak and strong necessity modals. In such languages, e.g. Farsi, the necessity modal is compatible with both interpretations. The use of adverbs such as *definitely* or *probably* can disambiguate between the two readings.

(i) (šayad/hatman) bayad ba-š harf be-zan-i.
  probably/definitely NEC to-her talk IMPF.SUBJ-hit-2SG
  'You should talk to her./ You must to her.'

[13]Note that this is possible when they imply counterfactuality.

(i) I'm always the one they really wish they could've been with but can't.

(41) a. You could/might leave # but you can't / may not leave.
b. She could/might be in her office; # in fact, she can/may be in her office.

Weak possibility modals appear to be rare cross-linguistically. Javanese provides a strong evidence for this cross-linguistic tendency. Vander Klok and Hohaus (2020) observe that Javanese has a dedicated functional morpheme, -NE, which combines with a strong necessity modal to derive a weak one. Crucially, Vander Klok and Hohaus (2020) show that -NE is not an X-marker.

(42) a. Bal-e mesthi neng C.
ball-def epis.nec in C
'The ball must be in C.'

b. Bal-e mesthi-ne neng C.
ball-def epis.nec-NE in C
'The ball should be in C.'

Interestingly, -NE cannot occur with possibility modals to derive weak possibility.

(43) Aku iso-(*ne) ngelangi.
1sg circ.pos-NE av.swim
'I can swim.' (Vander Klok and Hohaus 2020)

The question naturally is how we can account for the rarity of weak possibility modals. We believe that the notion of Actuality Strength provides an answer to this question. Given Actuality Strength, a weak possibility modal is an existential quantifier over possible worlds that are not necessarily candidates for the actual world. However, not presupposing the inclusion of the actual world in the quantification domain of an existential modal leads to an extremely weak meaning: a proposition is merely true in *some* possible world, where the chosen world *doesn't have to be a candidate for the actual world*. If this proposition is not to imply a counterfactual reading (in a language like Javanese, for instance, which has a different X-marker), the meaning is trivially true for every proposition that is not an impossibility, and irrelevant to the question under discussion, as most of our utterances are concerned with what is true in the actual world. The reason is in general possibility modal claims are proposals to make the prejacent compatible with the common ground (Mandelkern 2020). A weak possibility modal claim (which does not imply X-marked interpretation) then would amount to saying that while p is not a live possibility in the common ground, it is compatible with the worlds outside of the context set. This would only be an informative assertion if it is stated as a rejection of a negated strong existential modal claim i.e. ($\neg\Diamond_{strong}p$). Since natural language avoids triviality (Chierchia 2013 *et seq*), lexical items with a high probability of rendering triviality are expected to be rare.

As for X-marked possibility modals in English, one should note that there is nothing in the semantics of weak modals that forces the exclusion of the actual world. An integral part of the inquiry into the meaning of X-marked conditionals is the observation that they do not always imply falsity of their antecedent. For instance, the seminal observation by Anderson (1951) shows that they can be used to argue for the truth of the antecedent.

(44) If Jones had taken arsenic, he would have shown just exactly the symptoms that he does in fact show.

Given that the resulting reading when the exclusion of the actual world is assumed is too weak, the statement containing an X-marked possibility modal is interpreted as having the strongest meaning that is compatible with other assumptions in the context of utterance. There are two ways that can generate such a strong reading. The first option, which is exploited in English for the interpretation of X-marked possibility modals, is to take the actual world to be in the domain of quantification provided that the modal restrictions are compatible with the presuppositions of factive context set. This yield a strong possibility reading, as in (41). The second option, when the modal claim depends on restrictions beyond the default, is to strengthen the modal claim to a weak necessity reading along the line we proposed for the neg-raising reading. The latter strengthening mechanism is only expected outside of downward entailing contexts. Hungarian provides evidence for the second strategy, as shown below, though note that in Hungarian, a possibility modal in X-marked contexts also carry -nA.

(45) Péter el-mosogat-hat-ná az edényeket.
Péter prt-was-can-cond the dishes.acc
'Peter should wash the dishes.'
(X-marked interpretation: Peter could wash the dishes (but he isn't).)

(46) Ha belenéz-t-em vol-na a zsebembe, talál-hat-t-am volna egy pennyt.
If in-look-pst-1sg was-cond the into.pocket find-can-pst-1sg was-cond a penny
'If I had looked into my pocket, I could have found a penny.'[14]

In downward entailing contexts, however, only a possibility interpretation is available.

(47) Az iskolában Péter nem mosogat-hat-ná el az edényeket.
In the.school Péter not wash-can-cond prt the dishes
'In the school, Peter isn't allowed to wash the dishes.'

We also expect to find languages with possibility modals that are lexically underspecified with respect to whether they makes reference to the actual world. We predict these modals to be ambiguous between a strong possibility reading (if the actual world is in the final domain) and a weak necessity reading outside of downward entailing environments (if the existence of a modal restriction beyond the default leads to the exclusion of the actual world from the final modal domain). In terms of our world-sensitive pruning, the inclusion of the actual world in the modal base should lead to the unavailability of necessity readings; only modals that do not presuppose the inclusion of the actual world in their domain of quantification can give rise to a universal reading via exhaustification. This is precisely the pattern Newkirk (2022a, b) reports on Kinande, for which she shows that it has a variable-force modal prefix *anga* whose meaning only varies between possibility and weak necessity, never to strong necessity.[15]

(48) Kabunga a-anga-na-sya oko kalhasi ko munabwire.
Kabunga 3SG-MOD-T-come PREP class PREP today
'Kabunga might come to class today'
'Kabunga should be coming to class today'
#'Kabunga must be coming to class today' (Newkirk 2022a)

[14]We are grateful to János Egressy for the Hungarian data.

[15]Similarly, Staniszweski (2021) proposes that weak necessity modals like *should* and *supposed to* are existential quantifiers over possible worlds. In upward entailing environments, this existential reading is strengthened to a weak necessity modal via $\textsc{exh}^{IE+II}$. He assumes that the weakness is due to pruning of all alternatives that quantify over worlds in which one doesn't feel good (equivalent to the secondary ordering source in the system of von Fintel and Iatridou (2008)).

As predicted, *Anga* loses its ambiguity when negated.

(49) Kambere si-anga-bi-a eká yó lino.
Kambere NEG-MOD-be-FV home PREP now
#*‘Kambere doesn’t have to be at home now.’*
‘Kambere can’t be at home now.’ (Newkirk 2022a)

5. Further Predictions

Introducing the notion of Actuality Strength, we predict that there should be cases where strong modals (possibility and necessity) pattern together to the exclusion of weak modals. This is precisely what we observe in (50).[16] While both strong possibility and necessity modals are incompatible with the denial of the prejacent, weak necessity modals are felicitous in such a context. In some sense, weak necessity modals are perceived as weaker than a possibility modal claim.

(50) a. # It must/may/might be raining, but it isn’t.[17]
b. It should/ought to be raining, but it isn’t.

This follows from the notion of Actuality Strength. Strong modals have the actual world in their final domain of quantification, and thus cannot be followed with a contradictory claim that the prejacent is false in the actual world.

Another place where strong possibility and necessity modals pattern together is in neg-raising contexts. Note that weak necessity modals, unlike strong necessity and possibility modals align with NRPs.

(51) a. I don’t think that John should marry Susan (OK NR with *should* $>$ *not*)
b. I don’t think that John must marry Susan (# NR with *must* $>$ *not*).
c. I don’t think that John may marry Susan (# NR with *may* $>$ *not*).
(Homer 2015)

This indeed is fully in line with our proposal. As strong, but not weak necessity modals have the actual world in their domain of quantification, the singleton alternatives of negated strong necessity modals (but not of weak necessity modals) will be pruned under exhaustification. Hence, negated necessity modals can never give rise to NR readings.

6. Conclusions

In this paper, we have provided a non-lexical account of NR in terms of exhuastification (Bar-Lev 2018, 2020). We also introduced a world-sensitive pruning mechanism according to which the inclusion of the actual world in the final domain of NRPs leads to the pruning of all singleton alternatives. Applying EXH to the set of alternatives after pruning singleton alternatives does not yield a NR reading. We motivated this pruning mechanism with appealing to Kratzer’s notion of cognitively viable propositions. Assertion of singleton propositions whose worlds in their domain are taken to be candidates for the actual world (strong modals) need omniscience in a rather strong sense, and are thus not cognitively viable. Holding that duals are the same in

[16] A full-fledged account of this contrast is beyond the scope of this paper but we think the solutions offered by Kratzer (2020) for (50) within the Anchor Semantics, and by Silk (2022) for the difference between weak and strong necessity modals in (50) can be consistently adopted in our system.
[17] See Yalcin (2007) for an account of this anomaly in terms of *epistemic contradiction*.

the Actuality Strength (inclusion of the actual world), our account derives Horn's generalization that strong universal modals are never neg-raising predicates.

We then extended this idea about the importance of the actual world in determining NRPs to properties of modals in general. We showed that our account makes several predictions that are borne out:

- Only possibility modals whose domain doesn't include the actual world can and in principle must be strengthened (unless the superweak meaning is clearly intended) via exhaustification along the lines of Bar-Lev (2018, 2020).
- The strengthening process does not change the notion of strength in terms of the inclusion of the actual world. Thus, weak possibility modal are predicted to be strengthened to weak necessity modals.
- Strong modals share properties that weak modals lack, irrespective of the modal force.

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The Anaphoric Potential of Weak Definites[1]

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Abstract. Weak definites (WDs) as in *Max went to the cinema* differ from regular definites insofar as *the cinema* does not refer to a uniquely identifiable cinema. In this paper I propose that investigating the discourse properties of WDs helps us to distinguish and decide between various theories of WDs that have been proposed. I present two experiments in German. The first shows that WDs can be referred to by pronoun but less straightforwardly than anaphoric reference to indefinites lending support to the model initially proposed by Krifka & Modarresi (2016) for anaphoric potential of pseudo-incorporated nouns. The second experiment shows that anaphoric reference to WDs is distinct from associative anaphora, in contrast to predictions that analyze weak definites as reference to kinds.

Keywords: weak definites, referentiality, discourse properties, anaphora

1. Properties of Weak Definites

An expression is definite, by standard definition, when it refers to a uniquely identifiable referent (Russell, 1905; Neale, 1990), potentially restricted to a set of salient or familiar entities (Heim 1982, 1983). In many languages it is often signalled by using definite articles. However, there is a well-known family of definites descriptively referred to as **Weak Definites** (henceforth WDs) that behave differently from standard definites (Poesio 1994, Carlson & Sussman 2005, Bosch 2010, Schwarz 2013, 2014). Crucially, this kind of definites do not seem to require uniqueness. The difference is illustrated in (1) *going to the building* versus (2) *going to the cinema*. In (1a), *building* is marked by a definite article and refers to a uniquely identifiable building. In the continuation sentence (1b), it is stated that Mary went to the same (uniquely identifiable) building. In (2a), on the other hand *the cinema* does not necessarily refer to a uniquely identifiable cinema. In the continuation sentence (2b), Mary could have gone to a different cinema. The definite marked noun *cinema* in (2) is an example of a WD.

(1) a. Max went to **the** building. (single salient uniquely identifiable building)
 b. Mary did too. (it has to be the same building)

(2) a. Max went to **the** cinema. (not necessary for the referent to be identifiable cinema)
 b. Mary did too. (they possibly went to different cinemas)

WDs exhibit other peculiar properties such as **narrow scope** with respect to other quantifiers as shown below in (3a) in contrast with regular definite in (3b). As such, WDs appear to be like narrow scope **indefinites** (IDs) as in *going to a cinema.*

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(3) a. Everybody went to the cinema. (perhaps everybody went to a different cinema)
b. Everybody went to the building. (it has to be the same building everyone went to)

While (3a) makes WD looks like indefinites, WDs have a **number-neutral reading** as in *Max took the train to Munich* (it could be that he took one or more train) and in this respect they are different from indefinites e.g. *Max took a train to Munich.* WDs also contribute to an **enriched meaning** referring to a conventionalized activity; for instance, *going to the hospital* means not only going to the relevant location but also for the purpose of receiving medical care (Aguilar-Guevara, 2014; Schwarz, 2014). In these properties, WDs are similar to so-called pseudo-incorporated objects (cf. Massam 2017).

2. How do we account for the behavior Weak Definites?

Various theories have attempted to capture the properties of WDs. A successful theory should be able to address all the properties of WDs, preferably without violating the standard analysis of definiteness as a marker of uniqueness. In this paper I propose that investigating the discourse properties, in particular the **anaphoric accessibility** of WDs, is a key feature to distinguish between different theories. In what follows I start with investigating discourse properties of WDs and then discuss different theories in terms of their predictions concerning anaphoric potential of WDs.

2.1. Discourse properties of weak definites:

Previous accounts take Weak Definites as not supporting anaphoric reference in subsequent discourse, or at least not to the same extent as regular definites (see Scholten and Aguilar-Guevara, Schwarz 2014)**.** However, Scholten & Aguilar-Guevara 2010 present examples showing that "although pronouns referring back to WDs do not sound as 'natural' compared to pronouns referring back to definites and indefinites, they are certainly more acceptable than those with bare singulars as antecedents". Examples from Scholten & Aguilar-Guevara 2010:

(4) I checked <u>the calendar</u> when I was planning my appointments and put <u>it</u> back in my desk.
(5) $^{??}$Lola is still at <u>school</u> because today her class had to help to clean <u>it</u>.

Discussing the properties of WDs in English is difficult, as they are expressed in the same way as regular definites. For example, *the calendar* in (4) could also be a regular definite, referring to a unique calendar. In order to discuss the properties of WDs it is useful to switch to a language that has a particular morphosyntactic marking of WDs that sets them apart from regular definites. This is at least partially the case for German, and more generally in German dialects (cf. Schwarz 2009); it was first identified for North Frisian (Ebert 1971). Standard German has a morphosyntactic means to distinguish between regular definites as in (6a) and WDs as in (6b), when in the complement of certain prepositions, which combine with the definite article (e.g. *in das* > *ins*). They are contrasted to indefinites as in (6c) (cf. Nübling 2005, Schwarz, 2014).

(6) a. Max ist **in das Kino** gegangen. Regular definite
‘Max went to the cinema’
b. Max ist **ins Kino** gegangen Weak definite; enriched meaning
‘Max went to movies’
c. Max ist **in ein Kino** gegangen. Indefinite
‘Max went to a cinema’

(6b) represents a WD with the enriched meaning ‘going to a cinema to do the stereotypical activity, i.e. to watch a movie’. However, even this sentence is ambiguous because *ins Kino* can also refer to a unique or most salient entity given by the world knowledge of the interlocutors (as e.g. in *zum Mond* ‘to the Moon’). But in a context of a larger city with many cinemas, this potential reading of *ins Kino* can be neglected. Even when excluding the referring reading, anaphoric reference to the cinema is possible:

(7) Max ist gerne in Berlin, da es dort viel zu erleben gibt. Gestern ist er **ins Kino** gegangen. **Es** war riesig groß und hatte weiche Plüschsessel.
‘Max likes to be in Berlin, as there are many things to do. Yesterday he went to the cinema. It was very large and had soft velvet armchairs.’

Krifka & Modarresi (2016) observe other discourse properties for WDs that sets them apart from indefinites. First, WDs allow for possibly plural anaphoric reference despite their singular morphology, as illustrated in (8) and (9). Here, the combination of prepositions with the definite article is not visible in standard orthography (*mit dem*) but could be realized in spoken varieties (*mit’m*).

(8) Max ist **mit dem Zug** nach Paris gefahren. **Der Zug / die Züge** waren aber nicht pünktlich.
‘Max went by train to Paris. But the train / the trains were not on time.’
(9) Max ist **mit einem Zug** nach Paris gefahren. **Der Zug** / ??**die Züge** waren aber nicht pünktlich.
‘Max went with a train to Paris. But the train / ?? the trains were not on time.’

Another difference is that WDs lead to a maximality interpretation. In (10), *mit dem Zug* is understood as referring to all the trains that were used by Max to go to Paris.

(10) Max ist **mit dem Zug** nach Paris gefahren. ??Er musste dazu einen zweiten Zug nehmen.
‘Max went by train to Paris. He had to take a second train for that.’
(11) Max ist **mit einem Zug** nach Paris gefahren. Er musste dazu einen zweiten Zug nehmen.
‘Max went with a train to Paris. He had to take a second train for that’

In the following, I will discuss various theoretical proposals that have been developed for WDs, in particular with respect to their prediction about their anaphoric potential, as illustrated in (7). This includes proposals that have been made for pseudo-incorporated objects, as they show similarities to WDs. In particular, I will discuss theories that analyze them as **reference to kinds**, cf. Aguilar-Guevara & Zwart (2010); as denoting a **property**, cf. van Geenhoven

(1998), as involving meaning compositions by **restriction and saturation**, cf. Ladusaw & Chung (2003), as involving **reference to unique entities in situation**, cf. Dayal (2011), Schwarz 2014), as **introducing number neutral discourse referents**, cf. Modarresi (2015), and as involving **event kinds**, as in Schwarz (2013).

We will see that these approaches predict either that WDs do not support anaphora at all, or that they support anaphora just as easily as indefinites do. The only theory that clearly predicts a more nuanced pattern of anaphoricity is Krifka & Modarresi (2016), according to which WDs can be taken up by anaphora but in a more complex way that leads to a slightly reduced anaphoric potential. I will discuss this analysis and provide experimental evidence to support it. In the next section I present different predictions by the current proposals, considering anaphora as a key feature in our discussion then I present experimental data to support it.

2.2. WDs as reference to kinds?

One proposal for weak definites and pseudo-incorporated nouns assumes that they refer to kinds rather than object entities (Aguilar-Guevara & Zwart 2010). The kind analysis accounts for the occurrence of the definite article in spite of the apparent lack of uniqueness, as kinds are typically related to many specimens (cf. the account of Carlson 1977 for generic and episodic sentence). While the kind analysis appears plausible when considering it in isolation, it fails to account for the anaphoric behavior of such nominals.

Aguilar-Guevara & Zwarts couch their kind analysis within an event semantics. It is illustrated in ((12), where L represents the subject argument *Lola*, the Agent of the event. R is a relation that relates specimens to their kinds; R(x,k) states that x is a specimen of the kind k. Th(e) is the theme of the event e; it stands in a specimen-relation to C, the kind of Calender. U(e,C) states that e is a "stereotypical usage" of the calendar kind C. The definite DP *the calendar* is type-shifted to kinds, following Chierchia (1998).

(12) *Lola checked the calendar.*
$\exists e[\text{check}(e) \wedge \text{Ag}(e)=L \wedge R(\text{Th}(e),C) \wedge U(e,C)]$.

Without going into further details, we see that this representation is taken to predict that uptake of C as in (4) is not possible (also see Schwarz (2014) and Espinal & Cyrino (2017) for a critical discussion of the kind-referring analysis of weak definites). The representation (12) only provides for the kind Calendar, not for the particular calendar, the theme of e Th(e), that Lola checked.

To be sure, anaphoric reference to kinds is possible when the anaphoric uptake is itself an argument of a kind level predicate, as with *it* in (13). It is also possible to introduce a new specimen with the partitive anaphor *one*, or several new specimens with *some*, as shown in the third sentence of (13). However, reference to a particular specimen is excluded.

(13) Shockley invented <u>the transistor</u>. <u>**It**</u> revolutionized the economy. My grandfather bought *<u>it</u> / <u>one / some.</u>

However as shown before and repeated in (14), anaphoric reference to weak definites object is in fact possible, hence different from anaphoric reference to kinds as in (13).

(14) *Lola was about to check the calendar but then dropped it / # one* (in intended reading)

Thus, it seems, with respect to anaphoric uptake, the kind account does not represent WDs in an appropriate way.

2.3. WDs as reference to properties?

I now turn to a close relative of the kind proposal. According to this proposal, WDs denote properties, e.g. *the cinema* denotes the property $\lambda x[\text{cinema}(x)]$, which is rendered here extensionally for simplicity (Van Geenhoven 1992, Mc Nally 1995, Cohen & Erteshik-Shir 2002, Dayal 2011, Espinal & Mc Nally 2011, Carlson & Sussman, 2005; Dayal, 2011). These properties are incorporated into the verbal predicate, similar to the phenomenon of noun incorporation in West Greenlandic (Van Geenhoven, 1992). The verbal predicate contains an existential quantifier that introduces a variable that satisfies both the argument position of the verbal predicate and the nominal property. This is illustrated in (15).

(15) *Zoe went to the cinema.*
$\lambda P \exists x[P(x) \wedge \text{go-to}(x)(z)](\lambda x[\text{cinema}(x)])$
$= \exists x[\text{cinema}(x) \wedge \text{go-to}(x)(z)]$

Although proponents of the property analysis do not discuss the anaphoric potential of these nominals, the account predicts that anaphoric uptake to the entity is impossible, as the existential quantifier has narrow scope with respect to the verbal predicate. However, if we turn to a dynamic framework and assume that the existential quantifier is dynamic, as proposed by van Geenhoven (1998), we do predict that anaphoric uptake is possible. But now we have the opposite problem: We predict that anaphoric uptake should be as easy as with regular indefinite nominals, as they are represented by dynamic existential quantifiers as well.

In sum, under the Property account, WDs are predicted to either not supporting anaphoric reference at all, or to be easily picked up just like indefinites. I will test this prediction in the sections 3.

2.4. Restriction and Saturation?

Chung & Ladusaw (2004) develop a proposal to deal with incorporated objects that could be extended to WDs. In their theory, an incorporated object does not fill the argument position of a verbal predicate but "restricts" it. In a second step, called "saturation", the argument position is existentially quantified over. For WDs this would result in the following representation:

(16) a. RESTRICT (cinema, $\lambda x[\text{go-to } (x)(z)]) = \lambda x[\text{cinema}(x) \wedge \text{go-to}(x)(z)]$
b. SATURATE($\lambda x[\text{cinema}(x) \wedge \text{go-to}(x)(z)]) = \exists x[\text{cinema}(x) \wedge \text{go-to}(x)(z)]$

As for anaphoric reference, the prediction again depends on the nature of the existential quantifier: If it is static, anaphoric uptake is not possible; if it is dynamic, anaphoric uptake should be as straightforward as the antecedent were an indefinite DP.

2.5. Reference to unique entities in a situation?

Schwartz (2014) proposed that regular definite nominals denote functions from situations to unique entities, e.g. *the newspaper* would have the meaning λs.ι(newspaper(s)), the function that maps situations s to the unique calendar in s (this is defined iff in s there is one, and only one, calendar). For WDs, this is shifted to a property, in particular, a function from entities to propositions. For example, the weak definite version of *the newspaper* is interpreted as λyλs[y = ι(newspaper(s))], a function that maps entities y to a function that maps situations s to truth iff y is the unique newspaper in s. This is now combined with the proposal of Dayal (2011) for incorporated arguments, which is a version of the property account as discussed in Section 2.3. In particular, on Dayal's account, the property-taking version of a predicate involves sum formation, expressed by the operator "*", over events, as in (17):

(17) *read* (with property argument):
$\lambda P \lambda s\ \iota\ {*}\{e \mid \text{read}(e) \wedge \exists x[P(x)(e) \wedge \text{Th}(e)=x] \wedge e \leq s\}$

Applied to the WD interpretation of *the newspaper* gets us (18) (where Schwarz tacitly assumes that events are of the same type of situations). This is a function that maps situations s to the sum of all events e in s that are reading events such that the theme of e is the unique newspaper in e. In short, s is mapped to the sum of all reading events in s of the unique newspaper in those events. As there might be multiple such events, there also might be multiple newspapers involved.

(18) *read the newspaper*
$\lambda s\ \iota\ {*}\{e \mid \text{read}(e) \wedge \exists x[x = \iota(\text{newspaper}(e)) \wedge \text{Th}(e) = x \wedge e \leq s\}$

This is technically an event kind, in the framework of Chierchia (1998). If we want to specify the subject, it has to be reduced to specimens of this event kind. Glossing over details, we end up with the following interpretation, for the WD reading:

(19) *Max read the newspaper*
$\lambda s\ \exists e'[\text{Ag}(e') = \text{M} \wedge$
$e' \leq \iota\ {*}\{e \mid \text{read}(e) \wedge \exists x[x = \iota(\text{newspaper}(e))] \wedge \text{Th}(e) = x \wedge e \leq s\}]$

This maps situation s to truth iff there is an event e′, with agent Max, that is a part of the sum of all reading events in s of the unique newspapers in those events.

Schwarz states explicitly that this representation prevents anaphora from occurring, and he is right: The newspaper(s) of the event(s) are introduced within the sum operation over all events e, and even if the existential quantifier ∃x were dynamic, it is difficult to see how it could extend over the sentence.

I would like to point out that anaphoric reference perhaps could be handled via the situation s, if this is accessible for follow-up sentences. After all, the newspaper(s) in question are part of the individual reading events e, which are themselves part of the situation s. Due to the summation operation expressed by $\iota^*\{e \mid ...\}$, we could even hope to explain the observations made in (8) and (10), that plural reference is possible and that there is a maximality effect. Plural reference is clearly possible:

(20) In the cafe, Max read the newspaper. They / / The newspapers had similar headlines.

A maximality effect appears in the following example when restricting the interpretation of the first sentence to the WD reading (the example is fine with ordinary definites).

(21) In the cafe, Max read the newspaper. ?? He also read a second newspaper.

In our analysis in section 2.7 I will also assume a summation operation but within a dynamic theory that was designed to model anaphoric uptake.

2.6. Number-neutral discourse referents?

Modarresi (2015) proposes that bare noun objects in Persian are pseudo-incorporated objects and introduce number-neutral discourse referents. This predicts a possible plural interpretation of such bare nouns. When extended to WDs, we would predict a possible plural interpretation of WDs as well. as we have seen in (20).

Modarresi proposes an implementation in Discourse Representation Theory (DRT, Kamp & Reyle 1993), which provides for such number-neutral discourse referents (DRs). Her interpretation is illustrated in (22) with a WD, and in (23) for an indefinite nominal. Greek δ represents DRs that are number-neutral, whereas Latin d represents DRs that are anchored to atomic entities. The usual box notation of DRT is avoided here for a leaner representation in angular brackets.

(22) Max read the newspaper. $[d_1\ \delta_2 \mid d_1=\text{Max}, \text{newspaper/s}(\delta_2), \text{read}(d_1, \delta_2)]$
He put it / them back. it if $\#(\delta_2)=1$, them if $\#(\delta_2) \geq 2$

(23) Max read a newspaper. $[d_1\ d_2 \mid d_1=\text{Max}, \#(d_2)=1, \text{newspaper}(d_2), \text{read}(d_1, d_2)]$
He put it / *them back. it, as $\#(d_2)=1$

Modarresi shows how general expectations may push the interpretation towards predicting that null anaphora, lacking a number specification, can pick them up more easily. Also, if world knowledge suggests a singular or plural interpretation of the number-neutral DR, overt singular or plural anaphora should be acceptable.

However, this theory predicts that WD objects support anaphoric uptake with null anaphora similar to indefinites and with singular or plural anaphora, depending on world knowledge (Modarresi 2014, 2015). The only reason why uptake with anaphora might be slightly disadvantaged with WDs, in comparison with singular indefinites, may consist in the fact that anaphoric pronouns are always specified for number (as singular or plural), which might be problematic if the antecedent is number-neutral. However, such additional semantic specification with anaphoric expressions is acceptable in other cases. For example, sex-based pronouns are possible even if the sex of the antecedent is unspecified, as in *A strange person was standing in front of the building. She / He shouted at us*.

2.7. Abstraction and summation of event-dependent definites?

Thus far the proposals predict that either anaphoric reference is similar to indefinites or anaphoric uptake is not possible. I now will turn to a proposal that predicts intermediate accessibility, Krifka & Modarresi (2016). It was developed primarily for pseudo-incorporated nominals in Persian (cf. also Modarresi & Krifka 2021).

The proposal is built on Discourse Representation Theory (DRT) in the format of Kamp & Reyle (1993). This format has also been used by Farkas & de Swart (2003) to model pseudo-incorporation in Hungarian. They assume that pseudo-incorporated nominals do not introduce any DRs immediately but that DRs can be accommodated by a special rule of creation of a discourse referent in hindsight, if the anaphoric element is phonologically null. However, it is unclear why overt anaphora (with more descriptive power than null anaphora) cannot achieve this; if the DRs are accommodated, we should also expect a preference for definite descriptions as anaphoric expression. Also, there are technical problems with the implementation of this account that has been discussed in Yanovich (2008) and Krifka & Modarresi (2016).

Krifka & Modarresi (2016) introduce a theory that predicts a more nuanced pattern for anaphoric potential of WDs that does not result in predictions like uptake is impossible, or as easy as with indefinites. They combine Kamp & Ryle (1993), Diesing (1982) and Yanovich (2008) to a theory that predicts anaphoric uptake to be **possible but slightly reduced** compared to indefinites. This theory was originally developed for bare nouns in Persian (Modarresi, 2014; Krifka & Modarresi (2016). Based on this theory, weak definites do introduce a discourse referent, but it is embedded in the scope of a quantifier from which it can be retrieved by an otherwise established mechanism, which makes it less accessible than the DRs introduced by indefinites.

I first start with an introduction to DRT, as the best-known framework for the modelling of discourse referents (DRs), cf. Kamp & Reyle (1993). In DRT, sentences and discourses are interpreted as discourse representation structures (DRSs). A DRS is technically a pair of a set of variables, or DRs, and a set of conditions which will be represented here in angled brackets, ⟨ DRS | conditions ⟩. For instance, in (24) the two arguments introduce two object DRs d_1, d_2 where d_1 is anchored to the person *Max* and d_2 has the property of being a *calendar* and being of cardinality 1.

(24)	Max took out a calendar.	[d_1 d_2 | d_1= Max, calendar(d_2), take-out(d_1,d_2)]
	It was black.	[d_1 d_2 | d_1= Max, calendar(d_2), take-out(d_1,d_2), black(d_2)]

In contrast, the theory predicts that indefinites in the scope of quantifiers as in the first sentence in (25) do not introduce DRs that are accessible beyond the scope of the quantifier. Indeed, uptake by a singular DR is impossible in this case (even though it might be possible in cases of modal subordination, cf. Sells 1985, Roberts 1989). However, we find that uptake with a plural pronoun is perfectly possible.

(25) Everyone took out a calendar. *It was/They were black

Kamp & Reyle 1993 present a solution for cases such as (25) by a combination of two rules, Abstraction and Summation. (26) shows the discourse referents as exhibited in DRT:

(26) Everyone took out a calendar. $[\,|\,[d_1 \mid person(d_1)] \Rightarrow [d_2 \mid calendar(d_2)]$
They were black. $[d_3 \mid [d_1 \mid person(d_1)] \Rightarrow [d_2 \mid calendar(d_2)],$
$d_3 = \boldsymbol{\Sigma d_2[d_1\ d_2 \mid person(d_1), calendar(d_2)]}\ black(d_3)]$

Abstraction is a non-compositional device requiring copying of structure with subsequent interpretation, but it likely can be made compositional, e.g., in the continuation semantics of Qian & Amblard 2013). I propose that weak definites are in VP-internal position and under an existential quantifier over the event variable, which is independently motivated as "existential closure" in Diesing (1992); this was also assumed by Modarresi (2014) for pseudo-incorporation in Persian. We furthermore assume that weak definites specify a unique entity relative to a situation, similar to Schwarz (2014), cf. Section 2.5. For instance, in (29) it is presupposed that e_1 is an event for which a unique calendar is defined. The apparent indefinite reading of WDs is due to this dependency on the event existential closure.

Let us see the ingredients of this proposal step by step. I assume existential quantifier in DRT as illustrated (27a). This is interpreted with respect to a variable assignment g as being satisfied in a model iff g can be extended to include d in its domain that makes the condition […d…] true. The truth conditions are similar to cases in which d is a discourse referent in the upper DRS, but the DR d it is not accessible outside of the DRS with the existential quantifier.

(27) a. Existential quantifier: $[\ \mid \exists[\ d \mid \ldots d \ldots]\ ]$
b. DR in maximal DRS: $[\ d \mid \ldots d \ldots\ ]$

We furthermore assume event discourse referents, illustrated in (28a). The discourse referents of WDs are dependent on events, similar to Schwarz (2014), as illustrated in (b).

(28) a. Event discourse referents $[\ e_1 \mid check(e_1,d_1,d_2)]$
b. Definite dependent on the event variable $d_2 = calendar(e_1)$

We also assume existential closure over the VP that binds the event variable, as in Diesing (1992), for the representation of sentences with WDs, where the WD necessarily occurs inside the scope of the existential quantifier, as otherwise it could not access the event variable, cf. (29a). Anaphoric uptake is possible after abstraction and summation, as illustrated in (b).

(29) a. Max checked the calendar.
$[d_1 \mid d_1{=}Max, \exists[e_1\ d_2 \mid d_2{=}calendar(e_1), check(e_1,d_1,d)]]$
b. It was black.

$[d_1\ d_3 \mid d_1{=}\text{Max},\ \exists[e_1\ d_2 \mid d_2{=}\text{calendar}(e_1),\ \text{check}(e_1,d_1,d_2)]$
$d_3 = \Sigma d_2[e_1\ d_2 \mid d_2{=}\text{calendar}(e_1),\ \text{check}(e_1,d_1,d_2)],\ \text{black}(d_3)]$

This account thus predicts that WDs can be taken up by anaphora, but only after abstraction and summation. The accessibility to such DRs is more complex than the standard uptake of DRs that are introduced by an indefinite antecedent. Thus, WDs introduce DRs but they are less accessible than DRs introduced by indefinites. In other words, anaphoric reference to WD antecedents is possible but more complex, and we should expect that they are less salient than the DRs introduced by indefinites.

The theory also predicts that uptake by singular or plural anaphors is possible, and that uptake by number-neutral anaphors such as null anaphors is possible as well. The theory also predicts a Maximality interpretation, due to the summation operation, that is, a reference to all calendars checked, as shown in (29). In this, WD antecedents differ from indefinite antecedents. Also, I would like to point out that abstraction and summation are rules that are independently established in Kamp & Reyle (1993), they are not just invented for the current purpose.

An example of anaphoric uptake of a WD antecedent from German is presented in (30). Here, the contracted form of definite article or WD *ins Kino gehen* 'going to the cinema' is used to refer to a stereotypical activity. Notice that the interpretation of WD in this example is, cinema(e_1) the (unique) cinema of event e_1. This **presupposes** that e_1 is an event for which a cinema is defined, which is satisfied if e_1 is seen as an event referring to a stereotypical activity like 'going to a cinema to watch a movie'. Thus, the presupposition expressed by the WD, that the event has a unique object of the required type, goes some way to establish that the event is a an activity where this object is involved in a stereotypical way. In (31) we show the uptake of the event-dependent definite by established rule of abstraction and summation:

(30) *Max ist* [$_{VP}$ *ins Kino gegangen*].
$[d_1 \mid d_1{=}\text{Max},\ \exists[e_1\ d_2 \mid d_2{=}\text{cinema}(e_1),\ \text{go-to}(e_1, d_1, d_2)]]$

(31) *Es war klein.* $[d_1\ d_3 \mid d_1{=}\text{Max},\ \exists[e_1\ d_2 \mid d_2{=}\text{cinema}(e_1),\ \text{go-to}(e_1, d_1, d_2)]$
$d_3{=}\Sigma d_2[e_1\ d_2 \mid d_2{=}\text{cinema}(e_1),\ \text{go-to}(e_1, d_1, d_2)],\ \text{klein}(d_3)]$

Note that, in contrast to Schwarz (2014), we do not assume summation (which is the operation $*\iota(...)$ in that account) as part of the interpretation of the sentence that contains the antecedent, (30). Rather summation happens at the point where the anaphoric expression is interpreted. Also, notice that anaphoric uptake to the event discourse referent of the preceding sentence would also require abstraction and summation.

This account predicts various properties of WDs, in particular narrow scope interpretation, as the object discourse referent d_2 is related to the event bound by the existential quantifier, and hence has to have the same scope. It also predicts that the anaphoric uptake is more complex, different from indefinite DP, as d_2 is introduced in a dependent DRS and can be made accessible only by abstraction and summation.

The proposal also accounts for number neutrality of WDs, just as for incorporated nominals, as $\exists[e_1\ d_1 \mid \dots]$ allows for multiple ways of making the DRS $[e_1\ d_1 \mid \dots]$ true. This is different from the representation of indefinites like in *Max went to one cinema*, as the numeral *one* is in competition with other numerals like *two, three* etc., which would lead to a scalar implicature that strengthens the meaning to 'exactly one'. Diesing's existential closure ∃ does not have plural alternatives. The present framework also predicts Maximality effects due to summation.

2.8. Existing proposals and their prediction with respect to anaphoricity

I have discussed a number of proposals that have been made for the semantic representation of WDs (or for pseudo-incorporated nominals, which may have a similar interpretation). We looked, in particular, at the predictions these theories make with respect to the anaphoric uptake of DRs that are associated with these WD antecedents. The following table summarizes our results.

Theories	**Prediction about anaphoric uptake**
Kind Theory	reference is only possible to kind individual
Property-denoting incorporated object	either no uptake or with dynamic quantifier uptake is possible as easy as indefinite nominal
Restriction & Saturation	either no uptake or with dynamic quantifier uptake is possible as easy as indefinite nominal
Kinds of events	no anaphoric uptake
Farkas & de Swart (2003)	no uptake except for null anaphora by accommodation
number neutral discourse referent	anaphoric uptake with null anaphora similar to indefinites and with singular or plural anaphora, depending on world knowledge
Abstraction & Summation for event dependent definites	anaphoric uptake is possible as WDs are event-dependent definite, but it is somewhat reduced as it has to be retrieved with special rules.

In what follows we present two experiments that will, in general, lend support to the analysis of Krifka & Modarresi (2016).

3. Experiment 1: Weak definites vs. indefinite antecedents

In this experiment I compare the ease of reference to weak definites (WDs) and indefinite (IDs) antecedents in similar contexts, which leads to relatively subtle differences. Here I report on an experiment that uses a novel technique involving competing antecedents. The first sentence contains both an ID antecedent and a second antecedent that is realized either as ID or as WD. The second sentence contains a pronoun that is compatible with either antecedent in its gender and its plausible interpretation. Consider the example below, where the pronoun *Es* 'it' can be a reference to either *Museum* or *Kino*:

(32) a. Nora hat sich gestern **ein Museum** angeschaut, bevor sie **ins Kino** gegangen ist. **Es** war gerade neu eröffnet worden.
'Nora went to a museum yesterday before going to the cinema.
It was recently opened'

b. Nora hat sich gestern **ein Museum** angeschaut, bevor sie in **ein Kino** gegangen ist. Es war gerade neu eröffnet worden.
'Nora went to a museum yesterday before going to a cinema.
It was recently opened.'

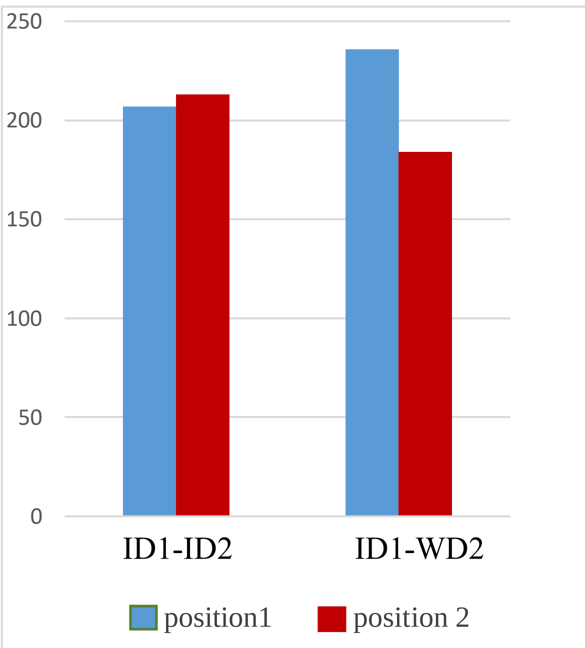
Method and Participants. 60 students from Humboldt University participated in an online survey. All participants were native speakers of German between 18 to 29.

Procedure. In an online survey with 14 experimental items and 7 fillers, randomized using Latin Square, the participants task was to read the antecedent clause as in the sample items (32a) or (b), followed by a subsequent sentence with a pronoun that potentially refers to either one of the antecedents. The participants are then asked, in a separate slide on the screen, to decide whether the pronoun refers to the first or the second antecedent:

(33) Was ist gerade neu eröffnet worden? Select between Museum or Kino!
'What was opened recently? Select between: Museum or Cinema!'

As a general principle of recency, one expects the last discourse referents for *ins / in ein Kino* be more accessible than *ein Museum* due to recency. The theory by Krifka & Modarresi (2016) predicts that discourse referents introduced by the indefinite noun *in ein Kino* is more accessible than > the weak definite *ins Kino*. It also predicts substantial number of uptakes for WDs *ins Kino* even though slightly less than indefinites. Most other theories as explained before, predict either no or highly limited accessibility by the WD *ins Kino* or an uptake for WDs similar to indefinites (*in ein Kino* = *ins Kino*)

Figure 1: Anaphoric Reference to competing antecedents, absolute numbers; ID1 ID2: two indefinites, ID1 WD2: Indefinite followed by Weak Definite



Results. The results illustrated in Figure 1, shows that WDs are taken up quite often but slightly less so than indefinites (significant difference, chi square p = 0,01). When the two antecedents are both indefinite the only difference being their position in the sentence (ID1 first position versus ID2 second position), the participants responses seem to be at chance level, referring to both antecedents with nearly equal probability, although the most recent antecedent is taken up slightly more often (though it is not significant). With the presence of a WD (WD2) antecedent, reference to first indefinite noun (ID1) is much higher, as participants choose WDs less favorably compared to the competing indefinite antecedents. WD in the second position (WD2) is also picked up less often compared to cases where the indefinite noun is in the second position (ID2).

The result contradicts the accounts that predict no anaphoric reference to WDs as well as the theories that predict WDs similar to indefinites (chi square= 0.01).

This experiment shows that WDs are anaphorically accessible (otherwise, uptake of WD2 would be non-existing or much rarer). Furthermore, it shows that WDs are less accessible than singular indefinites, everything else being equal. Hence it is in support of the theoretical account presented in Section 2.7.

4. Experiment 2: Anaphoric Uptake by Associative Anaphora?

In this section I will consider whether there is an alternative way to explain our empirical findings, that WDs can be taken up by anaphora, but not as easily as indefinites. A possible alternative is associative anaphora or bridging (cf. Clark 1975). This is responsible for the anaphoric uptake in cases like *I walked into the ballroom. The chandeliers sparkled brightly*, where the chandeliers are given because they are stereotypically associated with ballrooms.

Associative anaphora has been proposed for anaphoric reference to arguments that are implicit or embedded in a compound. In (34) we can use the bridging mechanism to account for anaphoric reference to *apple-picking*, a compound that arguable is not able to introduce a DR. Here, *the apples* can refer as the accessible antecedent *apple-picking* introduces an event of apple-picking, and every such event comes, by its very meaning, with corresponding apples.

(34) Mary went apple-picking. **The apples** /**#They** were delicious (cf. Ward et al.1991).

In fact, associative anaphora have been proposed by Asudeh & Mikkelsen (2000) to explain anaphoric uptake for pseudo-incorporated objects in Danish. According to their proposal, such nominals do not introduce DRs but may allow for “inferential pronominalization” (cf. also Schwarz 2019). But the problem with this explanation is that it predicts a preference for anaphoric uptake by full DPs rather than overt pronouns, as shown in in (34) and (35), in which reference by pronoun seems to be much degraded.

(35) Max flew to Costa Rica. He was afraid when he saw **the airplane / *it**.

However, there are rare cases where anaphoric reference to implicit arguments with prnouns is possible, as in the following examples. They typically rely on the pronouns *he* and *she* that are semantically more specific, as they carry a sex-based gender feature.

(36) Max met the Millers yesterday. **She** was nice, but **he** was a bore.

(37) John married. **She** is beautiful.

The experimental items in Experiment 1 used pronouns, which makes it unlikely that the findings can alternatively be based on bridging. However, I investigated this alternative possibility in a second experiment.

In Experiment 2, I investigated whether WD uptake could be due to bridging. We did this with examples like (38), which comes in two varieties: One with a WD antecedent (here *mit dem* (or *mit'm*) *Flugzeug* 'the airplane'), and one with a bare verb (here: *geflogen* 'flew') that is strongly associated with the same entity as the WD antecedent, as flying, for humans, is stereotypically done with airplanes. We have seen that associative anaphora preferably is done by full definite DPs, not with pronouns. Hence we investigate the preferred type of pronominal uptake with respect to the two versions of the text.

(38) Susanne ist Journalistin bei einem Nachrichtensender.
'Susanne is a journalist at a news broadcaster. '
a. Gestern ist sie **mit dem Flugzeug** nach Costa Rica **geflogen**.
'Yesterday she flew with the plane to Costa Rica.'
b. Gestern ist sie nach Costa Rica **geflogen**.
'Yesterday she flew to Costa Rica.'
Da über dem Atlantik starke Stürme herrschten, geriet **es /das Flugzeug** öfters in Turbulenzen.
'As there were strong storms, it / the airplane often faced turbulences.'

The prediction is that if anaphoric uptake of WDs is due to associative anaphora, then there should be no difference between WD antecedents like *mit dem Flugzeug geflogen* and simple verb antecedents like *geflogen*; both cases should strongly prefer definite DPs like *das Flugzeug*. If WDs are taken up along the mechanism of abstraction and summation suggested in Section 2.7, we should expect that this uptake is more often in the form of pronouns, as the simpler expressions, while uptake by definite DPs are still possible.

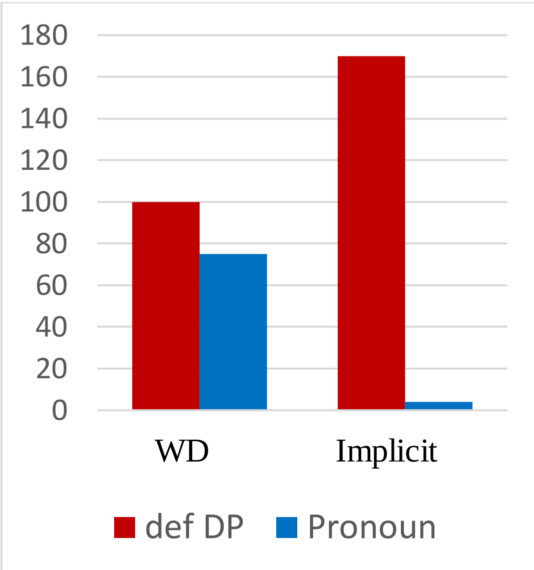
Participants. 36 students from the University of Humboldt participated in an online survey. All participants were native speakers of German between 18 to 29.

Materials. We constructed 25 experimental items similar to sample item in (38). The first sentence either contains a weak definite (WD) or the object remained implicit (Ø). The second sentence was contains either anaphoric reference with a pronoun or a full DP. The items were randomized using Latin square design in two lists.

Procedure. In an online survey, participants task was to read the antecedent clause containing either a WD or a simple verb, as described above, and then select the best anaphoric expression (pronoun or the full DP) for the subsequent sentence, as potentially referring to the antecedent in each trial.

Results: As shown Figure 2 below, participants continued items consisting of WD antecedents frequently with pronouns; definite DPs were chosen only slightly more frequently. However, cases in which there was no explicit antecedent nearly always required a full DP. The difference is highly significant.

Figure 2: Uptake of sentences with a WD antecedent or with an implicit antecedent by full definite DPs or pronouns, absolute numbers.



Experiment 2 shows that anaphoric uptake of WDs is different from associative anaphora. To be sure, it does not rule out associative anaphora in this case, but there must be either another option for anaphoric uptake, or associative anaphora in case of WDs must have some special property that is absent in case the antecedent clause only invokes an object implicitly. Defenders of the associative anaphora account would have to spell out the precise mechanism that is behind this facilitation.

5. Conclusion

In this paper I investigated the anaphoric uptake of weak definites (WDs) vs. indefinites (IDs). I proposed that investigating the anaphoric potential of WDs is helpful in distinguishing between the various theories for weak definites that have been proposed. Current theories of WDs and pseudo-incorporated nominals either predict that WDs are not accessible at all, or that WDs are as accessible as indefinites. Krifka & Modarresi (2016), which was developed for pseudo-incorporated nominals, predict WDs to be accessible but by a more complex process (abstraction and summation). I presented two experiments. The first experiment investigates two competing antecedents in the same clause, WDs vs. IDs. It was shown that WDs are easily accessible to anaphora, but less so than IDs; this pattern is consistent with the theoretical assumptions of Krifka & Modarresi (2016). In the second experiment I tested whether associative anaphora (bridging) is an alternative way to explain anaphoric uptake of WDs. I found that this is not the case; true cases of associative anaphora show a different pattern, as they strongly disfavor uptake by pronouns, which is not the case for uptake of WDs.

A further research question would be testing experimentally whether the uptake of WDs is similar to the uptake of indefinites under other quantifiers, as treated by Kamp & Reyle 1993 for abstraction or summation. Also, for comparison with the anaphoric potential of other expression types, see Modarresi & Krifka (2022) and Krifka & Modarresi (2023).

Appendix: Experimental Items of Experiment 1

1. Marie hat ihrem Chef mitgeteilt, dass sie am Mittwoch zu einem / zum Arzt gehen musste. Er fährt nächste Woche in den Urlaub.
2. Nora hat sich gestern ein Museum angeschaut, bevor sie in ein / ins Kino gegangen ist. Es war gerade neu eröffnet worden.
3. Elisa konnte gestern einen großen Koffer transportieren, weil sie einen / den Bus genommen hat. Er war sehr voll, daher war es etwas mühsam.
4. Arno möchte wissen, was in der Welt los ist. Heute Morgen hat er eine Sendung im Radio gehört, bevor er eine / die Zeitung gelesen hatte. Sie war ihm empfohlen worden.
5. Lorenz ist ein älterer Junggeselle. Dieses Jahr hat er eine Aufführung der Matthäuspassion erlebt, als er an Ostern in eine / die Kirche gegangen ist. Sie war sehr eindrucksvoll.
6. Leon hatte heute frei. Er wollte mit seiner Freundin in ein Konzert, weswegen er eine / die U-Bahn genommen hat. Sie war leider unpünktlich.
7. Birgit hat ein Wochenende in einem schicken Hotel in München verbracht, bevor sie mit einem / dem Flugzeug weiter nach Hamburg geflogen ist. Es war beinahe komplett ausgebucht.
8. Das Restaurant hat Florian, den Koch, beauftragt, bei einem / beim Bäcker Baguette zu kaufen. Er versteht sein Handwerk gut.
9. Heinrich ist niemals aus seiner Geburtsstadt herausgekommen. Er hat 81 Jahre in seinem Elternhaus gelebt, bevor er zwölf Jahre in einem / im Altersheim verbracht hat. Es ist eines der schönsten Häuser in der ganzen Stadt.
10. Otto hatte sofort nach dem Kauf eines Gebrauchtwagens einen Unfall, sodass er in ein / ins Taxi gestiegen ist, um nach Hause zu kommen. Es war ein etwas älterer Mercedes.
11. Marco hat eine Pizza gebacken, wobei er die Tomatensoße in einer / der Pfanne vorgewärmt hat. Leider hatte sie ein Loch im Boden und ein Teil der Soße ist durchgelaufen.
12. Lena hat ihren Fitnesstrainer getroffen, als sie gerade von einem / vom Friseur kam. Er hatte ihr einen Kurzhaarschnitt empfohlen.
13. Valerie war in einem Park spazieren, bevor sie mit ihren Kindern zu einem / zum Spielplatz gegangen ist. Er liegt am Ufer eines Flusses.
14. Erwin arbeitete sieben Jahre als Kellner in einem Restaurant, bevor er in ein / ins Kloster ging. Es lag in einem kleinen Ort in den Bergen.

Example filler: Ingo ist mit seinem Motorrad beim Ausparken gegen eine Autotür gestoßen. Es hat einen Kratzer bekommen. Was hat einen Kratzer bekommen? Motorrad – Auto.

The full items and the items of Experiment 2 can be accessed at:
https://bit.ly/AnaphoricPotentialWeakDefinitesExperimentItems

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Lack of access to alternatives can feed distributive inferences: The view from q-spreading in children[1]

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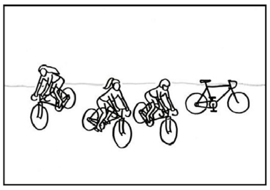
Abstract. This paper engages with a recent analysis by Denić and Chemla (2020) who argue that what appears to be quantifier spreading in child language is in fact the result of children deriving the distributive inference. While such an analysis straightforwardly accounts for the child data involving q-spreading, they claim that a certain aspect of the adult data is left unexplained. The authors suggest a number of possible reasons for this divergence and in this paper I lay out yet another possible solution to this problem. This solution is in line with recent literature arguing that children have difficulties deriving inferences which involve alternatives obtained by lexical replacement.

Keywords: q-spreading, acquisition, distributive readings, embedded implicatures.

1. Introduction

There is a longstanding observation (Inhelder and Piaget 1964) that children and adults differ in their interpretation of universally quantified sentences. Given a sentence such as (1), involving a universal quantifier in subject position and an existential one in object position, children's judgements point to a symmetrical interpretation, namely one where both (1a) and (1b) need to be satisfied in order for the sentence to be judged as true. Specifically, in the scenario depicted by the picture below, children tend to judge the sentence as false, given that the condition in (1b) is not satisfied. Adults, on the other hand, judge it as true given that the only condition they take into account when evaluating its truth is in (1a). This apparent tendency to interpret both the subject and object as universally quantified has been dubbed a "q(auntifier)-spreading" effect (Roeper and de Villiers 1991).

(1) Every girl is riding a bicycle.
  a. Every girl is riding a bicycle.
  b. Every bicycle was ridden by some girl.



As with all cases where children differ from adults in their linguistic behavior, the question that arises is the following: is this difference due to an issue with the experimental design, and if so, what is the issue and how do children reinterpret the sentence so as to accommodate said issue. To this end, there has been a recent surge in experimental work aimed at showing precisely that, namely that children are heavily influenced by the experimental design and that provided with the right conditions, children's judgements become (almost) adult-like. Most work on this comes from the domain of pragmatic enrichment, specifically scalar implicatures of weak quantifiers and disjunctions (Katsos and Bishop 2011 and Skordos and Papagragou 2016 to name only a few). More recently, however, a number of studies have also shown this to be the case in the domain of universally quantified sentences: provided that certain experimental

[1] I would like to thank Yasu Sudo and Paul Marty for extensive discussions on this topic. I am also grateful to the Sinn und Bedeutung Prague reviewers and participants who provided insightful feedback, as well as to Aron Hirsch and Milica Denic for comments on later versions of this work. All errors are my own.

factors are controlled for, children start to behave more adult-like (Crain et al. 1996; É. Kiss and Zétényi 2017; Skordos et al. 2022).

This paper begins with one of the questions mentioned above: how do children end up with a symmetrical interpretation for universally quantified sentences like (1)? Here I will follow a recent proposal by Denić and Chemla (2020) who assume that the relevant q-spreading interpretation children obtain for (1) is similar in nature to the distributive inference obtained for sentences involving a disjunction in the scope of a universal quantifier. The main contribution of this paper, however, will be to provide a(nother) possible explanation for the difference between children and adults' interpretation of such sentences in light of this account. The proposal put forward here will also take into account the aforementioned studies discussing how the choice of experimental task impacts children's behavior and I will discuss how Denić and Chemla's proposal can be understood in light of these results. The remainder of the paper is organized as follows. In Section 2 I introduce the proposal in Denić and Chemla 2020 as well as some relevant background on children's acquisition of different types of inferences. In Section 3 I put forward my proposal for the difference between children and adults and in Section 4 I discuss how this fits in with more recent development data. This section also puts forth some predictions and ideas for future research in this area. Finally, Section 5 briefly concludes.

2. Background

2.1. Distributive inferences

On its literal interpretation, a sentence like (2) is compatible with situations where every child had one and the same dessert; for example, (2) should be felicitously uttered in a situation where only muffins were eaten. It has been noted, however, that such sentences often give rise to the distributivity inferences in (3) that all disjuncts were acted upon, namely that each of the desserts was eaten by some child (Spector 2006; Fox 2007; Crnič et al. 2015; Denić and Chemla 2020; Ramotowska et al. 2022).[2]

(2) Every child had a cookie, a muffin, an ice-cream cone or a piece of cake.

(3) Distributive inferences of (2):
 a. Some child(ren) had a cookie.
 b. Some child(ren) had a muffin.
 c. Some child(ren) had an ice-cream cone.
 d. Some child(ren) had a piece of cake.

The source of the distributive inference is, unsurprisingly, the disjunction, and it can be derived similarly to other implicatures that arise from the use of disjunction, namely via exclusion of stronger alternatives (Sauerland 2004; Fox 2007; Chierchia et al. 2012; Chierchia 2013). Observe that (2) has as possible alternatives the subdomain alternatives in (4), obtained by replacing the disjunction in (2) with all the possible three-way disjunctions. In conjunction with the utterance in (2), the entailments in (3) follow straightforwardly once the alternatives in (4a-d) are negated: if every child had one of the desserts but not every child had a cookie, a

[2]Most (if not all) experimental work investigating distributive inferences have tested only two-membered disjunctions (e.g., *Every child had a cookie or a muffin*), unlike the example discussed here. Theoretically, however, the same argument should go through for multiple disjunctions, so we would predict that adults would derive distributive inferences at a similar rate regardless of the size of the disjunction.

muffin or an ice-cream cone, it follows that some child had a piece of cake, and so on.[3]

(4) Excludable sub-domain alternatives to (2):
  a. Every child had a cookie, a muffin or an ice-cream cone.
  b. Every child had a cookie, a muffin or a piece of cake.
  c. Every child had a cookie, an ice-cream cone or a piece of cake.
  d. Every child had a muffin, an ice-cream cone or a piece of cake.

2.2. Symmetrical readings as distributive inferences

Existential quantifiers, indefinite noun phrases and disjunctions are all taken to express, at their core, a disjunction, or existential quantification, over the members of a particular domain. Given this assumption, Denić and Chemla put forward the proposal that the symmetrical interpretation of universally quantified sentences involving an indefinite in the scope of a universal is nothing more than a distributive inference over the domain of the indefinite. Crucial to their argument is the observation above, namely that an indefinite like *a dessert* denotes a disjunction over possible desserts and that the relevant alternatives considered when evaluating the strengthened meaning of the sentence are those involving these disjuncts. Specifically, in the case of a sentence like (5), assuming the possible desserts are those listed above, the relevant alternatives would be the same as for (2), namely (4). The corresponding distributive inferences would be the same as in (3), repeated below in (6).

(5) Every child had a dessert.

(6) Distributive inferences of (5):
  a. Some child(ren) had a cookie.
  b. Some child(ren) had a muffin.
  c. Some child(ren) had an ice-cream cone.
  d. Some child(ren) had a piece of cake.

To reiterate, the prediction is that a sentence like (5) should be able to give rise to distributive inferences similarly to the corresponding EVERY[OR] sentence, namely (2). In combination with the utterance, these inferences amount to the symmetrical interpretation: every child had some dessert and every dessert was had by some child. In a scenario with leftover desserts then, children would correctly reject a sentence like (5) given that the distributive inferences are not all satisfied.

Interestingly, however, children and adults behave differently when it comes to evaluating the truth of a sentence like (5) in a context with leftover desserts. Since Denić and Chemla were interested in this specific question, they tested adults with EVERY[AN] sentences like (5) and found no evidence of q-spreading, contrary to what had been shown to be the case for children;

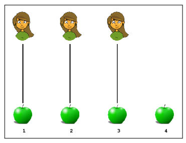
[3] Another option for deriving the distributive inference is via innocent inclusion of the alternatives in (i), which are obtained via double-replacement of the universal quantifier with an existential and the disjunction with each of its singleton subdomain alternatives (Bar-Lev and Fox 2017; Bar-Lev and Fox 2020):

(i) Includable sub-domain alternatives to (2):
  a. Some child(ren) had a cookie.
  b. Some child(ren) had a muffin.
  c. Some child(ren) had an ice-cream cone.
  d. Some child(ren) had a piece of cake.

adults were accepting such sentences in scenarios with leftover objects almost at the same rate as they accepted the true controls.[4]

They furthermore went on to show that adults differ in their interpretation of EVERY[AN] and EVERY[OR] sentences in contexts where one of the disjuncts was not acted upon, as per the image below, by testing sentences like (7a) and (7b). In a between-subject experiment, they found that in these cases adults were more likely to judge the disjunctive sentence in (7b) as false than its indefinite counterpart (7a). In other words, with disjunctions, but not indefinites, adults were less likely to accept leftover objects, similarly to children's behavior with indefinites.

(7) a. Every girl took an apple.
  b. Every girl took Apple 1, Apple 2, Apple 3 or Apple 4.



These contrasts are not expected if, like Denić and Chemla (2020) claim, symmetrical interpretations are nothing more than just distributive inferences over the domain of the indefinite quantifier. In the following subsection I will briefly outline one of their suggestions for overcoming these problems: (i) why adults and children differ in their responses to EVERY[AN] sentences in contexts with leftover objects, and (ii) why adults differ in their responses to EVERY[AN] on the one hand and EVERY[OR] sentences on the other hand in contexts with leftover objects.

2.3. Children's variable ability to enrich meaning

Before introducing my proposal in the following section, it will be helpful to introduce some background on children's ability to derive the type of enrichment necessary for deriving distributive inferences. Developmental work on children's ability to derive pragmatic inferences involving scalar items like quantifiers and disjunctions shows, broadly, two different patterns of behavior. For scalar implicatures of the *some* $\rightsquigarrow$ *not all* and *or* $\rightsquigarrow$ *not both* kind, children lag behind adults in terms of their propensity to derive such inferences (cf., Smith 1980; Braine and Rumain 1981; Noveck 2001; Chierchia et al. 2001; Papagragou and Musolino 2003). On the other hand, these same 4-and 5-year olds pattern with adults in their ability to derive free-choice inferences for both disjunctions and free-choice quantifiers (Tieu et al. 2016). On the view that both inferences can be derived via the same enrichment mechanism (for example

[4]Chen et al. (2021) found that children and adults also differ when it comes to evaluating the truth of the negative version of (5), namely sentences like *Not every child had a dessert*. They found that the same kids who judged sentences like (5) false in the presence of a leftover object, judged the negation of these sentences as true in the presence of a leftover object. In other words, kids were sensitive to the presence of a leftover object in both cases, in contrast with adults. Chen et al. (2021) take these data to argue that symmetrical interpretations cannot be viewed as implicatures since implicatures are known not to be generated in the context of negation, given that the corresponding alternatives are weaker than the assertion and thus no strengthening can occur. One could still maintain Denić and Chemla's (2020) analysis in light of these results if one were to assume that children always strengthen universally quantified sentences very locally; in the case of the negation, that strengthening would be happening below it, so the resulting interpretation would be the negation of the conjunction of two propositions $\neg(p \wedge q)$, where p = *Every child had a dessert* is the assertion and q = *Every dessert was had by some child* corresponds to the conjunction of the relevant alternatives to be included (see fn. 3). Note that this is equivalent to the disjunction of the two negated propositions, meaning that it suffices for one of the disjuncts to be true in order for the sentence as a whole to be true. In a context with leftover objects, $\neg q$ would be satisfied, hence children's acceptance of these sentences.

via application of an exhaustification operator in the grammar, in the spirit of Chierchia et al. 2012), the one main difference between scalar inferences (SIs) on the one hand and free choice (FC) inferences on the other hand is the nature of the alternatives involved in deriving them: whereas SIs appeal to lexical alternatives obtained by replacement (*some* with *all* and *or* with *and*), FC inferences involve appeal to sub-domain alternatives, which have either been explicitly provided as sub-strings of the assertion or were made (visually) salient in the discourse context. These results thus suggest that children have difficulties accessing alternatives that involve lexical replacement but no problems with inferences involving sub-domain alternatives. That children are proficient at deriving FC inferences suggests that they should be similarly good at deriving other inferences involving domain alternatives. In work aimed at testing precisely this, Pagliarini et al. (2018) showed that children were in fact adult-like in their ability to derive distributive inferences for EVERY[OR] sentences such as *Every elephant caught a big butterfly or a small butterfly.*

3. Intervening scalar implicature

Recall that the analysis of symmetric readings/q-spreading as distributive inferences (DIs) proposed by Denić and Chemla leaves open the following two questions:

1. Why do children, but not adults, derive DIs for EVERY[AN] sentences?
2. Why do adults derive DIs for EVERY[OR] sentences but not for EVERY[AN] sentences?

In this section I offer an answer to these two questions which relies on the aforementioned contrast, namely that children do not have access to or fail to invoke a particular alternative. Adults, on the other hand, do have access to this additional alternative and it is this alternative, I will show, which interferes with the derivation of the distributive inference for the indefinite quantifier in the scope of a universal. No such interference occurs in the case of the disjunction occurring in the scope of a universal, hence the higher rates of distributive inferences for EVERY[OR] sentences for adults.

3.1. Why do children, but not adults, derive DIs for EVERY[AN] sentences?

Of importance is the observation noted above that while children are adult-like in their ability to derive FC inferences, they have difficulties deriving scalar implicatures which involve access to lexical alternatives. With that in mind, let's return to the task at hand. In order to test for the existence of q-spreading, the context must be such that there are more objects than agents acting on them.[5] Looking at the examples in (6), repeated below in (8), in order to get a distributive inference in a situation where there are more apples than there are girls, multiple apples would have to be taken by at least one of the girls.

(8) a. Every girl took an apple.
    b. Every girl took Apple 1, Apple 2, Apple 3 or Apple 4.

The intuition I will pursue here is that adults, but not children, derive the inference that *Every girl took exactly one apple* for (8a), provided in (9a), which is at odds with the distributive inference, provided in (9b), in a situation where there are more apples than there are girls.

[5] As M. Denic points out (pc), if the context is such that multiple agent can act on the same object, e.g., by reading a book, then this condition of #objects>#agents is not longer a requirement.

(9) Possible inferences for (8a)
 a. Exactly inference: *Every girl took exactly one apple.*
 b. Distributive inference: *Every apple was taken by some girl.*

The strengthened meaning that *Every girl took one and only one apple* is obtained by negating the stronger alternative obtained by replacing the indefinite *an apple* with the plural *(multiple) apples* in (10a); I remain agnostic here as to how the plural alternative is represented. It suffices to note that in the presence of this alternative, the domain alternatives in (10b) are no longer excludable (or includable, depending on what theory of *exh* one adopts).[6,7]

(10) Every girl λx [x took an apple].
 a. lex-alt: {x took multiple apples}
 b. dom-alt: {x took A1, A2 or A3, x took A1, A2 or A4, x took A2, A3 or A4, ...}

Under this view, children's derivation of q-spreading is due to them not calculating this additional scalar inference, which I argue is due to them not having access to the lexical alternative in (10a); without this alternative they can rely only on the alternatives in (10b), allowing them to derive the distributive inference in (9b) and not the exclusive one in (9a). The solution to the contrast between adults and children thus appeals to the contrast discussed in the developmental literature, namely that children do not have access to or fail to invoke lexical alternatives obtained by replacement, such as the stronger scalar alternative in (10a), allowing the distributive inference to go through for EVERY[AN] sentences.

3.2. Why do adults derive DIs for EVERY[OR] sentences but not for EVERY[AN] sentences?

Let's turn now to the second question, namely why adults derive DIs for (11a) but not for (11b).

(11) a. Every girl took Apple 1, Apple 2, Apple 3 or Apple 4.
 b. Every girl took an apple.

Observe the relevant lexical alternative to (11a) is one involving the conjunction, (12a). The corresponding scalar implicature that *Every girl took some but not all of the apples*, derived by negating the conjunctive alternative, is consistent with the distributive inference that each apple was taken by some girl, obtained by appealing to the alternatives in (12b).[8]

[6]For concreteness, I assume that the *exactly one* inference is obtained via local exhaustification and its derivation precludes any further global exhaustification which would have delivered the distributive inferences.

[7]Note that another possible inference for the EVERY[AN] sentence, besides EVERY¬[MULTIPLE], is the weaker, global ¬EVERY(MULTIPLE) inference, which crucially is compatible with the distributive inference. This would predict that for those adults who derive the weaker anti-plurality inference, q-spreading effects should arise, namely they should start rejecting the sentence in contexts involving leftover objects. This prediction, however, is not borne out by the adult data reported by Denić and Chemla. This contrast could, in principle, be accounted for by appealing to the Principle of Charity, which leads subjects to view a sentence as true as long as it is true on one of its readings. We return to a discussion of predictions of adult behavior in §3.4.

[8]The claim above is a simplification since the conjunctive alternative is not the only possibility, nor is the *not all* inference the only possibility. It's been long noted that even a disjunction consisting of more than two members, such as (i), gives rise to the inference that a single dessert was eaten by Jordan (cf. Simons 1998; Sauerland 2004).

(i) Jordan ate a cookie, a muffin or a croissant. $\rightsquigarrow$ *John ate only one dessert.*

Note crucially that this inference is stronger than that obtained via the negation of the conjunctive alternative and in fact resembles the inference obtained from the use of a singular indefinite, as discussed. Interestingly, however, the alternative involved in deriving this inference involves not mere lexical replacement, but deletion as well, as the relevant alternatives are of the form *John ate a cookie and a muffin*. To what extent this inference is as readily

(12) Every girl λx [x took A1, A2, A3, or A4].
  a. lex-alt: {x took A1, A2, A3, and A4}
  b. dom-alt: {x took A1, A2 or A3, x took A1, A2 or A4, x took A2, A3 or A4, ...}

The crucial difference between the indefinite and the disjunction then is that for the disjunction, the corresponding scalar inference obtained by negating the alternative obtained via lexical replacement, (13a), does not interfere with the distributive inference in (13b) in a scenario where there are more apples than girls.

(13) Possible inferences for (8b)
  a. Scalar inference: *No girl took all the apples.*
  b. Distributive inference: *Every apple was taken by some girl.*

This contrast could then explain why adults derive different inferences for these two types of universally quantified sentences.[9]

4. Predictions of the SI account

4.1. Predictions for child language

Let's turn first to what predictions such an account makes for child behavior. The analysis presented above relies on children's inability to access the relevant plural alternative; recall that this is similar to what has already been observed for children's limited access to the stronger scalar alternatives *all* for *some* of the conjunctive alternative *and* for *or*. There is a line of research which argues that access to alternatives is variable and appears to be dependent to a large extent on what "Question under Discussion" (henceforth QUD, see Roberts 2012) is made available in the experimental setup. For example, Skordos and Papagragou (2016) found that children's ability to draw the implicature *not all* in a particular experiment depended on what the implicit QUD was. If the QUD was about the quantity of the quantifier object, that is, if the quantity is what made a sentence false (e.g., presenting *all girls ate apples* in a scenario where only some girls ate apples), then children were much more likely to derive the relevant scalar implicature. If the QUD was about the type of object involved (e.g., presenting *all girls ate apples* in a scenario where all girls ate pears), then children were much less likely to derive the relevant scalar implicature. Their conclusion was that when the context makes a QUD along

available for the disjunction as it is for the indefinite remains an open issue and one which should be investigated experimentally. I would like to thank P. Marty for extensive discussion on this point.

When this exclusivity inference is present, however, the distributive inference account predicts that it should interfere with the DI and thus that no q-spreading effect should be observed with disjunctions either. Note that Denić and Chemla conducted an experiment and showed that while adults are more likely to judge EVERY[OR] sentences as false in the presence of leftover objects, indicative of q-spreading, this still only happens about half of the time, which could be taken as an indication that the exclusive inference discussed above does play a role, at least some of the time.

[9] There is something more to be said, however, about the difference between indefinites and disjunctions with respect to their alternatives. While both of them can be argued to activate domain alternatives, only in the case of disjunctions are they spelled out. If we take this difference at face value, we could argue that with indefinites we have the option of ignoring the domain alternatives when computing strengthened meanings, the reasoning going as follows: if the domain alternatives were important enough to need to be incorporated into the strengthening, an alternative sentence involving the disjunction could have been uttered. The difference between indefinites and disjunctions with respect to their alternatives and possible inferences is the topic of ongoing debate, both at the empirical level as well as the theoretical level.

the lines of ”How many girls ate apples?” relevant, children behave more adult-like in their ability to derive the scalar implicature *not all girls* given a target sentence with *some girls*. This is due, presumably, to the fact that this QUD makes the *all* alternative relevant.

In a recent paper building on this idea, Skordos et al. (2022) show that children are much less likely to derive symmetric interpretations when provided with contexts where the relevant issue is the number of agents acting on particular objects; in the case at hand, that would be the number of girls eating apples. In a set of familiarization trials, children were presented with the same trial sentence *every girl ate an apple* either in a context in which only 2 out of the 3 girls ate apples, or in one in which all 3 girls ate apples and no apples were left over; note that the first context made the sentence false while the second context made the sentence true. They found that children who were exposed to the first type of familiarization item were more likely to exhibit adult-like behavior and not reject the target sentences showing leftover objects. One could explain these results along the same lines as above. Similarly to what was observed by Skordos and Papagragou for *some* sentences, what we notice here is that when the QUD is one making the quantity relevant, children become more adult-like in their responses. This, I argue, is due to the fact that children are more likely to start deriving scalar implicatures when the QUD is one that makes scalar alternatives relevant. The difference between this experiment and the one in Skordos and Papagragou 2016 is that the relevant alternatives are not directly addressed by the QUD, which is about the universally-quantified subject rather than the indefinite object. One suggestion could be that once one set of scalar alternatives is made relevant, any other scalar alternatives are made relevant as well. Once this *exactly* inference is derived, children become more adult-like by virtue of no longer deriving the distributive inference needed to obtain the q-spreading effect.[10]

Note that Skordos et al. (2022) offer a different take on their results. Their argument, following Crain et al. 1996, is that children exhibit non-adult like behaviour because the conditions for plausible dissent are not satisfied in the second type of familiarization trials (as well as most studies out there showing q-spreading effects in children); that is, the question being asked is pragmatically infelicitous since there are no contexts in which it is made false. In such situations, the argument goes, children converge on a different statement that does satisfy the condition of plausible dissent, such as *Every apple was eaten by a girl.* Since the first type of familiarization trials present cases where the target sentence is false, the issue of plausible dissent no longer arises and children thus are no longer forced to find a repair strategy. In their account then it’s not an issue of children drawing additional inferences but rather one of mis-interpretation of the sentence as a whole. Such accounts, however, suffer from one major issue, namely why all children would overwhelmingly converge on the same statement.

Denić and Chemla take yet another perspective on similar observations from studies showing that the choice of experimental topic can influence the presence of q-spreading in children (e.g., Hollebrandse 2004; Philip 2011). These studies show that if the focus is the universally-quantified subject, children are less likely to derive q-spreading and judge the target sentences as false. On the other hand, if the topic is the indefinite object, the q-spreading rates go up by comparison. Denić and Chemla argue that what is at the heart of this contrast is the following:

[10]To confirm this prediction, namely that children are more likely to derive these exactly implicatures, one could create scenarios where subjects have the possibility of acting on more than one object to see how children rate the relevant target sentences when the subject is acting on multiple objects.

when the subject is made more relevant and little attention is given to the object, children are less likely to consider as relevant the domain alternatives which are responsible for deriving the distributive/q-spreading inferences. Note that such an account could also explain the effects observed by É. Kiss and Zétényi (2017) in their study where it was shown that the more life-like/naturalistic the scene, the less likely children were to derive q-spreading inferences. Here too Denić and Chemla could argue that the more naturalistic the scene, the less relevant the individual members of the domain of the indefinite are, hence the reduction in q-spreading inferences. Along the same lines, it was found by Sugisaki and Isobe (2001) that when a higher number of extra objects were involved, the levels of q-spreading were drastically decreased.

Their proposal differs from the one I suggested above since they take the activation of domain alternatives to be subject to relevance whereas I argue that the scalar alternative is subject to relevance. It is completely plausible, however, to make these accounts compatible and argue that both domain and scalar alternatives are subject to relevance and that lack of q-spreading can be attributed to one of two sources: lack of active domain alternatives in the presence of too many or irrelevant objects or active domain and scalar alternatives in the presence of a certain type of QUD.

4.2. Predictions and complications from adult language

One prediction of the account proposed here is the following: in the absence of the stronger lexical alternative, adults should behave like children and derive distributive inferences, thus giving rise to q-spreading effects. For example, modified numerals such as *at least one* and mass nouns fall in this category in that they don't give rise to stronger scalar alternatives. The prediction then is that in a context with leftover apples and leftover water, respectively, the sentences in (14) should be judged as false since the distributive inference that every apple was eaten and all the water was drank would not be satisfied. Introspection suggests that this is likely not the case: even with leftover apples and water, we are still likely to accept these sentences as long as they are true on their literal interpretation.

(14) a. Every girl ate at least one apple.
b. Every girl drank water.

Assuming we take for granted that distributive inferences are obligatory, or as obligatory as they are with disjunctions, the present account could, however, still be maintained if we were to assume that adults appeal to domain restriction when faced with irrelevant material, e.g., leftover apples and water in (14), as per the suggestion in Denić and Chemla 2020. A similar mechanism appears to be at play in scenarios involving one or more of the girls taking multiple apples. Even in the presence of leftover apples, introspection suggests that speakers will accept an EVERY[AN] sentence, despite the fact that in this case neither the DI (involving the entire domain) nor the *exactly one* SI would be derived.

5. Conclusion

This paper presented an alternative view on what governs the difference between adults' and children's interpretation of EVERY[AN] sentences, taking as a starting point the hypothesis that children, like adults, are capable of deriving implicatures involving domain alternatives. I proposed that the difference in behavior can be traced to the (lack of) generation of an alternative involving lexical replacement, something that children have been shown to lag with when compared to adults.

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Alternatives and jurisdiction in predication[1]

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Abstract. While many predicates can compose consistently (e.g. *This dog is happy*), some can only compose via conjunctive material like additive particles (e.g. *This comedy is #(also) a tragedy*). This paper asks what relation must exist between predicates for them to fall in the latter category. In previous work, I suggested that predicates require *also* if they come from the same conceptual taxonomy. In the present paper, I show that another factor is at play, namely whether two predicates contribute the same kind of information ('have the same jurisdiction') in a given sentence. In particular, same-taxonomy predicates stop requiring *also* when they are interpreted with a different jurisdiction. From the observation that jurisdiction is pertinent to whether *also* is required, I suggest that jurisdictional identity is in fact the only factor in whether two expressions require an additive; bringing in the notion of taxonomic co-membership is superfluous.

Keywords: predicates, exhaustivity, alternatives, additive particles.

1. Introduction

Some (1a) but not all (1b) predicates require an additive like *also* to both be predicated of the same individual, or 'co-predicated' (Paillé 2020):

(1) a. Some comedies are #(also) tragedies.
 b. Some men are (??also) politicians.

In prior work (Paillé 2020), I have taken (1) to show that the meaning of predicates like *comedy* and *tragedy* involves exhaustification, modelled through the Exh(aust) operator of Chierchia et al. (2012). Additive particles like *also* are able to weaken this exhaustification (Bade 2016), so that *comedy* and *tragedy* no longer exclude one another when *also* is present.

The question asked in the present paper is what relation must hold between two predicates for them to require *also*—in other words, to be alternatives for this exhaustification effect. In Paillé 2020, I suggested that predicates are alternatives (for this particular effect) if they come from the same conceptual taxonomy, such as the taxonomy of genres for (1a). The current paper suggests a different way to understand the data.

The argumentation begins from the observation that there is context-sensitivity in whether two predicates require *also*. This can be seen with artefactual predicates, which can refer to either both the form and function of an individual, only its form, or only its function. In (2a), *shirt* and *hat* both describe both the form and function of the individual, and a contradiction results without *also*; in (2b), *shirt* describes the individual's form and *hat* its function.

(2) a. This shirt is #(also) a hat.
 b. This shirt is {a good hat, my hat}.

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The notion of taxonomy cannot by itself distinguish the sentences in (2); taxonomies must at the very least be enriched with another notion, namely the kind of information provided by a predicate in a given sentence. I will refer to this as the JURISDICTION of a predicate—the reach of the predicate's contribution of meaning to a particular sentence. The jurisdiction of *shirt* in (2a) is FORM and FUNCTION, but it is only FORM in (2b), for instance.

Since jurisdiction is apparently at play in determining whether two predicates require *also* to be co-predicated, a natural step is to question whether taxonomic co-membership is really at play too. I will show that, once we add in the notion of jurisdiction, there is no motivation left for taking taxonomic co-membership to be a factor in determining whether two predicates require *also*. Jurisdictional identity can be taken to be the only factor.

This paper is organized as follows. In section 2, I spell out a theory of (1a) based in exhaustification, putting aside the question of what determines Exh's alternatives. Then, in section 3, I discuss the proposal from Paillé 2020, according to which alternativehood is determined by taxonomic co-membership. Section 4 turns to the context-sensitivity of certain same-taxonomy predicates like the garments/artefacts in (2), and introduces the notion of jurisdiction as a factor in determining whether predicates require *also*. Section 5 asks whether the notion of taxonomy should still be kept in addition to jurisdiction; I show there is no reason to do so.

2. 'Controlled exhaustification' in predication

As already seen in (1), some (3a) but not all (3b) predicates are incompatible in basic sentences.

(3) a. #This fork is a spoon.
    b. This fork is a gift.

The naive way to understand (3a) is as showing that the extensions of the predicates *fork* and *spoon* have an empty intersection. Put a bit differently, the concepts FORK and SPOON are mutually exclusive. This is in fact predicted by certain theories in cognitive science, such as Gärdenfors' (2000) geometric approach to concepts, according to which conceptual domains are necessarily partitioned.

However, there are reasons to doubt this hypothesis. In particular, as seen in the introduction, (3a) belongs to a class of examples where contradictions that are intuitively due to the meaning of two predicates can be lifted by additives like *also*:[2]

(4) a. This fork is #(also) a spoon.
    b. This comedy is #(also) a tragedy.
    c. The white flag is #(also) green.
    d. This car is #(also) a boat.

These sentences could be uttered of a spork, a tragicomedy, a white and green flag, and a convertible vehicle. But, curiously, they all require *also*.

To be sure, *also* is not able to remove actual incompatibility between predicates. Contradic-

[2]The additivity in (4) is meant to be understood as *clause-internal*; *also* is not anaphoric to prior discourse material (cf. Kripke 1990), but to the predicate in the subject of the very clause it occurs in.

tions which are truly the result of conceptual incompatibility remain contradictory even in the presence of *also*:

(5) a. #This triangle is (also) a square.
  b. #A platypus is a duck that is (also) a beaver.

Compare in particular (5b) with (6), where we observe that the morpheme *-ish*, unlike *also*, does manage to broaden predicates' meanings.

(6) A platypus is a duck-ish, beaver-ish animal.

Since additives are not capable of weakening predicates' meanings, (4) must show that predicates like *fork* and *spoon* are in fact lexically/conceptually compatible.

What, then, causes such predicates to be intuited as inconsistent in basic sentences, and how does *also* remove this contradictory meaning? In previous work (Paillé 2020, 2021), I have suggested that lexically compatible predicates are intuited as incompatible due to a particular kind of exhaustification effect. Predicates like those in (4) are strengthened so as to exclude one another, making them intuited as incompatible in most sentences.

To start with, if lexically consistent material is intuited as inconsistent, this is descriptively a strengthening effect, and postulating an exclusion process from a domain-general exhaustification effect—to be modelled through the Exh(aust) operator of Chierchia et al. (2012)—should be the default hypothesis. But there is more to the argument that Exh is at play; specifically, additive particles have independently been argued to interact with Exh. First consider the fact that additive particles are often obligatory in discourse:

(7) Jade wrote a paper. Ahmed #(also) wrote a paper.

Here we have an additivity effect that has nothing to do with the meaning of predicates, letting us observe additives' behaviour independently of our research question. Why might the additive be obligatory in (7)? Some work (Krifka 1998, Sæbø 2004, Bade 2016, Aravind and Hackl 2017, Paillé 2022a) has claimed that, when additives are obligatory, it is because an obligatory exhaustification process would otherwise create problems; Bade (2016) specifically defends this view against an alternative based in Heim's (1991) 'Maximize Presupposition' maxim. In (7), the problem arising without *also* is that the second sentence would mean that *only* Ahmed wrote a paper, due to exhaustification (8). In (8), *Ahmed* is focused and bears *Jade* as an alternative due to Ahmed and Jade being contrastive topics (Krifka 1998).

(8) Exh_{ALT} [Ahmed_F wrote a paper] $=1$ iff A. wrote a paper $\wedge$ J. did not write a paper.

Of course, this raises the question of how *also* can fix the problematic meaning in (8). Paillé (2022a) suggests that this occurs through restriction of the Exh operators' alternatives in both sentences (cf. Aravind and Hackl 2017):

(9) $\text{Exh}_{\text{ALT-1}}$ [Jade_F wrote a paper]. $\text{Exh}_{\text{ALT-2}}$ [Ahmed_F also wrote a paper].
  a. ALT-1 = {~~Ahmed w.a.p.~~, Jade w.a.p., Ben w.a.p.}
  b. ALT-2 = {Ahmed w.a.p., ~~Jade w.a.p.~~, Ben w.a.p.}

Exh is present but weakened, avoiding a contradiction.

Since *also* is independently known to interact with exhaustification by weakening it, it is appealing to claim that the on-again-off-again incompatibility of predicates like *comedy* and *tragedy* is due to exhaustification. Thus, I take (3a) to have the LF in (10) (assuming a type-flexible Exh).

(10) This $[_{\text{NP}}$ Exh$_{\text{ALT}}$ fork$]$ is a $[_{\text{NP}}$ Exh$_{\text{ALT}}$ spoon$]$.

Exh needs a set of alternatives (ALT). For the time being, let's take a small leap of faith and assume that ALT includes at least forks, spoons, and knives. With this assumption, the meaning obtained from (10) is provided in (11).

(11) $$[\![(10)]\!] = 1 \text{ iff this } \begin{pmatrix} \text{fork \&} \\ \text{not spoon \&} \\ \text{not knife \&} \\ \text{not} \ldots \end{pmatrix} \text{ is a } \begin{pmatrix} \text{spoon \&} \\ \text{not fork \&} \\ \text{not knife \&} \\ \text{not} \ldots \end{pmatrix} \Rightarrow \text{contradiction}$$

In this way, lexically compatible predicates are made incompatible if they are alternatives for Exh.

But this is not a typical exhaustivity effect; it has the following twin properties (Paillé 2020). First, it is obligatory; otherwise a non-contradictory parse of (3a) would be available, and (of course) preferred. The idea that Exh is sometimes obligatory is not new (e.g. Magri 2009, Chierchia 2013, Bade 2016). But Exh in (10)/(11) has another property, namely that it is necessarily computed locally to the alternative-triggering expression (*fork*, *spoon*). If it was possible for Exh to be non-local (12), it would not create a contradiction, because its prejacent would entail that the subject is in the intersection of *fork* and *spoon*.[3]

(12) $[\![\text{Exh}_{\text{ALT}}$ [this fork is a spoon]$]\!]$
$= 1$ iff this fork is a spoon $\wedge$ this fork is not a knife $\wedge \ldots$
$\not\Rightarrow$ contradiction

See Paillé 2021 and 2022b for evidence that the locality constraint is observable generally with such predicates (i.e. even in non-contradictory sentences containing such predicates), rather than only being an ad hoc way to obtain contradictions where they are observed.

I refer to exhaustivity effects where Exh is both obligatory with and necessarily local to the alternative-triggering expression as 'controlled' exhaustivity (Paillé 2020); Exh is 'controlled' by the expression which requires it and dictates where it appears. Exh's controlledness gives its effect a lexical-like flavour, since it always co-occurs with the expression it exhaustifies and cannot be scopally detached from it.

With this much in hand, we can now update this paper's research question. Recall that the original question was framed in the following way: what kind of relation must hold between two predicates for them to require *also*? We can now ask this in a slightly sharper way: what relation must exist between two predicates for them to be alternatives for controlled Exh? In other words, what is the membership of the two alternative sets (ALT) in (10) and (11)?

[3] In (12), I only show *spoon* as triggering alternatives, but this might be incorrect. If *fork* bears alternatives too, there is another problem with (12): the global Exh will create entailments about other referents altogether by excluding alternatives like 'This knife is a spoon.'

3. Alternatives from conceptual taxonomies

Since predicates like *fork* or *comedy* are intuited as strong due to controlled Exh, the particular nature of these predicates' strong meanings depends entirely on the nature of the set of alternatives taken by Exh. In this section, I summarise the claim from my previous work (Paillé 2020), where I suggested that the alternatives for Exh are the predicates from a given conceptual taxonomy. These taxonomies include the following for the sentences in (4):

(13) a. **UTENSILS**: {*fork*, *spoon*, *knife*, ...}
b. **GENRES**: {*comedy*, *tragedy*, *epic*, ...}
c. **COLOURS**: {*green*, *white*, *red*, ...}
d. **VEHICLES**: {*car*, *boat*, *plane*, ...}

(14) follows because *fork* and *spoon* are taken from the same taxonomy, and are therefore alternatives for controlled Exh; in contrast, *fork* and *green* are not part of the same taxonomy. They are exhaustified so as to exclude some other predicates (e.g. *fork* excludes *spoon* and *green* excludes *white*), but not each other.

(14) a. #This fork is a spoon.
b. This fork is green.

The taxonomies in (13) are somewhat reminiscent of Horn scales (Horn 1972), but without logical relations between the predicates—not even mutual exclusivity, since the predicates, on the theory laid out in section 2, are lexically compatible.

The taxonomies one can infer from obligatory clause-internal additivity go much beyond those in (13). (15) provides some additional examples of predicates requiring *also*, and (on the right-hand side) suggests the taxonomy that these predicates may be taken from. Many of the examples (and taxonomies) are repeated from Paillé 2020.

(15) a. Some live-action movies are #(also) animated. **(FILM TYPE)**
b. (i) Some snowshoes are #(also) skis. **(GEAR)**
(ii) There's a new kind of bicycle that is #(also) a skateboard.
c. Some federal responsibilities are #(also) provincial. **(JURISDICTIONS)**
d. Some residential neighbourhoods are #(also) industrial. **(ZONING)**
e. SCENARIO: *Apple starts selling computers with two operating systems.*
Now, some Macs are #(also) PCs. **(BRANDS)**
f. He made a sling that is #(also) a bandaid. **(MEDICAL EQUIPMENT)**
g. Futons are couches that are #(also) beds. **(FURNITURE)**
h. Cyborgs are humans that are #(also) robots. **(HUMANOID)**
i. Are any derivational morphemes #(also) inflectional? **(MORPHOLOGY)**
j. Some left-wing ideas are #(also) right-wing. **(POLITICS)**

Of course, to argue that taxonomies feed alternatives for controlled Exh, we must not just observe that same-taxonomy predicates require *also*, but also that different-taxonomy predicates do *not* require *also*. We have already done this briefly with (14), but to cover more ground, let's try to mix and match predicates from different taxonomies identified in (13) and (15). At first glance, the prediction is borne out; the following different-taxonomies predications are all consistent without requiring *also*:

(16) a. Some live-action movies are comedies. (FILM TYPE + GENRES)
b. The train is a provincial responsibility. (VEHICLES + JURISDICTIONS)
c. Some industrial areas are a federal responsibility. (ZONING + JURISDICTIONS)
d. This robot is a car. (HUMANOID + VEHICLES)

We return to this point in section 5.

4. Jurisdictions

In this section, I introduce the notion of jurisdiction as a necessary component in understanding when predicates require *also* in a given sentence—possibly as an addition to taxonomic co-membership (a question we return to in section 5). Indeed, I will show that two same-taxonomy predicates can be co-predicated without requiring *also* if each predicate has a different jurisdiction in a given sentence.

This section is organized as follows. I first show in section 4.1 that predicates normally requiring *also* no longer do so when, in a given sentence, they do not contribute all the information that they could potentially contribute, given their lexical–conceptual meaning. To capture this, I suggest in section 4.2 that predicates take abstract jurisdictional arguments in sentences; these arguments must match some part of the predicate's lexical entry. I distinguish between 'inner jurisdictions,' which are the set of jurisdictions compatible with the predicate's lexical–conceptual meaning (essentially the 'qualia' of Pustejovsky (1995)), and 'outer jurisdiction,' which is the predicate's jurisdiction as intuited in a given sentence. Predicates only need *also* when they share an outer jurisdiction. I then show in section 4.3 that much of the data pertaining to which pairs of predicates require *also* can be explained from the notion of jurisdiction alone, without reference to taxonomies. This sets the stage for section 5, which asks whether the notion of taxonomic membership from section 3 is still needed at all.

4.1. Different-jurisdiction predications: no additive necessary

Let's begin with the general observation that many predicates that require *also* in basic sentences do not always require it; they only require it on their most literal interpretations. Many complicating factors can make them compatible without *also*, such as being true in different worlds or at different times:[4]

(17) a. SCENARIO: *We are setting up a play and decide to represent a red couch with a blue one.*
The blue couch is red.
b. SCENARIO: *A formerly fully white shirt emerges from the wash fully green.*
The white shirt is green.

This is the kind of complication in the data that one should put aside to study the lexical meaning of predicates and their interaction with exhaustification. It is true that modality and tense semantics make things appear complicated, but the data can be understood from facts of language not specific to predicates. One could model (17) through world and tense pronouns, for instance; in (18), w_0 is the real world and t_0 the time of utterance.

[4]I thank Michael Wagner for an example similar to (17a) and the audience at WCCFL 38 at UBC for (17b).

(18) a. The [blue w_0] couch is [red w_1].
b. The [white t_1] shirt is [green t_0].

Crucially, the predicates in (18) are still intuited as strong—the colour terms are interpreted as modifying *all* parts of their argument, despite being lexically existential (Paillé 2021). That is, the colour terms in (18) are exhaustified, with all colour terms as alternatives; the predicates are strong (incompatible) without resulting in a sentential contradiction due to holding at different worlds or times.

Now consider something that might initially appear to be a similar kind of superficial complication. Many artefactual predicates can have weak meanings due to only referring to the function of their subject, but not its form, or to its form but not its function (19a). In non-realist contexts, something similar goes for non-artefactual predicates too, which can refer to an individual's ongoing 'inner essence' (but not its current outer form) or its outer form (but not its inner essence); (19b) could be said of a donkey that has been magically transformed into a horse.

(19) a. This shirt is a good hat.
≈ it has the FORM of a shirt, the FUNCTION of a hat
b. This donkey is a horse. (*cartoon/magical setting*)
≈ it has the FORM of a donkey, the ESSENCE of a horse

Focusing on (19a), the effect is not only found with *good*; many definites, including possessives, also bring out the compatibility of the predicates:

(20) This shirt is my hat.
≈ it has the FORM of a shirt, but I treat it as having the FUNCTION of a hat

Crucially, the predicates in (19)/(20) do need *also* on their literal readings:[5]

(21) This shirt is #(also) a hat.

The problem with thinking of (19) as a mere complication is that, while (17) can be understood in terms of facts of language not specific to predicates (tense, modality), this is not clearly the case with (19). The effects in (17) are not directly relevant to a theory of the strength of predicates, but (19) is, because it is a case where we observe weaker meanings without an obvious explanation that is domain-general (i.e. not specific to predicates).

To state the obvious, what one wants to capture is that *shirt* and *hat* are both contributing information about form and function in (21), while only about one or the other in (19a). Apparently, in different sentences, the same predicate can have a broader or narrower scope in its ability to contribute information to a state/event. Call this scope the predicate's JURISDICTION. In (21), *shirt* and *hat* have the same jurisdiction (form and function), but they do not in (19a). Specifically, the extension of *hat* in (19a) is the set of objects that have the *function* of a hat (but not necessarily the *form* of a hat), including the shirt the speaker considers using as a hat; the extension of *hat* in (21) is the set of objects that have the *form and function* of a hat.

[5]At least, this is the case for *shirt* and *hat*. With *donkey* and *horse*, the predicates are lexically/conceptually incompatible, so *also* is of no help by itself.

4.2. Inner and outer jurisdictions

We have just seen that two predicates whose lexical meaning is such that they can share a jurisdiction in a given sentence only actually require *also* in sentences where their actually-intuited jurisdiction(s) is the same. To better understand this, I now introduce a distinction between inner jurisdictions (the jurisdictions compatible with a predicate's lexical meaning) and outer jurisdictions (the jurisdiction actually intuited in a given sentence).[6]

Let's start with the actually-intuited jurisdiction of a predicate. What we want to capture, of course, is that a predicate can be intuited as contributing different kinds of information depending on the sentence it is in. A simple way to do this is to claim that predicates take abstract arguments specifying what kind of information they are contributing about their subject—somewhat like degree predicates like *tall* take a degree argument. In (22), 'j' is for *jurisdiction*; these are abstract categories of meaning like FORM, FUNCTION, and so on, which I will write out as subscripts on j (e.g. j_{FORM}) when I refer to the syntactically present jurisdictional argument of a predicate.

(22) a. $[\![\text{shirt}]\!] = \lambda j.\lambda x.\, x \in \{y : y \text{ has the } j \text{ of a shirt}\}$.
b. $[\![\text{hat}]\!] = \lambda j.\lambda x.\, x \in \{y : y \text{ has the } j \text{ of a hat}\}$.

Call the actually intuited jurisdiction of a predicate in a given sentence (as determined, in the present formalism, by the predicate's j argument) its OUTER JURISDICTION.

With this in our pocket, we can capture that two predicates can be alternatives for controlled Exh without requiring *also*, if they have different j arguments (say, j_{FORM} and j_{FUNCTION}). Consider again (23a). It has the LF in (23b), where the lexical predicates *shirt* and *hat* both take a different jurisdictional argument, viz. j_{FORM} and j_{FUNCTION}. The controlled Exh operators take the resulting complex predicates as their argument.

(23) a. This shirt is my hat.
b. This [$\text{Exh}_{\text{ALT-1}}$ [j_{FORM} shirt]] is my [$\text{Exh}_{\text{ALT-2}}$ [j_{FUNCTION} hat]].

In expressions of the form 'j P' (e.g. 'j_{FORM} shirt'), call P the PREDICATIONAL NUCLEUS. The Exh operators' alternatives in (23) are as in (24a), where the jurisdictional argument stays fixed and the predicational nucleus is replaced by other nuclei (which, on the proposal from section 3, must be taxonomic peers of the original nucleus; we return to this in section 5). That is, (24b) is *not* a possible set of alternatives.

(24) a. (i) $\text{ALT-1} = \{j_{\text{FORM}} \text{ shirt}, j_{\text{FORM}} \text{ hat}, j_{\text{FORM}} \text{ pillow}, \dots\}$
(ii) $\text{ALT-2} = \{j_{\text{FUNCTION}} \text{ shirt}, j_{\text{FUNCTION}} \text{ hat}, j_{\text{FUNCTION}} \text{ pillow}, \dots\}$
b. $\text{ALT-1} \neq \{j_{\text{FORM}} \text{ shirt}, j_{\text{FUNCTION}} \text{ hat}, \dots\}$

On this view, the following meanings are obtained by composing the lexical predicates first with their jurisdictional arguments, then with their controlled Exh operators:

[6] I thank Aron Hirsch for pointing out to me that previous version of this work (including the version presented at *Sinn und Bedeutung* 27) used the term 'jurisdiction' in two related but different ways.

(25) a. (i) $[\![j_{\text{FORM}}\ \text{shirt}]\!] = \lambda x.\, x \in \{y : y \text{ has the form of a shirt}\}$.

(ii) $[\![\text{Exh}_{\text{ALT}}\ [j_{\text{FORM}}\ \text{shirt}]]\!] = \lambda x. \begin{cases} x \in \{y : y \text{ has the form of a shirt}\} \wedge \\ x \notin \{y : y \text{ has the form of a hat}\} \wedge \\ x \notin \{y : y \text{ has the form of a pillow}\} \wedge \\ x \notin \ldots \end{cases}$

b. (i) $[\![j_{\text{FUNCTION}}\ \text{hat}]\!] = \lambda x.\, x \in \{y : y \text{ has the function of a hat}\}$.

(ii) $[\![\text{Exh}_{\text{ALT}}\ [j_{\text{FUNCTION}}\ \text{hat}]]\!] = \lambda x. \begin{cases} x \in \{y : y \text{ has the function of a hat}\} \wedge \\ x \notin \{y : y \text{ has the function of a shirt}\} \wedge \\ x \notin \{y : y \text{ has the function of a pillow}\} \wedge \\ x \notin \ldots \end{cases}$

No contradiction results in (23b), which co-predicates the complex predicates in (25a-ii) and (25b-ii): an individual can be in the intersection of the set of things with the form of a shirt (but not of a hat), and the set of things with the function of a hat (but not of a shirt). At least, this is the case if the notion of 'function' is understood as the real-world function of an object rather than all the possible functions it could in principle have, in which case virtually nothing with the form of a shirt would fall in the set of things that do not have the function of a shirt.[7] In sum, as long as 'j_{FORM} shirt' and 'j_{FUNCTION} hat' are not alternatives for either of the Exh operators, no contradiction obtains even following exhaustification.

Outer jurisdictions are non-lexical by nature. But they must be lexically constrained; predicates cannot be assigned any outer jurisdiction. For example, *tree* in (26) cannot refer to the set of things that have the *length* of a tree—despite LENGTH presumably being a jurisdiction due to the existence of lexical items like *long* and *short*.

(26) #This car is a tree.

As such, while a particular predicate can vary in its jurisdiction sentence by sentence, the lexicon imposes limits on its possible jurisdictions. Call the set of jurisdictions that are compatible with a predicate's lexical meaning its INNER JURISDICTION(S). This notion coincides with Pustejovsky's (1995) 'qualia structure,' whereby particular lexical items have their particular meaning specified for various general categories of meaning (e.g. form and function) separately. What I suggest about outer and inner jurisdictions is simply that (by some mechanism) the jurisdictional argument *j* taken by a predicate must be matched by something in its lexical entry.

On this view, the predicate *tree* cannot have the jurisdiction LENGTH because the predicate *tree* does not come pre-specified with any information about length. To give another example, the predicate *waterfall* could not have the outer jurisdiction FUNCTION because waterfalls are non-artefactual and do not exist in order to serve a function. We may have world knowledge about functions they happen to serve (oxygenating water, for instance) but unlike artefacts, these functions are incidental rather than being part of what causes them to be waterfalls. As

[7] One could reasonably disagree with this, in which case the fact that (23a) is non-contradictory would serve as evidence that *shirt* and *hat* are simply not alternatives at all in (23a). This is compatible with the basic claim of this paper that jurisdiction is at play in determining whether predicates require *also*, but (on this view) whether two predicates are alternatives would have to somehow be computed from the jurisdiction of a predicate in an actual sentence (its outer jurisdiction), in a way that isn't clear to me. Something would have to prevent 'j_{FORM} hat' from being an alternative to 'j_{FORM} shirt' as a result of 'j_{FUNCTION} hat' being asserted elsewhere in the sentence.

such, waterfalls' functions are not part of the lexical entry of *waterfall*: *waterfall* does not have FUNCTION as an inner jurisdiction.

4.3. Jurisdictions can explain some of the data previously covered by taxonomies

With this new understanding of the role of jurisdictions in predication, we can immediately explain the fact that many predicates are consistent (without *also*), without any reference to the notion of taxonomic co-membership. Consider the following examples, where two nouns (*mermaid* and *figure-skater*) or adjectives (*green* and *long*) are not intuited as mutually exclusive:

(27) a. This mermaid is a figure-skater.
b. The green table is long.

Recall the conclusion just reached from (26): a predicate P can only have a jurisdictional argument j (an outer jurisdiction) if it has a matching inner jurisdiction. Let's focus on (27b), assuming it has the following LF:

(28) The [Exh_{ALT} [j_{COLOUR} green]] table is [Exh_{ALT} [j_{LENGTH} long]].

These predicates are immediately predicted not to have each other as alternatives (for the purposes of controlled Exh), without needing to appeal to taxonomic membership. Recall that alternatives for controlled Exh are created by keeping j constant and replacing the predicational nucleus with other predicates. For *green* in (27b)/(28), the alternatives are only well-formed if the predicational nucleus can take j_{COLOUR} as an argument—that is, if it has COLOUR as an inner jurisdiction. Thus, (29a) can be one of the alternatives of 'j_{COLOUR} green,' but (29b) cannot, simply because it is ill-formed; COLOUR is not an inner jurisdiction of the predicate *long*.

(29) a. j_{COLOUR} blue
b. *j_{COLOUR} long

Thus, beyond the well-formedness of alternatives, no constraint needs to determine that (29b) is not an alternative to 'j_{COLOUR} green'; the non-alternativehood of *green* and *long* falls out for free from (29b) being ill-formed. Similar points hold for the nouns in (27a); *mermaid* has the FORM inner and outer jurisdictions, but *figure-skater* does not, since *figure-skater* can only contribute information about how an individual spends their time, not the nature of their form.

Of course, if one were to formalize outer jurisdictions differently from the j arguments I have been using, it is possible that two predicates like *green* and *long* would no longer lead to ill-formed alternatives. Specifically, a purely pragmatic approach to outer jurisdiction would not lead to the expectation that the predicates *green* and *long* would give rise to semantically ill-formed alternatives. Nonetheless, even on a pragmatic approach to outer jurisdiction, the more general point I am making stands: if sharing an outer jurisdiction is a *sine qua non* for two predicates to require *also*, then *green* and *long* are expected never to require it. The fact that they cannot have the same outer jurisdiction stands regardless of how outer jurisdiction is to be formalized.

4.4. Interim summary

In section 2, I claimed that predicates require *also* if they are alternatives for controlled Exh. In the present section, I gave a slightly different picture: predicates can *feed* complex alternatives

(‘$j\ P$’) for controlled Exh without needing *also* if they are assigned a different outer jurisdiction in a given sentence. Once jurisdictions are taken seriously as a factor in whether a pair of predicates requires *also*, we find that at least some of the data pertaining to which pairs of predicates require *also* can be explained immediately from the notion of jurisdiction alone. We expect that the adjectives *green* and *long*, for instance, are not made mutually exclusive through a controlled Exh because they have different inner jurisdictions and therefore cannot feed well-formed alternatives for one another.

In principle, the claim from section 3 (that taxonomic co-membership is a necessity for two predicates to be alternatives) might still be correct. Or we might find that everything can be explained by jurisdictional (non-)identity alone. We now turn to seeing which one of these possibilities is correct.

5. No taxonomic constraint on predicates feeding alternatives for controlled Exh

We have seen that sharing an outer jurisdiction (and therefore necessarily also overlapping in inner jurisdictions) is a required condition for two predicates to require *also*. However, section 3 took a somewhat different notion, viz. taxonomic co-membership, to be at play. Is taxonomic co-membership a factor in addition to jurisdictional identity, or is it only the latter?

If taxonomic co-membership does have a role to play in determining alternatives for controlled Exh, the role of taxonomic co-membership would be to constrain the set of predicational nuclei feeding alternatives. In other words, once a predicate P has a jurisdictional argument j, the alternatives for controlled Exh are obtained by keeping j constant and replacing P not with *any* predicate with the right inner jurisdiction(s), but exclusively with its taxonomic peers (30). The sets in (30) are equivalent on the assumption that alternatives must be semantically well-formed; as discussed in section 4, $j\ Q$ is only well-formed if Q has j as an inner jurisdiction.

(30) $\textsc{alt}(j\ P) = \{\lambda x.[\![j\ Q]\!](x) : Q$ has j as an inner jurisdiction $\wedge$ P and Q are in the same taxonomy$\} \equiv \{\lambda x.[\![j\ Q]\!](x) : P$ and Q are in the same taxonomy$\}$

On the other hand, it could also be that the notion of jurisdictional identity should in fact replace taxonomic co-membership entirely. On this view, alternatives would be all predicates that can consistently compose with the asserted jurisdictional argument j:

(31) $\textsc{alt}(j\ P) = \{\lambda x.[\![j\ Q]\!](x) : Q$ has j as an inner jurisdiction$\} \equiv \{\lambda x.[\![j\ Q]\!](x)\}$

I will refer to (30) as the TAXONOMIC APPROACH and (31) as the JURISDICTIONAL APPROACH (of course, jurisdictions are actually at play in both hypotheses). The latter is simpler and therefore a default hypothesis. It is also less at odds with the discussion in section 3 than may appear: sisters in a taxonomy usually have the same inner jurisdictions, so jurisdictional identity will correspond to some degree with taxonomic co-membership. It may well be that section 3, in discussing the notion of taxonomic co-membership, was really discussing an epiphenomenon of jurisdictional identity.

Let’s start with a brief review of why the more complex (30) might be necessary. Many of the *different* taxonomies posited in section 3 (and Paillé 2020) involve predicates with the *same* inner jurisdiction(s). If the predicates from those different taxonomies do not require *also* when they are co-predicated, that would be evidence in favour of the more complex (30). To see this, consider (32), repeated from (15f) and (15g). In section 3, I identified these pairs of predicates as coming from different taxonomies (therefore not requiring *also*, hypothetically) but all the relevant predicates have the same inner jurisdictions: FORM and FUNCTION.

(32) a. He made a sling that is #(also) a bandaid. **(MEDICAL EQUIPMENT)**
b. Futons are couches that are #(also) beds. **(FURNITURE)**

If it was correct to group *sling* and *bandaid* separately from *couch* and *bed*, then jurisdictional identity is not enough to describe the data, since it cannot tell these predicates apart; rather, reference to taxonomies is required.

I now show that, in fact, there is no empirical evidence in favour of (30); reference to taxonomies is not needed to describe the data. I therefore defend the view that all predicates that *can* feed alternatives for controlled Exh (due to having the right inner jurisdictions) *do* feed alternatives, without being constrained by taxonomic co-membership.

To start with, the taxonomies identified in section 3 are in many cases too narrow. I argued in that section—see the discussion of (16)—that different-taxonomy predicates do not require *also*, based on the taxonomies suggested in (13)/(15). However, this does not actually hold for all the taxonomies identified in (13)/(15); (33) co-predicates predicates from different taxonomies identified there, and *also* is required.

(33) a. This couch is #(also) a car. **(FURNITURE + VEHICLES)**
b. He made a sling that is #(also) a ski. **(MEDICAL + GEAR)**
c. Now, some Macs are ??(also) skateboards. **(BRANDS + GEAR)**

If taxonomic co-membership really constrains which predicates can feed alternatives for controlled Exh, what we learn from (33) is that the two relevant predicates in each of these sentences must both come from the same taxonomy. A natural step, then, is to postulate a general ARTEFACTS taxonomy. Many of the rather specific taxonomies suggested in (13)/(15) would be viewed as particular branches of this ARTEFACTS taxonomy, including VEHICLES (13d), GEAR (15b), MEDICAL EQUIPMENT (15f), FURNITURE (15g), BRANDS (15e), and UTENSILS (13a).

Thus, the taxonomic approach to alternatives for controlled Exh predicts that any predicates with the FORM and FUNCTION inner jurisdictions will be alternatives to each other, *as long as they are artefacts*. It is not immediately clear that this is a substantial prediction, since it may be that all and only artefactual predicates have both the FORM and FUNCTION inner jurisdictions, in which case both the taxonomic and the simpler jurisdictional approaches make the same prediction for the alternatives of predicates with FORM$\oplus$FUNCTION as their outer jurisdiction. However, on the assumption that the ARTEFACTS taxonomy is a stand-alone taxonomy rather than being part of an even larger taxonomy, we can in fact get a substantial prediction from the taxonomic approach. Specifically, there are many predicates that have FORM but not FUNCTION as inner jurisdictions (e.g. *buffalo*, *forest*, *human*, or *waterfall*; see the brief discussion of *waterfall* in section 4.2); call these (non-artefactual) form-denoting predicates. When such a predicate is asserted, it has FORM as its outer jurisdiction, of course (modulo (19b)-type examples). While it can never be that a non-artefactual form-denoting predicate is an alternative to an artefactual predicate with FORM$\oplus$FUNCTION as its outer jurisdiction (because non-artefactual predicates lack FUNCTION as an inner jurisdiction), it *could* in principle be (as far as jurisdictions and the well-formedness of alternatives is concerned) that an *artefactual* predicate is an alternative to a *non-artefactual* form-denoting predicate (because artefactual predicates *do* have FORM as an inner jurisdictions). But whether it is actually predicted that artefactual predicates should be alternatives to non-artefactual predicates depends on the theory of alternatives. The jurisdictional approach does indeed predict that artefactual predicates should be alternatives to non-artefactual form-denoting predicates; the taxonomic approach predicts that this should not be the case, because artefactual and non-artefactual predicates are not part of the same taxonomy.

More concretely, the jurisdictional approach predicts sentences like (34) to be contradictions without *also* as in (34a), because both the non-artefactual and the artefactual predicates have FORM as inner and outer jurisdictions (but see below on outer jurisdictions), while the taxonomic approach predicts that such sentences should be acceptable without needing *also* (34b).

(34) a. The (non-artefact) is #(also) an (artefact).
b. The (non-artefact) is (also) an (artefact).

This can only be tested if we manage to co-predicate a non-artefact and an artefact at all; in the real world, there are combinations of artefacts (e.g. sporks), but by the very nature of artefacts and non-artefacts, it is no *a priori* certainty that we could co-predicate artefactual and non-artefactual predicates (without getting into metaphor). As such, the predictions for (34) can only actually be tested if we find that it *is* possible to co-predicate an artefactual and a non-artefactual predicate; where the taxonomic and jurisdictional approaches differ in prediction is in whether or not *also* is required to do so.

There is another complication: the predictions for (34) only hold if we can ensure that the artefactual predicate has FORM or FORM$\oplus$FUNCTION as an outer jurisdiction, rather than just FUNCTION. In the latter case, *also* would immediately not be expected to be required, regardless of whether the artefactual and non-artefactual predicates are underlyingly alternatives. In principle, this complication should not be a problem: in at least the kinds of sentences looked at so far, it is only in certain environments that artefactual predicates can have FUNCTION (rather than FORM$\oplus$FUNCTION) as their outer jurisdiction:

(35) This shirt is {my, a good, #a} hat.

It is not clear how strong or general this is, however. Nonetheless, to get started, we will try not to worry about cases where artefactual predicates have only the FUNCTION outer jurisdiction simply by avoiding expressions like *good* or *my* that make it salient.

To approach a sentence like (34) and see which theory makes the right prediction, let's start with (36), where *waterfall* is a non-artefactual form-denoting predicate with only FORM as an inner jurisdiction and *door* is an artefactual predicate with both FORM and FUNCTION as inner jurisdictions. Imagine there is a dwelling in a cave behind a waterfall, and one can only enter through the waterfall.

(36) The waterfall is a door.

This is a perfectly good sentence, and it does not need *also*. At first glance, this looks in line with the prediction of the taxonomic approach (34b). But in fact, despite what I just claimed about avoiding the FUNCTION jurisdiction of artefactual predicates, it seems that (36) has the artefactual predicate *door* only contributing information about function. Intuitively, the waterfall is a normal waterfall, rather than having any physical properties associated with doors, and its function is that of a door. As such, we must be more careful about the potential difficulties raised immediately above about the outer jurisdiction of the artefactual predicate. In (36), since *waterfall* has only FORM as its outer jurisdiction and *door* only has FUNCTION, the fact that (36) does not require *also* does not constitute evidence that *waterfall* and *door* are not alternatives.

To avoid this problem, I suggest to choose the pair of artefactual and non-artefactual predicates such that the function of the artefactual predicate *P* and the form of the non-artefactual predicate *Q* are somehow unaligned. If the form of *Q* makes it impossible to accomplish the function associated with *P*, this might force a reading where the artefactual *P* also contributes information about form. An example is the following:

(37) The mad scientists have created a dog that is #(also) a ski.

The predicates *dog* and *ski* do precisely what I just described: a normal-looking dog could not function as a ski, so the animal must have some physical ski-like form for the state of affairs described by (37) to even be imaginable. Without *also*, the sentence is complete nonsense; with *also*, one is somehow directed to imagining a cartoon scenario where the dog's body is ski-like, however one wants to imagine that. While this example is obviously very cartoonish (precisely to avoid the problems we ran into with (36)), it is striking that *also* is quite necessary here.

In short, while the empirical picture involving the co-predication of an artefactual predicate and a form-denoting non-artefactual predicate is complex, I believe (37), unlike (36), is the datapoint that actually answers the present research question. Here, *dog* and *ski* both have at least FORM as an outer jurisdiction, and *also* is required. Thus, it must be that at least one of these predicates feeds alternatives for the other, such that controlled Exh creates a logical contradiction without *also*. Specifically, *ski* is an alternative to *dog* since *ski* has the FORM inner jurisdiction, matching the outer jurisdiction of *dog*. Given that the outer jurisdiction of *ski* in (37) is FORM⊕FUNCTION, *dog* cannot be an alternative to *ski* because *dog* does not have the FUNCTION inner jurisdiction; the alternative it would feed—'$j_{\text{FORM}\oplus\text{FUNCTION}}$ *dog*'—would be ill-formed.[8]

There are other examples which are perhaps more clearly acceptable than (37). One such example was in fact provided in section 3. In (15), there was a 'HUMANOID' taxonomy grouping together predicates like *human* and *robot*; (38) is repeated from (15h).

(38) Cyborgs are humans that are #(also) robots.

Robots are artefacts, but humans are not; yet, the predicates *robot* and *human* are alternatives for controlled Exh. We can see the same thing with predicates other than *robot*, e.g.:

(39) Flying cyborgs are humans that are #(also) planes.

[8]A possible criticism of my argumentation from (37) is that, given the mad scientists' involvement, the dog is not really a naturally occurring individual anymore—it is in some sense an artefact. This criticism is probably not quite right, if the dog either existed as a normal dog prior to the mad scientists' involvement, or if it is the offspring of another ski-dog (on the reading of (37) where the scientists have not created a single individual dog but a new breed of dogs).

Thus, the observation that *also* is required to co-predicate non-artefactual form-denoting predicates with artefactual predicates that have FORM⊕FUNCTION as their outer jurisdiction is not limited to (37).

In sum, it appears that whenever two predicates have FORM as an inner jurisdiction, they can feed alternatives for controlled Exh. As mentioned above, the fact that *also* is required to co-predicate a non-artefactual form-denoting noun with an artefactual noun does not *necessarily* mean that there is no taxonomic constraint on the creation of alternatives for controlled exhaustivity. It could be that the ARTEFACTS taxonomy posited above is simply too narrow, and all the predicates we have been looking at (whether *door*, *ski*, and *robot* or *waterfall*, *dog*, and *human*) are part of a very general taxonomy of THINGS WITH A BODY. However, it remains that there is no positive empirical evidence in favour of any taxonomic constraint on the creation of alternatives. It is at the very least *simpler* to take jurisdictional identity to be the only factor in creating alternatives for controlled Exh. The conclusion is therefore that all predicates feed alternatives for all predicates as long as the resulting alternatives are not ill-formed due to a jurisdictional mismatch. Q can be an alternative to P as long as the outer jurisdiction of P is among the inner jurisdictions of Q.

6. Conclusion

An obvious descriptive fact about language is that different expressions contribute different kinds of information. What the present paper has suggested is that this notion is of central importance in capturing the interaction between predicates and the logical expression *also*.

I have shown that many predicates (e.g. *green* and *white*) are lexically consistent despite leading to the intuition of a contradiction in basic sentences (40a). The incompatible meaning of predicates (the universal meaning of the colour terms in (40a)) is due to an obligatory and ultra-local ('controlled') exhaustification effect. Thus, one somehow has to capture that some lexically consistent pairs of predicates like *green*/*white* are intuited as *inconsistent*, while other lexically consistent pairs like *green*/*long* (40b) are intuited as *consistent*.

(40) a. #The green table is white.
b. The green table is long.

What relation exists between *green* and *white* that does not exist between *green* and *long*?

In prior work (Paillé 2020), I took this relation to be taxonomic co-membership. This paper has suggested that 'jurisdiction'—the kind of information contributed by a predicate, similar to the qualia of Pustejovsky (1995)—is a better notion. I started by observing context-sensitivity among predicates sometimes requiring *also*:

(41) a. This dishwasher is #(also) an oven.
b. This dishwasher is a good oven.

Predicates only require *also* to be consistent if they contribute the same kind of information in a given sentence, or have the same 'outer jurisdiction.' In (41a), both are contributing information about form and function, but this isn't the case in (41b).

From the observation that a jurisdictional-identity constraint is a required part of accounting for when *also* is required, I moved on to suggesting that this can in fact replace the notion of taxonomic co-membership altogether. First, many predicates that do not require *also*, like *green*/*long*, are predicates that cannot share an outer jurisdiction (in this case, *green* can only contribute information about colour, and *long* about length), so no reference to taxonomic co-membership is required anymore. Second, I showed that all form-denoting nouns can be alternatives, regardless of whether they are artefactual or not. This is captured on the jurisdictional approach without needing to make reference to taxonomies. This jurisdictional approach effectively puts no limits on predicates' alternativehood other than a well-formedness condition on alternatives, at least on the semantic approach to jurisdiction tentatively taken in this paper. If the asserted predicate has the outer jurisdiction FORM, this is due to it taking a covert jurisdictional argument j_{FORM}, and the predicate's alternatives are only well-formed if they can take j_{FORM} too; this in turn requires them to have FORM as an inner jurisdiction.

Many questions are left open. First, the notion of jurisdiction is obviously sketchy; my intention has been to show that it is better than taxonomies to capture which pairs of predicates require *also*, and I have not gone beyond this. The best path forward I know of in the literature is in the tradition of the generative lexicon (e.g. Pustejovsky 1995). Jurisdictions also suffer from the same problem observed many times in the literature on thematic roles (e.g. Dowty 1991): it is not clear what the exact set of jurisdictions is and if that set is even finite. A third question is how to formalize jurisdictions, and whether the j arguments in this paper are the way to do so. Such questions constitute an important research programme touching on predicates, strengthening, and the relationship between language, world knowledge, and the conceptual module of the mind.

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The search for universal primate gestural meanings[1]

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Abstract. This paper pursues the idea that human and non-human great apes share a common set of directive (imperative) gestures and their meanings. We investigate gestures that are multifunctional, in that they have different effects in different contexts, focusing on non-human ape gestures that communicate "Stop that" in some contexts, and "Move away" in others. What may superficially appear to be lexical ambiguity can be derived from a single abstract lexical entry, "Not X!", concluded to be a candidate for a universal building block of meaning, shared by human and non-human great apes, reflections of which may also be found in the pragmatic gestures in humans.

Keywords: gesture semantics; imperative gestures; ape gestures; directive gestures; Super Linguistics; semantic universals.

1. Introduction

1.1. Gestures as an object of linguistic inquiry

In linguistics, *gestures* are defined as communicative body movements (see, e.g., Abner et al. 2015). While modern gesture research has been pursued for roughly half a century, beginning with the work of Kendon (1972, 1980) and McNeill (1985, 1992), the last fifteen years have also seen the emergence of formal semantics work on gestures (e.g., Lascarides & Stone 2009a,b, Ebert & Ebert 2014, Schlenker 2018, Esipova 2019). This signifies what we may consider a new chapter in formal semantics that embraces multi-modality as an important aspect of human language.

Much of the above-mentioned formal semantics literature has focused on gestures that add descriptive content to the accompanying speech, such as a *LARGE* gesture while referring to a bottle of water (Ebert & Ebert 2014), or a *SLAP* gesture when discussing a *punish*-event (Schlenker 2018).[2] To illustrate, consider the example in (1), which is to be understood as follows: while pronouncing the word *this*, Alex performs the *LARGE* gesture, which involves holding one's hands apart at a distance that indicates the size of Sam's cat. The co-occurrence of *this* and *LARGE* is marked by the plus sign and underlining of *this*.

(1) Alex: Sam's cat is <u>this</u>+*LARGE* big.

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[2] Henceforth, italicized words in all caps (e.g., *LARGE* and *SLAP*) will be used to refer directly to the gestures.

A different type of gesture are *pragmatic gestures* (also referred to as *interactive gestures*), which have a discourse-managing use (see, e.g., Bavelas et al. 1992, Kendon 2004, Abner et al. 2015, Müller 2004, 2017, Wehling 2017). Example (2) illustrates a concrete example of a pragmatic gesture, namely the *throwing away* gesture, *THROW* (see, e.g., Bressem & Müller 2014, 2017).[3] Francis et al. (2023) argue that Sam's use of *THROW* in (2) communicates that it is unimportant whether it is getting late or not. The pragmatic contribution of the gesture is congruent with the implicatures of Sam's spoken utterance: Sam's statement that the following day is Sunday implicates that Sam and Alex can sleep in on Sundays, thus supporting Sam's dismissal of Alex's utterance by virtue of *THROW*.

(2) *Context: Alex and Sam are dancing at a club, it is 3am*
 a. Alex: It's getting late.
 b. Sam: Tomorrow is Sunday+*THROW* (Francis et al. 2023)

This paper focuses on a third type of gesture, which we may call *directive gestures*; we define directive gestures as attempts by the *signaler* (the person gesturing) to get the *recipient* (the intended addressee) to change their behavior.[4] Directive gestures are often referred to as *imperative gestures* (e.g., by Tomasello & Camaioni 1997, Kersken et al. 2019), but this label potentially conflates the morpho-syntactic notion of *imperative* (a linguistic verb form or sentence type) with the semantic-pragmatic notion of *directive* (a type of speech act). I will thus use the term *directive* in this paper. Examples of directive gestures include the *STOP* gesture in (3).[5] This gesture is often performed as a silent gesture (without accompanying speech). It is typically understood as an attempt to get the recipient to stop an activity, e.g., it can be a prompt (i) to stop moving towards the signaler, (ii) to stop speaking, or (iii) to simply hold still.

(3) 
stop hand gesture (cropped from original picture)
Source: Pexels.com (Free to use license)[6]

In the absence of any linguistic material, it is not trivial to describe the meaning of the *STOP* gesture; it could be paraphrased as a negative imperative that expresses prohibition (*Don't come closer*) or as a regular imperative that expresses a command (e.g., *Stop* or *Stay away*). Moreover, paraphrases are not limited to imperative-like paraphrases; the gesture may just as well be rendered by declarative paraphrases such as *You cannot come closer* or *I want you to stay away* (among other possible paraphrases). This highlights the usefulness of a more abstract semantic analysis of the type developed in Sections 2 and 3 of this paper.

At this point, it is important to address a phenomenon that we encounter when dealing with silent gestures, which we may descriptively call *multifunctionality*, and for present purposes,

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[3] Here, the dotted underlining (e.g., tomorrow) marks the gesture's preparatory phase, lifting the hand up into a vertical position where its palm is facing away from the speaker's body; regular underlining (e.g., Sunday) marks the gestural stroke, where the hand is dropped forward in a motion as if throwing away an object.
[4] We adopt the definition of *directive* from Searle (1975:355).
[5] The *STOP* gesture is related to the *holding away* gesture, see Bressem & Müller (2017:3) for discussion.
[6] URL: https://tinyurl.com/yckk6z8a (Last accessed on 10th March 2023.)

we define as follows: an expression is *multifunctional* if its use has different functions/effects depending on the context. Multifunctionality is illustrated by the *STOP* gesture in (3); in some contexts, the signaler will be satisfied by the recipient's response if the recipient stops moving toward the signaler. In other contexts, the signaler will be satisfied if the recipient stops speaking. These outcomes are not identical, since it is possible to stop moving toward the signaler while continuing to speak. This begs the question of how the observable uses of the gesture relate to its underlying core meaning.

Two concepts from linguistics are relevant for the analysis of such gestural multifunctionality (see, e.g., Falkum & Vicente 2015 and Recanati 2017 for recent discussion). First, *homonymy* (or *lexical ambiguity*) is defined as a case where a single expression (e.g., a gestural form) is associated with two or more distinct lexical entries. If we were to analyze the different uses of *STOP* in (3) as a case of homonymy, we would assume at least two distinct lexical entries, amounting to $STOP_1$ and $STOP_2$. A well-established example of homonymy is the English word *bank*, which can denote a riverside or a financial institution. Second, *non-specification* is defined as a case where an expression has a single abstract lexical entry that is compatible with different contexts, giving rise to distinct contextual effects. Applied to the gesture in (3), a non-specification account would assume a single lexical entry for *STOP*, which would be more abstract than either of the lexical entries that a homonymy view would posit.[7] The question of whether the case of multifunctional directive gestures involves homonymy or non-specification will be central to the discussion in Section 3.

1.2. The search for gestural universals – from non-human primates to humans

We now turn to the question whether there are universals in human gestures, an issue that dates back to the writings of Quintillian in 95 C.E. While it has since become uncontroversial that gestures are culture-dependent, recent research on the topic argues that there are *candidates* for gestural universals - though at a very general, abstract level. Cooperrider (2019:230) proposes that all human cultures may have (i) gestures for negation, (ii) pointing gestures, (iii) palm-up gestures, (iv) size gestures (such as the above-mentioned *LARGE* gesture), and (v) time gestures. While previous research on gestural universals builds on the cross-cultural comparison of human gestures, which is indeed an important line of inquiry, we build on work such as Byrne et al. (2017), Graham et al. (2018) and Kersken et al. (2019), and take the gestures of great apes as our point of departure, i.e., gestures that appear to be shared by bonobos, chimpanzees, gorillas, orangutans — and humans.

In recent primatology research, Kersken et al. (2019) observe that 1-to-2-year-old (pre-linguistic) human children have an 89% overlap with chimpanzees in their repertoire of communicative gestures. It is an open question whether this overlap is due to a shared innate gestural repertoire, or due to resemblance-based (iconic) properties of the gestures coupled with general cognitive abilities. Either way, the presence of gestures that are shared by human children and chimpanzees strongly suggests that the same gestural repertoire was

[7] *Non-specification* is related to the notion of *polysemy*, where one expression is used in different related senses, as illustrated by the word *line* in *draw a line* vs. *read a line* (from Falkum & Vicente 2015:1). The terms differ in that *polysemy* is a broader concept, which also includes phenomena and analyses that do not map onto the notion of *non-specification* as defined in this paper.

present in our last common ancestor, ~6.6 million years ago (see, e.g., Pozzi et al. 2014). While published studies on the gestures of human children and chimpanzees focus on the form of the gestures,[8] and not on their meanings, Graham et al. (2018) investigate gestural meanings across ape species; their findings unearth a meaning overlap between chimpanzees and bonobos, whose last common ancestor lived ~1.2 million years ago.

Taken together, the overlap in the form of gestures between human children and chimpanzees, and the plausible assumption that there is also an overlap in meaning (be it due to innateness or the iconicity of the gestures), give rise to an interesting line of inquiry: gestural form-meaning combinations that are shared between humans and non-human great apes may trace back to our last common ancestor ~6.6 million years ago, and thus be shared by *all* present-day humans, who plausibly share the same ancestor. As a direct consequence, we expect that gestural meanings shared by humans and non-human primates are part of the gestural universals and/or semantic universals in humans.[9] Whether this hypothesis can be confirmed is an empirical question, since some shared meaning similarities may have arisen by chance or due to convergent evolution. The more modest aim of this paper is to address the question of what these universal building blocks of meaning may actually look like.

2. Laying out the toolbox

Semantic research that aims to establish building blocks of gestural meanings shared by humans and non-human primates needs to start by addressing two questions. First, given that potential meanings are more constrained in great apes than in humans, we need to establish which meanings are found in great apes. Second, it is useful to put a formalism in place that permits us to establish maximally precise renderings of gesture meanings in the form of lexical entries; this allows us, among other things, to decide whether multifunctional gestures involve homonymy or whether non-specification can explain the observed gesture uses. Section 2.1 reviews the approach from primatology, Section 2.2 sketches a first translation into a formal semantic approach. Subsequently, Section 3 proceeds to refine this approach.

2.1. Methodology from primatology for establishing ape gestural meanings

While linguistic research on human languages has (within limits) direct access to native speaker intuitions on the meaning of linguistic expressions, we cannot probe the intuitions of non-human primates in order to directly access meanings. This creates a need for a reliable method that allows us to establish the "meaning" of a given ape gesture in a given context. The established view on ape gestures holds that ape gestures are exclusively "imperative", i.e., directive gestures as defined in Section 1.1 of the present paper; in other words: attempts by the signaler to elicit an action from the recipient (see, e.g., Gómez et al. 1993, Tomasello & Camaioni 1997 for discussion).

[8] For example, the *BECKON* gesture is defined as "Hand moved in a sweep from elbow or wrist towards signaller" (Byrne et al. 2017:758).
[9] On the topic of semantic universals, see, e.g., Wierzbicka (1996), von Fintel and Matthewson (2008).

Given that ape gestures are directive, Hobaiter & Byrne (2014:1596) infer the presumably intended "meanings" for such gestures on the basis of *apparently satisfactory outcomes* (ASOs), which is the intended action to be elicited from the recipient. Ape gestures are typically performed towards an intended recipient, and they are repeated more than once. The ASO of a gesture is defined as the recipient's reaction that makes the signaler stop gesturing. For instance, if a signaler performs a *BECKON* gesture, we observe that the signaler repeats the gesture, and stops repeating it when the recipient moves towards the signaler. This *moving-closer*-action constitutes the ASO, and Hobaiter & Byrne thus conclude that *BECKON* has the meaning "Move closer". In Hobaiter & Byrne's (2014) Table S1,[10] "Move closer" is defined more technically as "recipient moves closer to signaler".[11]

2.2. Comparing the ASOs in primatology to utterance denotations in formal semantics

Zooming out from the ASO "Move closer", we observe that 17 of 19 ASOs defined in Hobaiter & Byrne (2014) follow the template "recipient [VERB]-s […]", and the two remaining ASOs follow the template "[…] [VERB]-ing between the signaler and recipient". ASOs thus differ from the type of meanings generally assumed in formal semantic theory in that they are oriented exclusively towards a recipient and an outcome. In a linguistic analysis, this would be equivalent to rendering the meaning of the human-language imperative *Move closer!* by virtue of the paraphrase "addressee moves closer to speaker".

Comparing ASOs to the sentence/utterance denotations in human language semantics, the human-language imperative *Move closer!* would be analyzed as sketched in (4) for three different approaches to imperatives (modeled after Rudin 2018:106-109). The approach of Portner (2007), (4a), treats imperatives as property descriptions, which are proposed by the speaker as an addition to the recipient's *To-Do List*, a virtual set of properties that recipients aim to realize of themselves. Kaufmann (2012, 2016) treats imperatives as statements that contain a covert necessity modal (*must*), coupled with a performative presupposition (≈ *I hereby decree*), (4b). Condoravdi & Lauer (2012, 2017), by contrast, argue that imperatives encode a preference of the speaker, (4c), which the imperatives make public.

(4) *Informal renderings of different approaches to human language imperatives*

a. $[\![\textit{Move closer}]\!] =_{\text{(à Portner)}} [\lambda x : \text{x is the recipient . x moves closer to the speaker}]$

b. $[\![\textit{Move closer}]\!] \approx_{\text{(à Kaufmann)}} [\![\text{I hereby decree that you must move closer to me}]\!]$

c. $[\![\textit{Move closer}]\!] \approx_{\text{(à Condoravdi \& Lauer)}} [\![\text{I want you to move closer to me}]\!]$

Out of the approaches in (4), Portner's in (4a) is the most comparable to an ASO-based approach in that the semantics only encodes the desirable actions of the recipient in the form of a property description, and leaves it to the pragmatics to communicate the desirability of these actions, rather than semantically encoding it. The alternative approaches also entail semantically represented modality (e.g., *must* or *want*), and there is no reason to assume that the meanings of ape gestures contain such modality. As a point of departure, we can thus use Portner's approach to model the semantics of directive gestures, both in non-human apes and

[10] Table S1 and S3 of Hobaiter & Byrne (2014) are found in the *Supplemental Information* document.

[11] As a helpful convention, the names of ASOs and their descriptions will be set between double quotation marks (e.g., "Move closer") whereas English language expressions will be italicized (e.g., *Move closer*).

in humans. As an informal notation, we can use (5), where Hobaiter & Byrne's (2014) "Move closer" ASO is mapped onto a Portnerian denotation by virtue of a wave arrow.

(5) ASO:Move-closer $\rightsquigarrow$ [λx : x is the recipient . x moves closer to the signaler]

For the 17 ASOs in Hobaiter & Byrne (2014) with a "recipient [VERB]-s […]" template, a Portner-style analysis can be rendered via a direct mapping, substituting *x* for *recipient*. Similarly, an ASO that follows the "[…] [VERB]-ing between the signaler and recipient" template is illustrated in (6) for Hobaiter & Byrne's (2014) "Initiate grooming" ASO.

(6) ASO:Initiate-grooming $\rightsquigarrow$ [λx: x is the recipient . grooming between the signaler and x]

Note that the lambda notation in (5)-(6), which treats gesture meanings as expressions of type <e,t> may suggest a compositionality of gesture meanings that is not found. Crucially, the presupposition of these expressions requires the argument slot *x* to be contextually saturated by the recipient, which in fact precludes further compositionality. We will maintain this notation for present purposes as a means of highlighting similarities to human language imperatives.

We have thus put into place an initial formalization of the gestural meanings proposed in the primatology literature. Section 3 problematizes and further refines this formalization.

3. ***Core Meanings*: towards the meaning atoms of ape gestures**

3.1. Lack of one-to-one matching between gestures and ASOs

One well-established feature of non-human ape gestures is that there are virtually no one-to-one matchings of gesture to ASO. Some ASOs are only associated with one or two gestures, but other ASOs are associated with an entire range. To give an example for each scenario, Graham et al. (2018:9) cross 11 ASOs with 21 gestures. In their selection, the ASO "Travel with me" in chimpanzees is only associated with the *LOUD-SCRATCH* gesture, whereas, the ASO "Move closer" is associated with 9 distinct chimpanzee gestures. (Note also that this selection is not exhaustive in that, e.g., Hobaiter & Byrne 2014:1596 document 19 ASOs and 66 gestures.)

Making matters even more complex, a given ape gesture generally occurs with more than one ASO; for the 9 chimpanzee gestures that are associated with the ASO "Move closer" in Graham et al.'s (2018:9) selection, the authors list only one gesture (*BECKON*) that is only associated with "Move closer" in chimpanzees, whereas the other 8 gestures are associated with anywhere between three and seven ASOs (*OBJECT-SHAKE* being associated with seven ASOs). This overview may still be incomplete, since *BECKON* has elsewhere been established to occur with two different ASOs, "Move closer" and "Reposition body" (Hobaiter & Byrne 2014). The one-to-many matching of non-human primate gestures and ASOs will be the focus of the remainder of this paper.

Before we proceed to a more in-depth discussion of gestural multifunctionality, it is worth mentioning a distinction that was introduced by Cartmill & Byrne (2007), between “tight”, “loose”, and “ambiguous” gestures in great apes. Gestures are classified as “tight” when their use corresponds to a select ASO in 70% or more of the observations. By contrast, gestures that map onto a single ASO in 50% to 70% of observations are classified as “loose”, and the remaining gestures as “ambiguous”. This scalar distinction models the observed degree of multifunctionality of these gestures, i.e., it is not the case that “tight” gestures necessarily occur with only one ASO. Hobaiter & Byrne (2014) classify 13 of 36 gestures as “tight”, but only 4 of those “tight” gestures occur with only one ASO in their observations, whereas the remaining 9 “tight” gestures still occur with more than one ASO.

For the purposes of this paper, the “tight” vs. “loose/ambiguous” distinction is inconsequential, as we will focus on the ASOs themselves. To give a concrete example, *PUSH* in chimpanzees is a “tight” gesture that has “Move away” as a non-primary ASO. *PUSH* is used for “Stop that” in 78% of the observations of Hobaiter & Byrne (2014), and for “Move away” in 22% of the observations. Much in line with Graham et al. (2018:9), I will nevertheless assume that *PUSH* does in fact occur with the ASO “Move away” and thus needs to have a meaning compatible with this ASO. Using these two ASOs as a case study, an approach is outlined in Sections 4.1–5 that assumes non-specification rather than lexical ambiguity, as defined in Section 1.1, suggesting that abstract semantic analyses of this type are possible for many multifunctional gestures.

3.2. Stating the challenge and outlining a solution

For a linguist studying the gestures of non-human great apes, their high level of multifunctionality may suggest that these gestures are fundamentally distinct from human modes of communication. For example, the chimpanzee *ARM-RAISE* gesture maps onto five ASOs, given as “Acquire object” (48% of observations), “Move away” (19%), “Move closer” (15%), “Stop that” (11%),[12] and “Climb on you” (7%) (Graham et al. 2018:5). It may initially seem hopeless to posit a *core meaning*, i.e., a uniform lexical entry, for such a gesture, possibly even suggesting that such a gesture *lacks* meaning altogether. Much to the contrary, Sections 4.1–5 show that a formal semantics toolkit provides a useful technology to handle the observed variation in how such a gesture is used. As a first step towards a linguistic analysis, it is worth highlighting the ways in which standard linguistic expressions are no less multifunctional than great ape gestures.

In human language, many elements have a highly abstract meaning that is compatible with a range of different contexts. A classic example of such abstraction concerns German discourse particles; while a lexical entry for German *ja* may be posited along the lines of (7) (see Lindner 1991, Jacobs 1991, Grosz 2021), the variation in the actual uses of *ja* is reflected by its translation equivalents. When translating a sentence that contains *ja* into English, suitable translation equivalents include *as you know*, *after all*, *of course*, *in fact*, and *indeed*, but none of them are perfect counterparts for *ja* (see Gast 2022 for recent discussion and analysis).

[12] Graham et al. (2018) use the label “Stop behaviour”, while Hobaiter & Byrne (2014) use “Stop that”.

(7) *ja(p)* conveys: the possibility of $\neg p$ is not currently under consideration.
(quoted from Grosz 2021)

Even closer to the example of directive ape gestures, we observe that human language imperatives may easily involve non-specification, as illustrated by the English imperative *Stop!*, which is as multifunctional as the corresponding gesture in (3). (Compare also imperatives such as *Keep going!*, *Continue!* or *Go ahead!*) If we were to use ASOs to describe the meaning of the spoken language imperative *Stop!* in English, we would plausibly posit a range of distinct ASOs, including, but not limited to, "recipient keeps physical distance to signaler" and "recipient is silent".

This suggests that the real task for a semanticist (and an arena in which linguistics and primatology research can inform one another) is to aim to establish an underspecified core meaning for a given gesture such as *ARM-RAISE*, which is compatible with each of its attested uses. In other words, rather than positing five utterance denotations for *ARM-RAISE*, as sketched in (8),[13] we aim to find one single abstract denotation that can give rise to the five different communicative effects in a suitable context. (The denotations in (8) are adapted from the ASOs of Hobaiter & Byrne's (2014) Table S1, see Section 2.2.)

(8) *Sketch of a homonymy-based analysis (to be rejected) of the meanings of ARM-RAISE*
a. $[\![\textit{ARM-RAISE}_{\text{Acquire object}}]\!]$ ≈ [λx : x is the recipient . x gives the signaler a salient object]
b. $[\![\textit{ARM-RAISE}_{\text{Move away}}]\!]$ ≈ [λx : x is the recipient . x moves away from the signaler]
c. $[\![\textit{ARM-RAISE}_{\text{Move closer}}]\!]$ ≈ [λx : x is the recipient . x moves closer to the signaler]
d. $[\![\textit{ARM-RAISE}_{\text{Stop that}}]\!]$ ≈ [λx : x is the recipient . x either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual]
e. $[\![\textit{ARM-RAISE}_{\text{Climb on you}}]\!]$ ≈ [λx : x is the recipient . x permits signaler to climb on them]

For a researcher pursuing a non-specification account of the various uses of *ARM-RAISE*, different outcomes are conceivable. As with the expressions of human language, the observed multifunctionality may owe to homonymy, non-specification, or a combination thereof. In other words, it is conceivable that the five readings in (8) derive from one single abstract lexical entry, which would eliminate homonymy from the analysis of *ARM-RAISE* in favor of non-specification, but it is equally conceivable that they derive from two abstract lexical entries, allowing for residual homonymy in combination with non-specification. The worst-case scenario would be one in which five distinct lexical entries are needed, as this would not contribute to our understanding of why individual gestures typically map onto more than one ASO, and why select ASOs are typically expressed by more than one gesture. In what follows, we outline a descriptive strategy for grouping together ASOs that share semantic properties, Section 3.3, and then outline an attempt at an abstract lexical entry that may underlie both the "Stop that" ASO and the "Move away" ASO, Section 4.

[13] Notationally, (8) models ape gesture meanings the way imperatives are modeled in (4a), while sketching an approach based on lexical ambiguity, i.e., homonymy, which subscripts the ASOs onto 5 distinct lexical entries.

3.3. Probing for common denominators

Looking at the findings of Hobaiter & Byrne (2014) and Graham et al. (2018), in particular, one noticeable ASO overlap concerns the ASOs “Move away”, “Stop that” and “Follow me”, as defined in (9). Cumulatively, the two texts discuss a total of 11 gestures that are attested with two of these three ASOs, plus 3 gestures that are attested with all three ASOs.

(9) *Hobaiter & Byrne’s (2014) definitions for three connected ASOs*
 a. “Stop that” … the recipient either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual
 b. “Move away” … recipient moves away from signaler
 c. “Follow me” … mature recipient follows mature signaler, usually in consortship

For a concrete example of a gesture that is attested with all three ASOs in (9), consider the *OBJECT-SHAKE* gesture (defined as “repeated back and forth movement of an object” in Byrne et al. 2017:759); in the observations of Graham et al. (2018:7), *OBJECT-SHAKE* is most frequently associated with “Follow me” (73%) and counts as a “tight” gesture in the sense in which this label has been discussed in Section 3.1 (= one ASO more than 70% of the time). In addition, *OBJECT-SHAKE* occurs with “Move away” in 8% of the observations and with “Stop that” in 3% of the observations. (For now, we set aside further ASOs associated with this gesture, which are “Initiate copulation”, “Acquire object”, “Move closer” and “Initiate grooming”.) In the same data set, a gesture that is attested with two of the ASOs in (9) is *ARM-RAISE*, which occurs in the “Move away” meaning 19% of the time and in the “Stop that” meaning 11% of the time.[14] *ARM-RAISE* is most frequently associated with “Aquire object” (48%) and counts as an “ambiguous” gesture in the sense of our Section 3.1 discussion (= no ASO more than 50% of the time).

What stands out about the set of meanings in (9) is that their connection is not arbitrary; two of the meanings share a negative component (“Stop that” and “Move away”), whereas two of them share a locational component (“Move away” and “Follow me”). In a very first informal attempt, we could capture this by means of assuming a negative component that is crossed with a locational component, (10); the three gestures could then be described in terms of semantic feature matrixes. In the feature matrix, [±negative] denotes whether we are dealing with an encouraging [–negative] or discouraging [+negative] gesture; [±locational] denotes whether movement is involved; [±signaler] denotes whether the signaler intends to perform the same activity or not. The common denominator of these three gestures would then be the presence of the feature [+negative], bold typed in (10). Feature matrices of the type in (10) are a notational convenience in order to allow us to descriptively capture commonalities among different ASOs.

(10) *first informal rendering of negative meaning overlap*
 a. [**+negative**, –locational, –signaler] “Stop that” ⤳ “not *this activity*!”
 b. [**+negative**, +locational, –signaler] “Move away” ⤳ “(you) not *here*!”
 c. [**+negative**, +locational, +signaler] “Follow me” ⤳ “(you and me) not *here*!”

[14] These two ASOs correspond to (8b) and (8d). A noteworthy observation is that the remaining three ASOs of *ARM-RAISE*, (8a), (8c) and (8e), all involve movement *towards* the signaler.

Moving beyond the ASOs in (10), there is a range of gestures that overlap not only in the ASOs "Move away" and "Follow me", but also in the ASO "Move closer", e.g., *ARM-SWING*, *OBJECT-SHAKE* and *OBJECT-MOVE* in Graham et al. (2018:9). These could similarly be modeled by assuming that "Move closer" shares the [+locational, –signaler] composition of "Move away" but differs in that it is [–negative], i.e., an encouraging (non-negative) gesture. The corresponding feature overlap can then be illustrated as given in (11).

(11) *first informal rendering of locational meaning overlap*
  a. [–negative, **+locational**, –signaler] "Move closer" ⇝ "(you) *here*!"
  b. [+negative, **+locational**, –signaler] "Move away" ⇝ "(you) not *here*!"
  c. [+negative, **+locational**, +signaler] "Follow me" ⇝ "(you and me) not *here*!"

In words, the essential building block of meaning in (10) seems to be "*not*" or "*no*", whereas the corresponding building block in (11) would be "*here*".

The idea that [±negative] may be a central feature with regards to ape gesture classification is corroborated by the following observation with regards to the range of attested ASOs. Hobaiter & Byrne (2014) list the ASOs for 36 non-play gestures in their Table S3; out of those 36 non-play gestures, 8 gestures had "Stop that" as the most frequently attested ASO, and 6 gestures had "Move away" as the most frequently attested ASO, in addition to which these two ASOs were associated with a further 7 gestures, i.e., 21 in total. Since "Stop that" and "Move away" are transparently negative and discouraging (which we return to in Section 4), this indicates a division of gestures into discouraging/negative gestures (the meaning of which relates to "Stop that" and/or "Move away") and encouraging/positive gestures. ASOs that are clearly encouraging/positive are "Contact" and "Move closer", which Hobaiter & Byrne (2014) define as "physical contact of an apparently affiliative nature, such as hugging, touching etc. between the signaler and recipient" and "recipient moves closer to signaler", respectively.

Notably, a formalization of the hypothesized core meaning components of "Stop that" and "Move away", which would amount to "*not*" and "*no*", is not a trivial undertaking. The next section outlines first steps of doing so, and maps out the hypothesis space.

4. Towards a lexical entry for "Stop that" and "Move away"

We proceed to explore two possible approaches to the lexical entries of "Stop that" and "Move away": one analysis that is relatively complex and builds on the meaning commonly assumed for the English word *stop*, in Section 4.1. This is contrasted with a more minimal analysis in Section 4.2. As shown in Section 4.3, support for the more complex analysis stems from its potential for unifying "Stop that" and "Move away" at an abstract level.

4.1. Spelling out "Stop that" and "Move away"

Focusing on the ASOs "Stop that" and "Move away", a central commonality, (10a-b), is the fact that both are negative at an abstract level. The imperative command *Stop that* in spoken English could also be expressed by virtue of the prohibitive utterance *Don't continue doing* *that*. Similarly, a command *Move away* could be expressed by virtue of the prohibitives *Don't be so close to me* or *Don't stay here*. In human language, the negativity of *Stop that* (or rather *Stop doing that*) is not expressed at the clausal level, but contained in the predicate *stop*. Similarly, the negativity of *Move away* (or *Move away from me*) as a spoken language expression is not expressed at the clausal level, but contained in the locative adverb *away*.

Crucially, a fundamental property of gestures is that they are non-linguistic and do not contain words, i.e., we cannot know whether the "Stop that" ASO (= "the recipient either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual", as cited in (9a) from Hobaiter & Byrne 2014) is best modeled in parallel with the English-language imperative *Stop doing that* or in parallel with the English-language prohibitive *Don't continue doing that*. In fact, it is unclear whether such a distinction even makes sense in the realm of gesture analysis, given that there appear to be no formal theories of imperatives that draw a distinction between imperatives and prohibitives at the level of the denotation, once rendered in a formal metalanguage.[15] In other words, a more precise rendering of a "Stop that" ASO would have to collapse the denotation of "Stop doing that" and "Don't continue doing that" into a single formalization, as sketched very roughly in (12), which models it as the denotation of an English-language utterance for ease of exposition; (12) incorporates the meaning of the word *stop* from Zehr & Schwarz (2018:465).

In (12), the italicized $\textit{doing-that}_c$ is short hand for a contextually salient activity of the recipient. The idea behind this lexical entry is that *Stop doing that* presupposes that the recipient is currently (at t_c) engaging in a $\textit{doing-that}_c$ activity; if that presupposition is met, then the signaler attempts to add a property to the recipient's To Do List such that there is a point in time *t* in the immediate future, at which the recipient no longer engages in the same activity. Adapting notation from Rapp & von Stechow (1999) (among many others), "$t_c >< t$" means 't_c abuts t from the left side', i.e., *t* immediately follows t_c. Further refinements of (12) are, of course, possible; however, as of now, (12) suffices to illustrate how we may approach a formal rendering of a "Stop that" ASO, and we can now turn to the challenges it may face.

(12) $[\![\textit{Stop doing that}]\!]^c \approx [\![\textit{Don't continue doing that}]\!]^c \approx$
$[\lambda x : x \text{ is the recipient}_c \;\&\; x \text{ is } \textit{doing-that}_c \text{ at } t_c \text{ in } w\ .$
$\exists t\, [t_c >< t \;\&\; \neg[x \text{ is } \textit{doing-that}_c \text{ at t in w}]]]$

One central problem raised by (12) is the fact that a lexical entry along these lines would be far from minimal in a meaningful sense, i.e., much less minimal than what was implied in Section 3.3 by suggesting that "*not*" or "*no*" is a building block of meaning found in great ape gestures. In addition to containing logical negation, (12) assumes temporal reference, i.e., a notion of how the present point in time t_c differs from a future point in time *t*, and presuppositional meaning, i.e., an awareness of ongoing events or activities that are presupposed by a signaler when performing such a gesture. In a first step, we should ask whether such meanings — temporal reference and presuppositions — have cognitive reality in non-human great apes.

[15] I am grateful to Paul Portner (p.c.) for consultation on this matter.

As far as temporal reference is concerned, there is clear evidence that non-human great apes can plan for the near future, e.g., the next morning (see Janmaat et al. 2014). As a consequence, the temporal reference in (12) is conceptually unproblematic. (For discussions of whether chimpanzees remember have a concept of past events, see Janmaat et al. 2013.)

A reader may find it more questionable whether the lexical entries associated with chimpanzee gestures should contain presuppositional meaning of the type in (12). To see that this too, is unproblematic, consider the consequences of such an assumption. In humans, the presuppositions of the imperative *Stop doing that* would map onto the felicity conditions (or use conditions) of the imperative: if a speaker utters *Stop doing that* when the recipient is in fact not doing anything, then the imperative would clearly be infelicitous, prompting the recipient to respond by saying *I'm not doing anything*. This would plausibly be accompanied by a gesture / body movement of the type that signals presupposition denial, as described by Francis (2021) with the acronym *WAYTA*, i.e., *What Are You Talking About?!* For chimpanzee meanings, what we would predict is a similar reaction, i.e., bewilderment on part of the recipient if the signaler were to, in fact, communicate (12) in a situation in which the recipient is not engaging in any activity. For reasons that are self-evident, it is difficult to test experimentally if such bewilderment would arise, also since ASOs are defined in terms of recipient responses, which entails that a "Stop that" ASO would never be observed if the recipient wasn't engaging in an activity to begin with. However, for present purposes, there is no evident reason for *not* including assumptions on the recipient's current or prior behavior in the lexical entry of a gesture, as in (12), and presuppositions are one way of modeling this. An alternative would be to assume that gestures with a "Stop that" ASO have it as part of their at-issue entailment that the addressee was engaging in the activity to be stopped; this would eliminate the need to assume presuppositional meaning in non-human great apes. The empirical question remains, in either case, of whether presuppositional meaning is in fact found in non-human primates.

An entirely separate concern with the lexical entry in (12) is whether an imperative with such a meaning wouldn't in fact be vacuous in that every imperative command is an instruction to the recipient to stop doing one thing and do something else instead. For example, if an English speaker were to say *Close the window*, it would generally be the case that the intended recipient is in fact doing something else at the time, which is decidedly *not* a *closing-the-window* activity; this corresponds to the presupposition in (12). Subsequently, the recipient would stop engaging in that *not-closing-the-window* activity in order to close the window; this includes the main contribution suggested by (12). In other words, (12) may be a part of *any* imperative, rather than the specific meaning of "Stop that".[16] To see that this is intuitive, consider how most imperatives that prompt an immediate action of the recipient could easily be rephrased in *Do something else than what you are doing now, namely ...* Crucially, what sets *Stop doing that* apart from *Close the window* (in humans) is in fact the presuppositional nature of *Stop doing that*. While it is quite natural for a recipient to counter *Stop doing that* with the presupposition-denying response *I'm not doing anything*, as spelled out in (13a), it seems rather deviant to do so in response to a regular 'garden-variety' imperative, as shown in (13b). This means that the presuppositionality of (12) is, in fact, not a bug, but a feature of the analysis.

[16] I am grateful to Mats Rooth (p.c.) and Uli Sauerland (p.c.) for highlighting this concern.

(13) *Difference between "stop that" imperatives and garden-variety imperatives*
  a. A: Stop doing that. – B: I'm not doing anything!
  b. A: Close the window. – B: #I'm not doing anything!

To conclude this section, we can slightly modify the semantics of *Stop that* in (12) in order to model the semantics of *Move away*, as sketched in (14). We return to the similarity between the two denotations in Section 4.3.

(14) $[\![$*Move away (from here)*$]\!]^c \approx [\![$*Don't be so close to me*$]\!]^c \approx$
$[\lambda x : x \text{ is the recipient}_c \text{ \& } x \text{ is close to the location of the signaler}_c \text{ at } t_c \text{ in } w\ .$
$\exists t\ [t_c >< t \text{ \& } \neg[x \text{ is close to the location of the signaler}_c \text{ at } t \text{ in } w]]]$

Again, the presuppositional nature of "Move away" can be brought out by a mini dialogue, (15), where B denies A's presupposition (see Francis 2019 on *even* in presupposition denial.)

(15) A: Move away. – B: I'm not even close to you!

4.2. Exploring the hypothesis space

To conclude our discussion, let us start by revisiting central observations from the previous sections. First, we observed that a total of 14 non-play gestures (from a set of 36 gestures) in Hobaiter & Byrne's (2014) Table S3 have a most frequent meaning that amounts to "Stop that" (n=*8*) or "Move away" (n=*6*), both of which are negative in their nature. This suggests a partition of gestures into those that are negative/discouraging (including "Stop that" and "Move away") vs. those that are positive/encouraging (including "Contact" and "Move closer"). Second, we focused on the negative gestures and observed that their semantics may be complex in that they presuppose, in the case study of "Stop that", that the recipient is currently engaging in an activity, while prompting the recipient to change that activity. We can consider this our Hypothesis 1:

(16) *Hypothesis 1: semantically negative gestures*
$[\![\text{“Stop doing that”}]\!]^c \approx [\lambda x : x \text{ is the recipient}_c \text{ \& } x \text{ is } \textit{doing-that}_c \text{ at } t_c \text{ in } w\ .$
$\exists t\ [t_c >< t \text{ \& } \neg[x \text{ is } \textit{doing-that}_c \text{ at } t \text{ in } w]]]$

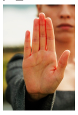
An alternative worth considering is to assume that the core meaning of such gestures is semantically much more minimal, leaving their actual use conditions entirely to the pragmatics. The complexities from (16) may be eliminated by simplifying it to something along the lines of "be still" when it amounts to the cessation of an activity, (17), or "interact with a (contextually salient) other individual" when it amounts to redirecting the recipient's behavior.

(17) *Hypothesis 2: minimal semantics of negative gestures + pragmatic enrichment*
ASO:Stop-that $\rightsquigarrow [\![\text{“Be still”}]\!]^c \approx [\lambda x : x \text{ is the recipient}_c\ .\ x \text{ is still}]$

A minimal semantics of this type would require a more heavy (but not implausible) reliance on pragmatics, e.g., by assuming that great apes (much like humans) only command an recipient to *be still* when the recipient is not still to begin with, but rather engaging in undesirable activity. Similarly, a semantics of "Move away" may not include an "away" component, but simply amount to "move in direction *y*", with a pragmatics that makes the directive infelicitous if the recipient isn't close to the signaler to begin with.

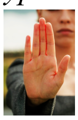
Issues of this sort, which concern the division of labor between semantics and pragmatics, are not unique to the study of great ape gestures. Similar questions arise with regards to the human *STOP* hand gesture illustrated in (3) and analyzed in (18). Does this gesture *mean* 'Stay away' or 'Don't come closer'? This may both involve negation and a presupposition that the recipient is moving towards the signaler at the utterance time t_c, as illustrated in (18).

(18) *Hypothesis 1: semantically negative gestures*

⟦  ⟧^{c} ≈ [λx : x is the recipient$_c$ & x is *moving towards the signaler*$_c$ at t_c in w .
∃t [t_c >< t & ¬[x is *moving towards the signaler*$_c$ at t in w]]]

Or should the meaning of *STOP* be rendered in terms of 'Be still', as sketched in (19)? Such questions need to be addressed in future research on the topic; the contribution of the present paper is to raise the question, which I consider to be fundamental for our understanding of directive ('imperative') gestures in general, and great ape gestures in particular.

(19) *Hypothesis 2: minimal semantics + pragmatic enrichment*

⟦  ⟧^{c} ≈ [λx : x is the recipient$_c$. x is still]

One evident drawback of the analyses in (17) and (19) is that they do not capture the negative discouraging nature of such gestures in the semantics proper, but rely heavily on the pragmatics to yield discouragement. It is an open question whether this is a desirable result or a concern to be remedied.

4.3. Unifying "Stop that" and "Move away"

Having explored a more minimal analysis of gestures such as "Stop that", we can return to the observation that great ape gestures are often systematically associated with certain sets of ASOs that do not seem accidental. For example Hobaiter & Byrne's (2014) Table S3 lists six gestures as occurring with both the "Move away" ASO and the "Stop that" ASO, with the observed frequencies of the ASOs cited in (20).

(20) *Gestures with ASO "Move away" and "Stop that", with percentages of observations, from Hobaiter & Byrne (2014), including their tight/loose/ambiguous terminology*

	gesture type	ASO	classification
a.	***HAND-FLING***	"Move away" (73%), "Stop that" (27%)	tight
b.	***SLAP-OBJECT***	"Move away" (60%), "Stop that" (13%)	loose
c.	***PUNCH-OTHER***	"Move away" (57%), "Stop that" (29%)	loose
d.	***TAP-OTHER***	"Stop that" (42%), "Move away" (25%)	ambiguous
e.	***SLAP-OTHER***	"Stop that" (64%), "Move away" (32%)	loose
f.	***PUSH***	"Stop that" (78%), "Move away" (22%)	tight

The abstract building blocks of meaning that we are looking for when we explore the possibility of gestural meanings that non-human great apes share with humans would plausibly amount to the common denominators of "Stop that" and "Move away". Such a "no/not" meaning atom is relatively easy to spell out in the more complex analysis of Section 4.1, as given in (21a). Here, P_c would be a contextually provided property, for which the specifications for "Stop that" and "Move away" are given in (21b-c). An attentive reader might notice that (21a) roughly amounts to the general meaning of "Stop!".

(21) *Common denominator of "Stop that" and "Move away"*
a. $[\![\text{Not X!}]\!]^c \approx [\lambda x : x \text{ is the recipient}_c \;\&\; P_c(x,t_c,w) \,.\, \exists t\, [t_c >< t \;\&\; \neg[P_c(x,t,w)]]]$
b. "Stop that": $P_c(x,t,w)$ = x is *doing-that*$_c$ at t in w
c. "Move away": $P_c(x,t,w)$ = x is close to the location of the signaler$_c$ at t in w

We can thus conclude that (21a) may be a building block of meaning present in great apes; this building block is plausibly shared by humans and non-human great apes (compare Patel-Grosz et al. 2023), indicating that it may be a semantic universal. The larger project involves the determination of a more extensive set of such building blocks by carefully looking at systematic ASO overlaps of the type found in (20).

5. Conclusion: revisiting building blocks of meaning and the consequences

This paper outlined a larger project with the premise that we can learn something about human gestural universals (and thus, possibly, human semantic universals) by looking at the gestures that humans share with non-human primates, and their meanings. The main contribution of this paper is to outline a methodology for determining the actual building blocks of meaning that may play a role in such an exploration. In doing so, we proceeded from the ASOs proposed in primatology, e.g., Hobaiter & Byrne's (2014) "Stop that" in (22a) and "Move away" in (22b). We then outlined a potential mapping onto an abstract lexical entry, sketched in (21a), building on established analyses of imperatives in human language.

(22) *from the ASOs of primatology to the lexical entries of formal semantics*
a. ASO:Stop-that … the recipient either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual
b. ASO:Move away … recipient moves away from signaler

Importantly, the idea that (21a) may be a universal building block of meaning has consequences not only for our understanding of human and non-human great apes, and for our understanding of directive ('imperative') gestures, but also for our understanding of semantic universals in pragmatic gestures. A wide-spread view (see, e.g., Abner et al. 2015:439) maintains that the management of discourse objects (i.e., information or topics in a discourse) can be metaphorically modelled as the management of virtual objects (McNeill's 1992 *conduit metaphor*). Particularly for the case of the gestures in (20), such metaphoric transfer can now be modeled quite directly. *HAND-FLING*, (20a), has been argued to fulfil the pragmatic function of rejecting a proposition φ that has been proposed (by the recipient) as an addition to the common ground (Patel-Grosz et al. 2023). Maintaining the core meaning in (21a), in (23a), we can transparently derive the meaning of *HAND-FLING* in (23a-b).

(23) *Revisiting pragmatic uses of HAND-FLING*

a. $[\![\text{Not X!}]\!]^c \approx [\lambda x : x \text{ is the recipient}_c \;\&\; P_c(x,t_c,w)\ .\ \exists t\ [t_c >< t \;\&\; \neg[P_c(x,t,w)]]]$

b. *pragmatic use:* $P_c(x,t,w)$ = x proposes at t_c in w that the proposition φ be added to the common-ground$_c$ of x and the signaler$_c$

This additional step from the shared directive gestures of primates to the pragmatic gestures of humans allows us to connect these findings to the question of universals in human pragmatic gestures, as in the findings of Bressem & Müller's (2014, 2017) family of *Away gestures*.

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You may like or dislike this paper, and we do care which. Sluicing and free choice[1]

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Abstract. In this paper we study how different FC inferences are derived in cases of sluiced sentences that differ just by the verb embedding the sluice, improving on Fusco (2019). We propose to add a new economy condition to Rudin (2019) that is able to derive – together with other existing constraints – the desired sluices from certain syntactico-semantic properties (temporal orientation; Condoravdi 2001) of embedding verbs. We then present an analysis in which the attested FC inferences are derived from the different sluices through the interplay of scopal parallelism (Chung et al. 1995; Fusco 2019) and uniqueness presupposition of singular *which* clauses (Dayal 1996).

Keywords: Sluicing, Free Choice, Uniqueness Presupposition, Orientation.

1. Introduction

In this paper we discuss the mechanics of sentences involving both sluicing and free choice disjunction. In particular, we aim at providing an analysis for the different meanings generated by the following two sentences:

(1) a. You may have coffee or tea, I don't know which.
b. You may have coffee or tea, I don't care which.

Whereas the former seems to presuppose that only one alternative is possible (and the speaker cannot tell which one it is), the latter appears to entail that both alternatives are possible to the addressee (and the speaker does not care which one the addressee will actually choose). In technical terms, while (1b) licenses Free Choice inferences, (1a) blocks them. We follow Aloni's (2018) and Fusco's (2019) intuition that the different readings are tied to the presence of the modal in the interpretation of the sluice (the partially elided *wh*-question) in (1a), and to the absence of the modal in the interpretation of the sluice in (1b):

(2) a. You may have coffee or tea, I don't know which [you may have].
b. You may have coffee or tea, I don't care which [you have].

This work wishes to accomplish two tasks. The first one is understanding why (1a) and (1b) yield different interpretations of the elided material. The second one is explaining how from these different elided structures we get different inferences with regards to FC. To account for the first task, we claim that the possible interpretations of a sluice are governed by an economy constraint which predicts the ideal sluice to discard the modal, which is introduced again when maximal economy would give an infelicitous sentence. Our discussion will highlight the importance of the notion of temporal orientation: leaving out the modal in the sluice in (1a) would result in an infelicitous sentence ('#You may have coffee or tea, but I don't know which you have.'), because of a contrast between the future time of evaluation given to *have* by the modal *may* in the antecedent, and the present time of evaluation provided to the same event *have* by

[1] We would like to thank Thom van Gessel, Dean McHugh, Ciyang Qing, Floris Roelofsen, the audience at SuB27, and the anonymous reviewers for their useful comments.

know in the consequent. Repeating the modal ensures a match between the two event times. On the contrary, *care* in the consequent of (1b) is able to provide future time of evaluation even if the event in its scope is expressed with a present. It is so because while *know* has present orientation, *care* has future orientation just like *may*. From this, to achieve our second goal, we derive the different FC readings by assuming a uniqueness presupposition triggered by singular *which* clauses. In (1a) this presupposition applies to the modal and generates a contrast with the FC reading of the antecedent according to which the possibility modal applies to multiple elements. Therefore, the Non-FC reading of the antecedent in (1a) is selected. On the other hand, in (1b) the uniqueness presupposition applies to the event itself and not to its possibility. Therefore, no contradiction is detected with the FC reading of the antecedent and FC inferences are thus permitted and directly derived via a narrow scope configuration.

In the next section we will present the previous account of the FC-in-sluicing puzzle by Fusco (2019), together with our reasons to improve her analysis. In section §3, we formulate an economy constraint that shows how we can derive two different sluices and we explain the role of temporal orientation in the selection of the optimal sluice. In section §4, we show how we get from different sluice to different FC inferences, through the uniqueness presupposition of singular *which* clauses and different scopal configurations. And finally, in section §5, we summarize our work, and we propose possible directions and puzzles for future researcg on the topic.

2. Fusco's sluicing on free choice

The main predecessor of our work is Fusco (2019). In her paper, Fusco aims at providing an account for FC in sluicing by means of a scope-based account. Fusco's account departs from the crucial intuition mentioned before. The intuition is that FC is blocked in sluicing constructions when the modal is 'at-least-semantically' present in the elided material (Fusco 2019; Aloni 2018).

(3) a. You may have coffee or tea, but I don't know which you **may have**.
b. You may have coffee or tea, but I don't care which you **have**.

Starting from this observation, Fusco's theory develops on two main assumptions. The first assumption is that FC can only be generated when the disjunction takes narrow scope (NS) with respect to the modal. In other words, FC arises whenever we have a logical form of the kind $\Diamond(a \vee b)$ (narrow scope configuration), and does not arise whenever the logical form is $\Diamond a \vee \Diamond b$ (wide scope configuration). This will block FC when the modal is present in the sluice, because of scopal parallelism. We will use this notion too later, for now it suffices to say that whenever the modal is in the sluice, the disjunction in the antecedent will take wide scope configurations, and therefore will block FC. Conversely, the absence of the modal in the sluice, induces a NS interpretation of the antecedent, which gives rise to FC. Further evidence for this analysis comes from the fact that substituting FC disjunctions with FC indefinites even yields ungrammaticality for the *know* case:

(4) a. #John may sit in any chair, I don't know which one ~~he may sit in~~.
b. John may sit in any chair, I don't care which one ~~he sits in~~.

The ungrammaticality of (4a) is predicted under Fusco (2019) if we consider that *any* has an obligatory narrow scope configuration (Chierchia 2006, 2013), and this cannot satisfy scopal parallelism when its *wh*-correlate – *which one* – scopes above the modal. We will later show that there are also additional reasons that make (4a) infelicitous.

Fusco's second assumption concerns the motivations behind which such configuration would be triggered through the presence of the modal. A couple of remarks seem to tie the phenomenon to the notion of *ignorance*. It is the ignorance declaration of the speaker to give rise to Moorean tension with a FC (i.e. narrow scope, for Fusco) reading of the antecedent, revealing that the speaker is not in the position to grant a FC permission. To resolve the tension, the wide scope reinterpretation mentioned above would do the job. However, we believe this point should be further clarified. In the next subsections we bring some arguments that tackle these two assumptions. In particular:

1. we challenge the first assumption, providing evidence from existing literature on the existence of wide scope Free Choice, posing serious threats to Fusco's overall theory on the licensing of FC cancellation;
2. we will oppose the second assumption through a series of counterexamples, showing that ignorance cannot be taken to be the reason for the blocking of Free Choice.

2.1. Wide scope FC

Fusco's theory relies on the idea that the absence of the modal in the sluice would trigger the NS configuration of the sluice in (3b), giving rise to FC, while the presence of the modal in the sluice would trigger the WS configuration in (3a), blocking FC, or, more precisely, inducing a non-FC re-interpretation of the antecedent. However, dismissing the possibility of wide scope FC might be too hasty. Since Zimmermann's (2000) example (*Detectives may go by bus or they may go by boat.*), wide scope FC has been an open issue, and most recent FC theories aim at accounting for wide scope FC together with its narrow scope counterpart, as in Bar-Lev (2018), Goldstein (2019) and Aloni (2022). While in Aloni's state-based modal logic, wide scope configurations are just compatible with FC;[2] in Bar-Lev (2018) wide scope configurations generate FC when they are hiding a covert *else*. In fact, a crucial step in the debate is to properly isolate examples of wide scope FC. What we mean is that surface scope might just be apparent, and wide scope examples might reveal to result from operators or movements applied to a narrow scope LF. In order to find the desired examples, it is important to detect cases in which scope is fixed and overt. Bar-Lev (2018) reports the following example:

(5) Either Mary can have a pizza or else (= if she doesn't have a pizza) she can have a hamburger.

The claim is that *or else* fixes wide scope, while preserving FC. Crucially, Bar-Lev (2018) notices that every time a sentence with wide scope surface gives rise to FC inferences, it remains grammatical whenever we overtly introduce *or else* (Bar-Lev 2018). As a consequence, building on the theory of Klinedinst and Rothschild (2012), Bar-Lev (2018) claims that every wide scope FC involves a covert *or else*. According to Klinedinst and Rothschild (2012), the use of *or* with the meaning of *or else* is a 'non truth tabular disjunction'. Namely, *or* has two different uses: one in which it behaves as the commonly acknowledged truth tabular disjunction, and

[2] When pragmatically enriched, if we assume an indisputable accessibility relation (Aloni 2022); see the original paper for references.

one in which it means *and if not*. In particular the idea is that in wide scope FC *and* scopes above the modal, while *if not* takes a non modal argument, introducing for the second disjunct a scenario in which the event in the scope of the first modal (but not the possibility itself) is not realized. If we have this conjunctive meaning in apparent wide scope FC disjunctions, then the derivation of FC comes straightforwardly. '*(possible a) and, if not a, (possible b)*' gives us the FC meaning $\Diamond a \wedge \Diamond b$. Either way, considering the "or else" argument or not, FC can arise in wide scope configurations. The same conclusion has also been achieved through experimental methods by Cremers et al. (2017). Fusco's assumptions become then problematic. Interpreting the antecedent as having wide scope configuration, would not guarantee FC blocking, since FC is either derivable anyway, as in Aloni (2022) (under the assumption of an indisputable accessibility relation), or it might hide a covert "else", as in Bar-Lev (2018). Fusco might still argue that there is a strong contrast between the FC permission in the antecedent (caused by the conjuntive reading of the two disjunct) and the *ignorance* declaration in the consequent. Nonetheless, in the next section we will show that *ignorance* cannot be the culprit of FC cancellation (and thus of the contrast in (3)). We believe these examples are too big of an obstacle for Fusco (2019) and it is not clear how a scope-only account of FC would be able to properly account for FC cancellation in cases like (3a).

2.2. Ignorance shouldn't be blamed

Building on a consideration by Aloni (2018), Fusco's (2019) theory on sluicing and FC is grounded on the belief that FC is blocked whenever an ignorance (self)ascription by the speaker in the consequent triggers Moorean tension with the possible FC configuration of the antecedent. As a result, only the so-called 'ignorance sluices' would be responsible for FC cancellation, while 'other types of sluices, such as the indifference sluice [...] and the encouragement sluice [...], do not appear to cancel FC.' We believe that this observation is at least partially misleading. In fact, while Moorean tension might play an additional role for the specific *know* cases we observed with FC disjunction, 'indifference sluices' and 'encouragement sluices' are the *only* sluice types that do not block FC. It can be shown, it is not the case that the blocking of FC is always connected to ignorance and Moorean tension. Consider the following counterexamples:

(6) You may have coffee or tea
   a. ...guess which!
   b. ...and I'm surprised you don't even wonder which.

In examples like these the intuition is that we do not have FC. However, it can be noted that there is no ignorance ascription to the speaker, therefore there cannot be any Moorean tension between the antecedent and the consequence. After this observation, some might redefine the theory, objecting then that maybe Moorean tension ascribed to the speaker is not a necessary element, but a general connection with some kind ignorance is, nonetheless. In fact, avoiding *knowledge* verbs is not a guarantee that we are not facing ignorance ascriptions. The imperative *guess* in (6a) presupposes the ignorance of the addressee. Similarly, the verb *wonder* in (6b) might be connected to ignorance, although in a more vague way. However, any sort of indirect ignorance ascription is not necessary either, as can be seen in (7):

(7) You may have coffee or tea
   a. ...and I'm sure you (already) know which.

b. ...and even Susie can tell which.

Not only are these examples missing direct or indirect ignorance ascription, but they are precisely attributing knowledge. Crucially, even in these knowledge ascription sluices the prominent reading is FC blocking. The counterexamples we presented show that different FC readings in sluicing are not linked to direct or indirect ignorance attributed to the speaker, to the addressee, or to a third person. It has to be nonetheless recognized that a line is drawn between relevance (and encouragement) verbs and all the other ones. We have therefore to research the origin of FC cancellation on some crucial grammatical (or pragmatic) feature that divides these two classes.

To sum up, if in 2.1 we have shown that any framework reducing FC effects to NS configurations is faulty in accounting for the FC-in-sluicing puzzle, in 2.2 we have presented cases that brought us to reconsider Aloni's (2018) and Fusco's (2019) idea that FC blocking is linked to ignorance. If it is true Fusco's theory can be criticized because of these two wrong assumptions, it is also true that it makes crucial remarks and observations that have inspired this work and our solution, as we will discuss at the end of §4.

In the next section we will sketch a theory on something that so far has been left unexplained: namely, why the modal is present in the sluice of the *know* case, but absent in the sluice of the *care* case. Partially building on previous literature on the constraints that rule interpretation on sluices, we want to determine the grammatical features that separate relevance verbs from other sorts of verbs.

3. Part I: economy and orientation

Recall the examples we started with to present the FC-in-Sluicing puzzle, with their overt sluice intepretations (i.e. 'presluices'):

(8) a. You may have coffee or tea, but I don't know which you **may have**.
b. You may have coffee or tea, but I don't care which you **have**.

We can therefore start from asking whether such presluices are predicted by current theories of sluicing. In particular, we can notice that (8b) involve a modal mismatch: the possibility modal *may* in the antecedent is not repeated in the sluice. This implies that we need a theory that is able to predict sluicing mismatches, such as Rudin (2019). As we will show soon, Rudin's theory encounters some problems in deriving (8b), but we believe it's possible to improve his theory with a reasonable economy constraint that acts on the size of the default presluice and generates a new hierarchy of optimal sluices that will derive the desired results. Let us start presenting Rudin (2019) and the problem that arises when (8a) and (8b) have to be derived.

3.1. Rudin (2019): eventive cores and the pragmatic principle

Rudin (2019), like Kroll et al. (2017), is interested in explaining the limits of sluicing mismatches, those cases in which the ellipsis site present less, more, or (apparently) different material than its antecedent. Some of the most striking examples discussed by Rudin (2019) are reported down here:

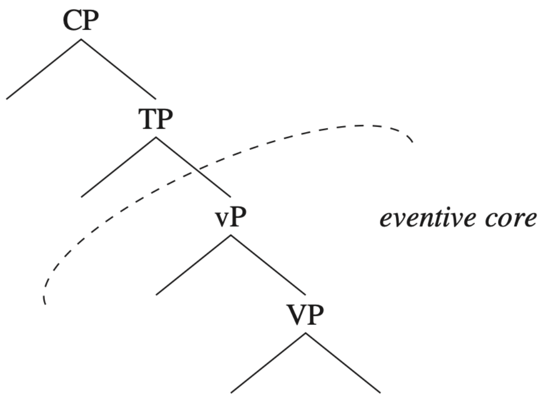
(9) a. [finiteness mismatch]
The baseball player went public with his desire *to be traded*. He doesn't care where

he is traded.

b. [modality mismatch]
Although Sally sees that she *must defeat her competitors*, she relies on Susie to tell her how *to defeat her competitors*.

Merchant (2001); Rudin (2019)

The generalization Rudin (2019) arrives to is that mismatches are possible whenever the mismatch involves material that originates outside the *eventive core*, where the *eventive core* is defined as 'the highest *v*P of a clause — the complete verbal complex, including the origin sites of verbs and their internal and external arguments' (Rudin 2019). This reflects an intuition already presented in Langacker (1974), namely that 'sluicing privileges content that originates within the verbal domain (the verb and its arguments) over content that doesn't' (Kroll et al. 2017). The generalization can therefore be exemplified by the following tree (Rudin 2019):



There is a cut-off at the level of *v*P: any head below it has to be identical between the antecedent and the ellipsis site, and any head above it is allowed to be different. Once this rule/generalization on possible mismatches has been established, a second principle, first proposed in Kroll et al. (2017), enters the picture in order to determine default sluicing interpretations:

(10) **Pragmatic principle to govern sluicing interpretations**
If a perfectly antecedent-matching ellipsis site yields an interpretation that is plausible in context, that interpretation should be strongly preferred to interpretations generated via imperfectly antecedent-matching ellipsis sites.

According to this principle, every head contained in the antecedent should be copied by the interpreter into the ellipsis site by default, and only when this is contextually not possible some modifications (on layers above *v*P) happen in order to obtain the optimal sluice. Note that these two principles directly derive the attested sluice interpretation for our *know* case since it involves perfect match:

(11) **You may have** coffee or tea, I don't know which [**you may have**].

On the other hand, however, it seems that the prediction for the *care* case yields the unattested interpretation in which the modal is repeated in the sluice:

(12) **You may have** coffee or tea, I don't care which [**you may have**].

To rule out (12) on the basis of Rudin's pragmatic principle, we should claim that its interpretation is somehow not plausible in context. However, it is not so clear why this interpretation should be implausible, and it is even possible to construct a scenario in which that is indeed a possible and plausible interpretation but it's still not the one recovered by speakers from the ellipsis site:

(13) SCENARIO: John's brother is taking John's 10-year old son George to a baseball game at Fenway Park. John's brother is very responsible and knows that George just underwent some kidney surgery and there are only specific kinds of food he can have, and he asks John, a very irresponsible father, what the doctor said that George can eat. John replies:

(14) George can eat cotton candy or hot dogs, I don't care which.

The intuition is that the elided material is interpreted by default as in (15a), rather than as in (15b):

(15) a. George can eat cotton candy or hot dogs, I don't care which (one) *he eats*.
b. George can eat cotton candy or hot dogs, I don't care which (one) *he can eat*.

Interestingly enough, however, (15b) is a perfectly grammatical sentence and conveys a plausible meaning. For these reasons, the perfect match interpretation in (15b) should be 'strongly preferred' to that in (15a), according to the pragmatic principle proposed by Rudin (2019) and stated in (10). It is therefore clear that refining the constraints that rule sluices interpretations is needed to account for both (8a) and (8b).

3.2. Economy, well-formedness, orientation

The failure of the pragmatic principle in the *care*-case, i.e. the fact that the perfect match is not the sluice's default interpretation even if it is a possible interpretation, could actually bring us to even more extreme consequences than those of Rudin (2019). In fact, the strategy we are going to propose could be seen as the reflection of taking the *eventive core* proposal seriously. If the identity domain is indeed the eventive core, i.e. if the identity we care about is the identity of *v*Ps, there seem to be no reason why we would assume as default the structure that perfectly matches the antecedent, when this antecedent contains more material than the one we are interested in. In fact, we can stipulate that the eventive core alone is also the default interpretation, since we don't need anything more than that to ensure identity. This reasoning could be summarized with a simple notion of economy.

(16) **Economy principle for sluicing**:
Do not include in the interpretation of the sluice more than what is required for identity (namely, the eventive core).

In Rudin (2019), the pragmatic principle is introduced because Rudin's generalization alone – the idea that any material generated above *v*P can mismatch – suffers from over-generation. In fact, if it's indeed the case that any material above *v*P can mismatch between antecedents and ellipsis sites, we expect a plenitude of different options to be available as possible reconstructions. However, while expanding the antecedent might require pragmatic intervention to determine what new material has to be brought in the ellipsis site, it is not clear how the principle comes in the way when the attested interpretation is strictly smaller than the antecedent, or when there is competition between sluices bigger and smaller than the antecedent. Our economy principle can be introduced in a harmless way, and this also repairs an anti-economical contradiction lurking in Rudin's (2019) theory: namely the fact that identity is checked at the level of *v*P but additional material should still be interpreted by default in the ellipsis site if this material happens to be in the antecedent.

Let's see how our principle derives the attested sluice for the *care* case:

You may have coffee or tea, I don't care which	ID$_{vP}$	ECON
☺ a. you have		
b. you may have		*!

Both *you have* and *you may have* are perfectly grammatical presluices, which preserve identity with the *v*P of the antecedent (modulo the antecedent for the *wh*-word, i.e. *you have x*). However, *you may have* violates our economy principles, since it includes material generated above the *v*P, namely the modal *may*, the head of the the Deontic Modal Phrase. We correctly predict that the interpretation of the elided material in the *care*-case excludes the modal. Under our assumptions, it is now the inclusion of the modal in the *know*-case that needs some more explanation. If interpreting the *v*P alone, leaving out the modal, is generally preferred, why is (17a) preferred over (17b)?

(17) a. **You may have** coffee or tea, I don't know which [**you may have**].
b. **You may have** coffee or tea, I don't know which [**you have**].

The answer is rather simple and follows from a widely-acknowledged principle that governs acceptable sluices:

(18) **Well-Formedness of sluices**
If a pre-sluice is infelicitous, then the corresponding sluice will not be well-formed.
(Dayal and Schwarzschild 2010)

Example (17b) is infelicitous and therefore it cannot be considered as possible interpretation for the sluice. The derivations for the optimal sluice in the *know* case goes as follows:

You may have coffee or tea, I don't care which	ID$_{vP}$	WELL-FORM	ECON
a. you have		*!	
☺ b. you may have			*

In other terms, our economy principle interacts with felicity, which operates on top, establishing a sluicing optimality hierarchy.

(19) **Sluicing optimality hierarchy**:
Eventive core > full antecedent > additional material

From this hierarchy, it is clear that when the eventive core and the full antecedent coincide, our predictions are the same as Rudin's (2019). However, when the eventive core is strictly smaller than the complete antecedent, we do predict the ellipsis site to 'shrink' (when this is possible), in contrast with Rudin (2019). The puzzle is now understanding why (17b) is infelicitous, in contrast with its *care* counterpart. We claim that this is tied to syntactico-semantic properties of modal and embedding verbs, those connected to (temporal) *perspective* and *orientation* (Enç 1996; Condoravdi 2001). The term *perspective* refers to the time of evaluation of the modal. On the other hand, the term *orientation* concerns the state of affairs of the event under the scope of the modal, and its time of evaluation may be different than the time of evaluation of the modal.[3] Consider the following examples of epistemic modals from Condoravdi (2001):

(20) a. He may have been sick.
MAY(PERF(he be sick))
b. He may be sick.
MAY(PRES(he be sick))
MAY(FUT(he be sick))

In both sentences the time of evaluation of the modal (*perspective*) is present. Yet, the time of evaluation of the prejacent (*orientation*) is past for (20a) and ambiguous between a present and a future in (20b). To see how this comes into play in our puzzle, consider that Enç (1996) points out that deontic *must* and *may* have future orientation, i.e. the time of the eventuality in the scope of the modal follows the time of evaluation of the modal. This means that the eventuality of having a drink in *You may have coffee or tea* is evaluated in the future.

(21) a. You may have coffee or tea.
MAY(FUT(have coffee or tea))

Let us now turn to the extension of the notion of *orientation* to question embedding verbs. Laca (2012) attributes to *know* and other attitudes verb present orientation.

(22) #You may have$_F$ coffee or tea, I don't know which you have$_P$.

As the previous example shows, there is a clash between the future time of evaluation given to have by *may* in the antecedent and the present time of evaluation provided to have by *know* in the presluice. This mismatch makes the sentence infelictious. Introducing the modal in the presluice ensures that *have* is again evaluated in the future:

(23) You may have$_F$ coffee or tea, I don't know which you may have$_F$.

Interestingly, Laca (2012) highlights 'a correlation between attitudes of preference (which assert an ordering among alternatives) and future temporal orientation'. We could then treat *care* equally to the attitudes of preference Laca (2012) refers to, like *want*.[4] *Care* indeed introduces a sort of preference order between alternatives. If *care* has future orientation:

(24) You may have$_F$ coffee or tea, I don't care which you have$_F$.

[3]In general, from a grammatical point of view, while perspective depends on the tense in which the modal auxiliary is expressed, orientation is generally determined by the *Aktionsart* of the verb under the modal's scope (Condoravdi 2001).

[4]Consider the following constrast:
(i) a. ??I know what you do tomorrow.
b. I care what you do tomorrow.

As (24) shows, *have* receives future time of evaluation both in the antecedent and in the presluice, and the sentence is felicitous. Note that this can be seen as a more radical notion of identity between *eventive cores*: two events are the same only if they are evaluated at the same time. As a prediction, we expect all *relevance verbs* (‘care’, ‘it matters’, ‘it is important’) to behave the same way with respect to FC permission in sluicing, since they have the same property of future orientation. This is indeed the case, as pointed out in Fusco (2019). Another felicitous prediction is that epistemic modals should never cancel FC (Aloni 2022), since they don’t have future orientation and the time of evaluation of their prejacent is purely given by the tense and aspectual markers on the prejacent.

(25) a. You might have voted for John or for Paul, I don’t know which [you **have voted** for].
b. You might have voted for John or for Paul, I don’t care which [you **have voted** for].

In this case, we indeed observe that *know* and *care* behave in the same way, and FC goes through. Let us now move to the second part of our solution, explaining how from different sluice interpretations we obtain different inferences concerning FC.

4. Part II: scope and uniqueness

In the previous section we provided motivations to ground Aloni’s (2018) and Fusco’s (2019) intuition according to which the contrast between *know* and *care* when it comes to FC inferences is tied to two different presluices:

(26) a. You may have coffee or tea, but I don’t know which you **may have**.
b. You may have coffee or tea, but I don’t care which you **have**.

While in (26a) the modal is present in the sluice, in (26b) it is absent. It is therefore natural that the two embedded questions have different meanings and it is crucial to understand how these two different meanings interact the antecedent, in particular with disjunction. To see what might play a role, it is particularly useful to take a step back from FC disjunction and look at another set of examples. Remember that is section §2 we showed how the ungrammaticality of the *know* sluice with FC indefinites is connected to their obligatory narrow scope. Considering now the following examples, in which the modality applies to multiple elements in the antecedent without using FC indefinites:

(27) a. There’s (only) one chair you can sit in, I don’t know which one it is.
b. There’s (only) one chair you can sit in, I don’t care which one it is.
c. # There’re multiple chairs you can sit in, I don’t know which one it is.
d. # There’re multiple chairs you can sit in, I don’t care which one it is.

We used the cleft *it is* to force the presence of the modal in the *care* sluice too. This is to show that it really is the presence of the modal in the embedded question that creates a problem, whenever there is a clash between possibility over multiple members in the antecedent, and singular *which* questions as sluices. Our claim is that the oddness of these sentences is caused by a uniqueness presupposition brought up by *which* that creates a contradiction-like contrast with the antecedent. While the antecedent states the possibility of sitting in multiple chairs in (27c) and (27d), the consequent claims through a presupposition that there is only one chair in which sitting is possible. This constitutes an additional reason for which *know* sluices with FC *any* antecedents result in ungrammaticality. The claim that *any x* is possible, clashes with the singular *which* question that presupposes that only one *x* is possible. Clearly, this clash arises only when the uniqueness presupposition includes the modal in its scope. In the other cases, the uniqueness presupposition simply applies to the event itself – *there is only one chair you (will) sit in* – and this is perfectly compatible with a scenario in which possibility applies to multiple elements. We will now unfold this observation, connecting it to the existent literature on the uniqueness presupposition.

4.1. The uniqueness presupposition

Singular *which*-clauses are generally thought to bear a uniqueness presupposition. For instance, the question *Which cat purred?* presupposes that there exists a unique *x* such that *x* is a cat and *x* purred. The traditional analysis of the aforementioned presupposition is the one by Dayal (1996), that assumes uniqueness to be triggered by ANS, an answer operator applying at the highest level, above CP, to the whole question. ANS operates on question extensions, presupposing that there exists a maximally informative member in the Hamblin set of possible answers.[5] Clearly, if we are dealing with a singular question, possible answers are all disjoint and ANS presupposes that there is *exactly one* true answer (Hirsch and Schwarz 2020). Following this reasoning, it is clear that whenever the uniqueness presupposition applies to possibilities, we have incompatibility with any scenario in which possibilities are distributed over multiple elements, like FC disjunctions and FC indefinites. However, there have been recent attempts to show, precisely in the case of answers featuring FC disjunction, that this uniqueness presupposition does not necessarily scopes above modals (Hirsch and Schwarz 2020; Kobayashi and Rouillard 2021). The most prominent counterexamples involve teleological constructions, like the following example from Hirsch and Schwarz (2020):

(28) The skeleton of a word with a missing letter is *fo_m*.
  a. Which letter could we add to make a word?
  b. *A* or *r*.

For this reason, Hirsch and Schwarz (2020) develop a local approach that can generate uniqueness in two different positions, one of which being under the modal. They manage to do so by conjecturing that it is *which* itself the element that conveys the presupposition and not the answer operator ANS. On the one hand, there is the High Uniqueness (HU) reading, generated when *which* scopes high, above the modal, and, on the other hand, there is the Low Uniqueness (LU) reading, generated when *which* scopes low, below the modal. According to Hirsch and Schwarz (2020) the logical forms of the HU and the LU reading of (28a) are respectively:

(29) a. **HU**: which > may $\ldots\exists!\ldots\Diamond\ldots$
  b. **LU**: may > which $\ldots\Diamond\ldots\exists!\ldots$

HU for (28a) says that there is a unique *x* such that *x* is a letter and it is possible to add *x* to make a word. On the contrary, LU in (28a) says something like ‘it is possible to complete a word inserting a unique *x* such that *x* is a letter’. However, while we do believe that explaining what is going on in (28) is a real theoretical puzzle, we are skeptical about any local solution that assumes two different sites for uniqueness presuppositions to apply. In particular, we are

[5] i.e. ‘a proposition that is true and entails any other proposition that is true’ (Hirsch and Schwarz 2020).

worried that the question-answer pair in (28) might constitute a peculiar case of accommodation. Our reason to claim this comes from the fact that the best way to test presuppositions in questions is through embeddings, and the low uniqueness presupposition does not survive this test. In fact, FC disjunctions are not good answers to singular *which* questions when they are embedded, as in (30a), and to be good they rather request plural marking, as in (30b):

(30) a. *I know which letter we could add to make a word: *a* or *r*.
b. I know which letters we could add to make a word: *a* or *r*.

We are therefore going to assume the datapoint in (30a) to affirm that there is no worry in ruling out the possibility of low uniqueness when discussing sluicing, since at the very least in embedded questions this possibility is not an option. We therefore assume that the two different sluices trigger each one a different presupposition: the sluice in (26a) triggers the presupposition that there exists a unique x s.t. it's possible for you to have x ($\exists!x\Diamond Hx$); while the sluice in (26b) triggers the presupposition that there exists a unique x s.t. you (will) have x ($\exists!xHx$). We will start now showing how the global uniqueness presupposition attested in embedded singular-*which* questions interacts with the sluice antecedents.

4.2. Sluices and antecedents

The gist of our proposal is that the interpretation of the antecedent of a sluice is affected by that sluice in a twofold way: (i) a sluice can help disambiguating a scopally ambiguous antecedent because of scopal parallelism, as already proposed in Fusco (2019); (ii) a sluice and its presupposition can restrict the meaning of antecedents that would be otherwise compatible with multiple scenarios. These two points will be now unpacked, starting from the possible meanings of antecedents involving FC disjunction. We adopt here the Bilateral State-based Modal Logic (BSML) defined in Aloni (2022), which allows us to capture both narrow scope and wide scope free choice.[6] Note that any semantics that is able to derive free choice in wide scope configurations would serve as a good tool for our solution. The motivations for this, however, are external to this work and are those mentioned in §2.1. In some sense, if we didn't consider the possibility of wide scope free choice, the following part of our solution would just be an extension to Fusco (2019), highlighting the existence of uniqueness presuppositions, which would however be redundant to solve the puzzle.

On a purely representational level, the sentence *You may have coffee or tea* might have two different meanings: the free choice one, $\Diamond Ha \wedge \Diamond Hb$; and the strengthened non-free choice one $\Diamond Ha \vee \Diamond Hb \wedge \neg(\Diamond Ha \wedge \Diamond Hb)$. The question is how these two different meanings are obtained from the disjunction in the sentence. In BSML, while the Non-FC meaning can only be compatible with a wide scope configuration, FC can be obtained through both narrow scope and wide scope configurations (Aloni 2022), via pragmatic enrichment (+):

- $[\Diamond(\alpha \vee \beta)]^+ \vDash \Diamond\alpha \wedge \Diamond\beta$
- $[\Diamond\alpha \vee \Diamond\beta]^+ \vDash \Diamond\alpha \wedge \Diamond\beta$ (if the relation is indisputable)[7]

[6]For a detailed description of the system please see Aloni (2022).
[7]In both Aloni (2018) and Aloni (2022), indisputability is linked to knowledge, and whenever there is an indisputable accessability relation, together with pragmatic enrichment, FC is predicted to arise. There seems to be a problem for those cases in which wide scope configurations appear to block FC even though knowledge is pervasive, like *You may have coffee or tea, and everybody knows which.* However, we can maintain the link between

Now consider that in *You may have coffee or tea, I don't know which [you may have]*, the *wh*-word in the sluice scopes above the modal, and by scopal parallelism (Chung et al. 1995; Tancredi 1992; Fox 1999) we need to assume that the disjunction scopes above the modal in the antecedent too:[8]

You may have coffee or tea...	**...which you may have**
$\boxed{\Diamond Ha \vee \Diamond Hb}$	$\boxed{\exists x \Diamond Hx}$ [9]

At this point of the argument, we only know that antecedent and sluice have the same wide scope configuration, but we still don't know if FC is licensed or not, since both FC and non-FC scenarios are compatible with a wide scope configuration. This is where the uniqueness presupposition kicks in. We know that the sluice for the *know*-case triggers the following presupposition $\exists! x \Diamond Hx$, namely $(\Diamond Ha \wedge \neg \Diamond Hb) \vee (\Diamond Hb \wedge \neg \Diamond Ha)$, which is compatible only with the Non-FC antecedent, since it is in blatant contradiction with the FC permission $\Diamond Ha \wedge \Diamond Hb$. Therefore, a wide scope non-FC interpretation of the antecedent is selected and FC is 'cancelled'. In the case of *care* sluice, the *wh*-word (the existential, in inquisitive terms) does not scope above any modal and by scopal parallelism it cannot scope above the modal in the antecedent too. This triggers a narrow scope configuration of the disjunction with respect to the modal for the antecedent.

You may have coffee or tea...	**...which you have**
$\boxed{\Diamond(Ha \vee Hb)}$	$\boxed{\exists x Hx}$ [10]

Narrow scope configurations are only compatible with FC, which is therefore derived. This time, the uniqueness presupposition of singular *which* clauses applies below the modal and thus it does not interfere with the FC permission arising from the antecedent. As we said in §2, our solution is profundly inspired by Fusco's. In particular, like Fusco, for the *care* case we assume that narrow scope is only compatible with FC and for the *know* case we assume that whenever we have FC-cancellation we also have wide scope. On the other hand, unlike Fusco, in our solution it's not the wide scope *per se* that blocks FC, since it could be compatible with it, but rather the uniqueness presupposition of singular *which* clauses.

5. Conclusions

In this paper we have provided a new account for the different FC readings that arise from the following sluiced sentences:

(31) a. You may have coffee or tea, I don't know which.

indisputability and knowledge, assuming that the uniqueness presupposition blocks FC cancelling the pragmatic enrichment, which is indeed optional (Aloni 2022).

[8]Since we adopt a state-based semantics for FC, we also need to adopt a state-based semantics for questions. This could be inquisitive semantics (Ciardelli et al. 2018), and in particular we exploit its existential quantifier and flattening operator to calculate the semantics of the question and its presupposition.

[9]Where $\exists$ is the inquisitive existential quantifier. On a semantic level, we obtain the completely antecedent-parallel $\Diamond Ha \vee \Diamond Hb$, by flattening the two contextually restricted alternatives $\Diamond Ha$ and $\Diamond Hb$.

[10]After flattening the alternatives: $Ha \vee Hb$.

b. You may have coffee or tea, I don't care which.

After presenting our motivations to improve on Fusco (2019) in section §2, we have grounded the mismatch intuition by Aloni (2018) and Fusco (2019) that assumed the modal to be present in (31a), but absent in (31b). To do so, we have provided a new economy constraint that modifies the dynamics of the constraints proposed by Rudin (2019) to rule mismatches and identity. In particular, we have claimed that *eventive cores* alone are default reconstructions, which can be extended whenever they result in infelicitious presluices. That is the case of *know*, which needs the repetition of the modal to ensure its prejacent to have the same evaluation time of the same event in the antecedent. For this discussion, the notion of temporal orientation proved to be fundamental. In section §4 we argued for a new solution to the FC-in-sluicing puzzle based on previous literature on the uniqueness presupposition of singular *which* clauses. Once different sluices are generated, different presuppositions arise: in the case of *know* the presupposition applies above the modal, creating a contrast with a possible FC antecedent, while in the case of *care* it applies below the modal and FC inferences go through. These considerations developed from the idea of scopal parallelism, which was the core for Fusco (2019)'s analysis, and determines whether the antecedent has to be interpretated as having a wide scope or narrow scope configuration of the disjunction with respect to the modal. We hope our analysis solves the puzzle, while informing us on various interesting dynamics. In particular, from our work it emerges that sluices are selected via economy on the basis of some grammatical properties, and that, once they are selected, they can affect the interpretation of their antecedent. This effect is two fold: there are both scopal and strictly semantic considerations that come into play determining the meaning of an antecedent given a certain sluice. For the future, we would like to provide a fully compositional analysis of the FC-in-S puzzle, starting from our results. More broadly, we would also like to gather cross-linguistic data on the FC-in-S puzzle and check our predictions: in particular,if the contrast baseline is replicated in all languages, we could either establish the universality of future orientation of relevance verbs or we would need to find new pragmatic solutions to the puzzle. Finally, we would like to study a puzzle that arises from *or else* disjunctions and scopal parallelism. Consider the following sentence:

(32) You may have coffee or else you may have tea, I don't care which ~~you have~~.

On the one hand, the theory suggests that the antecedent has wide scope, fixed by *or else*. On the other hand, the antecedent should have narrow scope because of scopal parallelism with its antecedent, in which *which* doesn't scope over the modal. Conversely, Patrick Elliott (p.c.) observed that the wide scope of *know* sluices seems to violate scopal parallelism in the following sentence, where discolated *either* should fix narrow scope for disjunction (Larson 1985; Wu 2018):

(33) You may either have coffee or tea, I don't know which ~~you may have~~.

We currently have no theoretical stance on how this tension might be resolved. For the moment, we hope to have shed some light on sluicing, and the various dynamics that play a role in the derivation of free choice from elided structures.

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Quantifying weak and strong crossover for wh-crossover and proper names[1]

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Abstract. Despite the status of crossover phenomena as key data in the theoretical study of pronominal syntax/semantics, crossover structures have been subjected to relatively little experimental testing. We investigate *wh*-crossover, quantificational crossover, and analogous structures involving proper name cataphora in behavioral rating studies, deploying a novel experimental paradigm which contrasts the acceptability of multiple readings of a target sentence. Using this more sensitive experimental task, our results favour an acceptability distinction between weak and strong *wh*-crossover, and provide a baseline against which to compare more controversial cases of crossover. We further find that proper name cataphora display a remarkably similar crossover effect, including a distinction between "strong" and "weak" cases.

Keywords: binding, crossover, anaphora, cataphora, semantics, experimental semantics

1. Introduction

This paper investigates crossover phenomena from an experimental perspective. We develop a general method to measure the deviance of crossover sentences with respect to each other and to grammatical controls. This is useful and necessary in order to address the many empirical controversies that still surround this classical topic, and hinder progress in understanding why crossover constraints exist. Crossover refers to a specific syntactic configuration in which pronouns cannot be interpreted as coconstrued with a particular antecedent, even though that antecedent ostensibly has scope over the pronoun. Classical cases of crossover involve either *wh*-words (Postal 1971) or quantifiers (Chomsky 1976):

(1) *Wh*-crossover
  a. *The teacher couldn't remember **which**$_i$ of the students they$_i$ said __ didn't need to hand in the essay.
  b. *The teacher couldn't decide **which**$_i$ student's poem they$_i$ liked __ the most.
  c. *?The teacher wondered **which**$_i$ student **their**$_i$ project topic frustrated __ the most.
  d. The teacher wondered **which**$_i$ of the students __ enjoyed the essay topic **they**$_i$ had chosen.
  e. The teacher couldn't decide **which**$_i$ student's poem __ frustrated **them**$_i$ the most.
  f. The teacher wondered **which**$_i$ of the students __ enjoyed **their**$_j$ project topic.

(2) Quantificational crossover
  a. *The lawyer noticed that **they**$_i$ forgot something about **every witness**$_i$' statement.
  b. *?The lawyer noticed that **their**$_i$ statement at the trial was upsetting for **every witness**$_i$.
  c. The lawyer noticed that **every witness**$_i$' statement at the trial was upsetting for **them**$_i$.
  d. The lawyer noticed that **every witness**$_i$ forgot something about **their**$_i$ statement.

[1] We would like to thank four anonymous reviewers for Sinn und Bedeutung as well as the members of the Meaning and Modality Lab at Harvard University for their feedback. Special thanks go to research assistant Sara Manning.

Traditionally, (1a), (1b) and (2a) are marked ungrammatical and referred to as *strong crossover* while the examples (1c) and (2b) are often deemed less severely deviant and referred to as *weak crossover* (Wasow 1972). In strong crossover, the pronoun c-commands the quantifier or the *wh*-word's gap, and thus cannot bind the pronoun; binding is possible when the gap c-commands the pronoun (as in (1d), (1e), (1f), (2c) and (2d)). In weak crossover, the pronoun precedes but does not c-command the gap or quantifier. Some authors further divide strong crossover into "true" strong crossover as in (1a) versus secondary strong crossover (Postal 1971), as in (1b) and (2a), where the *wh*-word or quantifier is nested inside a larger constituent.

The paradigm in (3) constitutes a minimal set that vividly illustrates the problem specifically with quantifier scope. The inverse scope construal is straightforward in (3a), yet pronoun binding in the very same configuration in (3b) and (3c) appears to be unavailable.

(3) Scope vs. binding
  a. The teacher thought that **someone** liked **every student**'s essay topic.
     '∀ over ∃' construal possible
  b. *The teacher thought that **they**$_i$ liked **every student**$_i$'s essay topic.
  c. *?The teacher thought that **their**$_i$ friends liked **every student**$_i$'s essay topic.

One of our goals is to find a way to measure whether *wh*-crossover is as deviant as quantificational crossover with respect to grammatical controls and whether strong crossover is as deviant as weak crossover. We use two grammatical controls. The first type involves exactly the same sentences (i.e. (1a), (1b), (1c), (2a), and (2b)) except that the pronoun is not understood as bound by the *wh*-phrase or the quantifier. Instead, we target the reading where it corefers with the matrix subject NP (*teacher / lawyer*) which we refer to as the "distractor NP". By providing an alternate referent for the pronoun explicitly, we not only create a grammatical control but also avoid participants accommodating such a referent, which can be a confound for acceptability judgement studies on binding/crossover (Kush 2013; Kush et al. 2017). The second of type of control involves sentences in which the structural relation between the pronoun and the gap is inverted to form a standard binding configuration (as in (1d), (1e), (1f), (2c), and (2d)).

Quantitatively measured judgements will help us decide whether strong vs. weak crossover are on par or, as tradition has it, that weak crossover is less deviant. It will also provide us a with a methodological basis to address controversial cases. For example, there is disagreement on the extent to which strong vs. weak relative clause variants of *wh*-crossover are deviant: weak crossover in relative clauses is sometimes found to be less deviant than its *wh*-question counterpart (Lasnik and Stowell 1991). Postal (1993) claims that relative clauses in French display no weak crossover effects at all (unlike English relative clauses, which he claims do). Further, a plethora of languages including German, Kiswahili, Hindi, Malayalam and Mandarin are argued not to show weak crossover effects under certain conditions, such as scrambling (Bresnan 1998; Fanselow et al. 2005; Lyu 2017; Bhatt and Keine 2019). This area is clearly ripe for experimental work. To showcase how our design can be applied to such controversies, we study cases structurally parallel to those in (1)-(2) involving coreference with proper names.

(4) Constraints on coreference (cataphora with proper names)
  a. ***He**$_i$ claimed that **Daniel**$_i$ was an amazing chef.
  b. *The chef knew that **he**$_i$ was disappointed by the soup **Daniel**$_i$ made.
  c. ?The chef$_j$ knew that **his**$_i$ soup had disappointed **Daniel**$_i$.

In (4a) and (4b), which are parallel to strong crossover configurations, the pronoun cannot be understood as coconstrued with the proper name *Daniel* that it c-commands. This is particularly interesting since no constraint on binding can per se automatically prevent two referential expressions from coreferring. By contrast, coreference/coconstrual of the pronoun with the proper name appear to be much more accessible in weak crossover configurations such as (4c). However, these basic intuitions can be challenged, with the readings available in these constructions affected by contextual factors, and by phenomena like focus (Heim 1998, 2007; Bianchi 2009; Moulton et al. 2018; Gor and Syrett 2019, pear), and so we apply our method to probe crossover severity quantitatively to these cases as well.

It turns out that the most widely used, perhaps at this point even "classic", experimental method for investigating semantics, namely acceptability or truth-value judgements given a context, is difficult to implement for binding or coreference phenomena.[2] This is because providing a context is not sufficient for participants to read the target sentence with the desired bound reading: if they find the sentence acceptable, it's often still possible they have instead understood the sentence with the pronoun referring to a distractor NP, as in (5a) and (5b). Moreover, they may actually judge the sentence as *unacceptable* relative to a context that describes the bound reading (since they understand the sentence as having a different reading).

(5) a. The lawyer$_j$ noticed that **they**$_j$ forgot something about **every witness**$_i$' statement.
b. The lawyer$_j$ noticed that **their**$_j$ statement at the trial was upsetting for **every witness**$_i$.

Instead we deploy a "meaning availability" design inspired by the unambiguous paraphrases commonly used in syntax/semantics teaching, described in Section 2, which directly compares the two available readings side-by-side. A direct comparison of this approach to the classic sentence acceptability design, using the same experimental items, can be found in Appendix A.

The structure of this paper is as follows: Experiment 1 and Experiment 2 investigate *wh*-crossover and quantificational crossover respectively. This showcases our experiment design on relatively well-understood cases of crossover, creates a baseline for more controversial cases of crossover to be compared against, and allows us to probe whether *wh*-words and quantifiers really behave identically. In brief, we find a significant impact of crossover on pronoun binding for both *wh*-binding (Experiment 1) and quantifier binding (Experiment 2). We also find a significant difference between weak and strong cases, but only for *wh*-crossover. This will be relevant in assessing the empirical coverage of theories which do vs. don't distinguish strong and weak crossover. We then move on to a more controversial case, investigating coreference between pronouns and proper names in Experiment 3. We also find a significant effect of cataphora, analogous to crossover, and a significant difference between weak and strong configurations: (4b) is more deviant than (4c). These results have implications for theories relating coreference and binding, such as Rule I (Grodzinsky and Reinhart 1993) and its derivatives.

[2]An acceptability design is used by Kush (2013); we suspect that this, along with issues with plausibility, may explain why he found no difference between weak and strong crossover. While he did find an effect of crossover overall, this is arguably confounded by the implausibility of his crossover sentences under their bound reading.

2. Experiment 1: *wh*-crossover

Our first experiment investigates *wh*-crossover by comparing possible crossover interpretations to two controls: the same sentence where the pronoun is interpreted as the distractor NP, and structurally similar sentences involving straightforward (possible) binding.

2.1. Method

We use a "meaning availability" design which sidesteps the idea of sentence acceptability and jumps immediately to the question at the heart of crossover, namely what the pronoun is coconstrued with. Participants see the target sentence along with two unambiguous paraphrases corresponding to the two readings, and are asked to rate "To what degree can this mean...?" each paraphrase on a Likert scale of 1-5. A screenshot from this study showing this meaning availability design (used in all subsequent experiments) is given in Figure 1. Presenting the two paraphrases side by side helps participants be aware that the sentence may be ambiguous, and consider a second reading they may not initially have spotted.[3] We use a 2x3x2 cross, crossing the two orders *wh*. . . [gap]. . . pronoun (corresponding to binding) and *wh*. . . pronoun. . . [gap] (corresponding to crossover) with three structural configurations corresponding to strong, secondary strong and weak crossover, and each of those with two potential readings.[4]

(1) *Wh*-crossover and *wh*-binding (repeated from the introduction, without judgements)
  a. The teacher$_j$ couldn't remember **which**$_i$ of the students they$_{i/j}$ said _ didn't need to hand in the essay.
  b. The teacher$_j$ couldn't decide **which**$_i$ student's poem they$_{i/j}$ liked _ the most.
  c. The teacher$_j$ wondered **which**$_i$ student **their**$_{i/j}$ project topic frustrated _ the most.
  d. The teacher$_j$ wondered **which**$_i$ of the students _ enjoyed the essay topic **they**$_{i/j}$ had chosen.
  e. The teacher$_j$ couldn't decide **which**$_i$ student's poem _ frustrated **them**$_{i/j}$ the most.
  f. The teacher$_j$ wondered **which**$_i$ of the students _ enjoyed **their**$_{i/j}$ project topic.

To better control the domain of quantification and noun gender, we use *which NP* phrases instead of plain *who*. We note that *which NP* constructions (D-linked *wh*-phrases) have been claimed to result in weaker (weak) crossover effects than *who* (Wasow 1972; Pesetsky 1987; Falco 2007), but do not anticipate this as an issue since it will apply to all our items equally.

A second notable feature in our experiments is the use of singular *they* rather than gendered pronouns. Most traditional examples of crossover in the literature involve masculine pronouns; however, many anecdotal reports among younger English speakers suggest a dispreference for coconstrual between masculine pronouns and *wh*-words like *who* in English. Singular *they* has been in use for centuries precisely in these epicene cases, where the gender is unknown or irrelevant (Balhorn 2004; Bjorkman 2017; Conrod 2019). We include masculine, feminine and singular *they* pronouns for a final 2x3x2x3 design. Finally, we conducted a separate norming study on the plausibility of the paraphrases used, which we omit for space, but which ensured that readings were similarly plausible across sentences.

[3]Unlike the forced-choice design of Felser and Drummer (2017) (studying crossover in German), this allows participants to rate both readings high if they feel both to be available, meaning that the possibility for the pronoun to refer to something other than the *wh*-word does not occlude the ratings for it being bound by the *wh*-word.
[4]The full set of experimental items (108 sentences) is available on OSF at `https://osf.io/dh2qb`

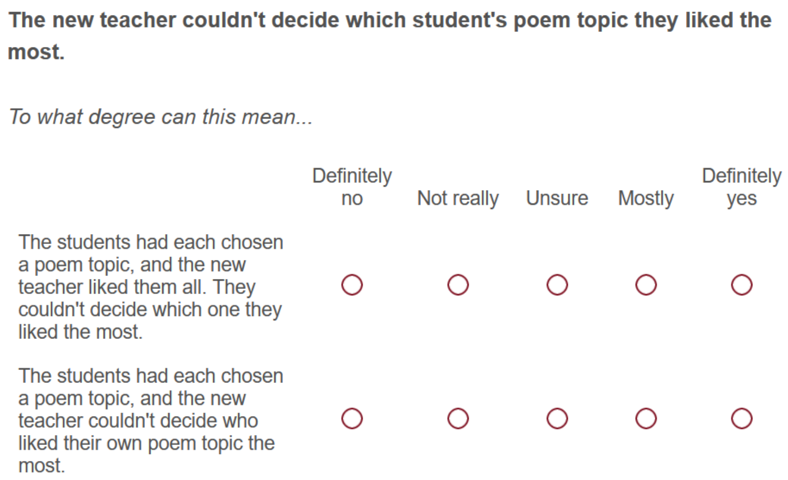


Figure 1: Screenshot of a secondary strong crossover sentence in the meaning availability design (Experiment 1). The first paraphrase describes the distractor NP reading (*they* coconstrued with *the new teacher*), while the second describes the bound reading (*they* coconstrued with *which student*). We expect high ratings for the first paraphrase and low ratings for the second.

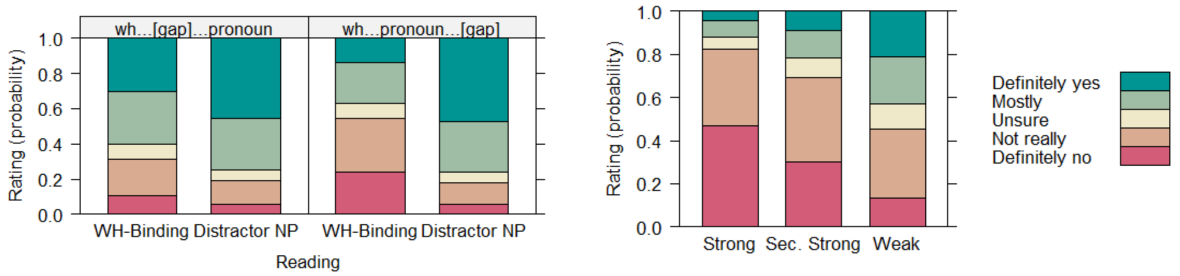
We preregistered this study on OSF.[5] We recruited 144 self-reported native English speakers on Prolific, of which we excluded 7 due to failed attention checks and 1 who learned English later than age 5.[6] Participants saw 6 target items and 6 fillers in random order. These and all other participants in the studies reported in this paper were paid for their time at a rate of $12/hr.

2.2. Results

We fit an ordinal mixed effects model in R (R Core Team 2021) using the `ordinal` package (Christensen 2019) with an interaction between gap/pronoun order and reading, as well as random effects for participant ID, average rating of each paraphrase from the norming study and the tendency of participants to identify ambiguous filler items (some participants always rated both readings of ambiguous fillers high, while others only ever rated one of the two readings high).[7] Figure 2a shows the model's proportions of ratings for each condition.

We see no significant effect of reading alone ($p = 0.14$), but a clear, significant effect of pronoun-before-gap on the bound reading (i.e. crossover vs. binding) between columns 1 and 3 of Figure 2a. This decreases the odds of a high rating by a factor of 0.38 ($SE = 1.31$, $p < 0.05$). We also see a significant positive effect of pronoun-before-gap with the distractor reading (compare columns 3 and 4), which increases the odds of a high rating by a factor of 2.81 ($SE = 1.49$, $p < 0.05$). In other words, we find that we do indeed see that the crossover (pronoun before gap) configuration significantly reduces the availability of coconstrual (combined across strong, secondary strong and weak crossover). These results also show that it is specifically the coconstrued reading causing the low ratings, not the syntax, since the distractor reading receives high ratings and the sentences are identical apart from the interpretation of the pronoun.

[5] `https://osf.io/9p3ws`
[6] While we stick to standard practice here, see Cheng et al. (2021) for discussion of the concept of native speaker.
[7] Later AIC tests found that the ambiguity availability on fillers did not actually improve the model's overall performance; however, we leave this random effect in since it was used throughout the original analysis.



(a) Effect of gap/pronoun order on reading

(b) Strong vs. weak crossover

Figure 2: Results for Experiment 1. We see a significant effect of crossover (columns 1 and 3 of (a)) and a significant effect of strong vs. weak crossover.

To quantify the effect of strong vs. weak crossover, we fit a second ordinal mixed effects model on just the bound reading of pronoun-before-gap (crossover) items, with the same random effects as before, shown in Figure 2b. Notably, this effect is significant: weak crossover roughly doubles the likelihood of a high rating, increasing the odds of a high rating by a factor of 2.19 ($SE = 1.26$, $p < 0.05$). The difference between strong and secondary strong shows a trend for secondary strong to be weaker than true strong crossover, but this is not significant ($p = 0.30$).

The above results are shown combined across all pronoun genders (masculine, feminine and singular *they*). We also investigated the effect of pronoun gender on binding, and found that in fact, singular *they* provides the highest ratings for the bound reading (and the most balanced between the bound and distractor reading). Participant age has no significant effect on the availability of bound singular *they*. More details can be found in Appendix B.

2.3. Discussion

Experiment 1 demonstrates the utility of the meaning availability design: we are able to reliably detect crossover and even a significant difference between strong and weak crossover, supporting long-held intuitions (Wasow 1972) that weak crossover violations are less severe than strong crossover. This also matches the work of Felser and Drummer (2017) on German *wh*-crossover. That said, the overall ratings for weak crossover are still relatively low, with 66% of ratings "Unsure" or lower (compared to 77% for strong crossover and 76% for secondary strong crossover) so this does not mean that weak crossover violations are not still violations. Finally, we find that singular *they* yields the crispest results in this experiment design on standard binding, motivating the use of just singular *they* in subsequent experiments.

3. Experiment 2: Quantificational crossover

3.1. Method

Experiment 2 uses exactly the same method as Experiment 1[8], namely the meaning availability design with a 2x2x2 design crossing the two orders *wh*. . . [gap]. . . pronoun (corresponding to binding) and *wh*. . . pronoun. . . [gap] (corresponding to crossover) with two sentence types

[8] We did not preregister Experiment 2, but used an identical method and plan of analysis to Experiment 1.

corresponding to secondary strong and weak crossover, and each of those with two potential readings.[9] We use singular *they* throughout. As before, we also conducted a separate norming study on the plausibility of the paraphrases, which ensured that readings were similarly plausible across sentences. We recruited 60 self-reported native English speakers on Prolific, of which we excluded 1 due to failed attention checks and 1 who learned English later than age 5. Participants saw 6 target items and 6 fillers in random order.[10]

(2) Quantificational crossover / binding (repeated from introduction, without judgements)
  a. The lawyer$_j$ noticed that **they**$_{i/j}$ forgot something about **every witness**$_i$' statement.
  b. The lawyer$_j$ noticed that **every witness**$_i$' statement at the trial was upsetting for **them**$_{i/j}$.
  c. The lawyer$_j$ noticed that **their**$_{i/j}$ statement at the trial was upsetting for **every witness**$_i$.
  d. The lawyer$_j$ noticed that **every witness**$_i$ forgot something about **their**$_{i/j}$ statement.

3.2. Results

We fit an ordinal mixed effects model with an interaction between gap/pronoun order and reading, as well as random effects for participant ID, average rating of each paraphrase from the norming study and the ability of participants to identify ambiguous filler items. Figure 3a shows the model's proportions of ratings for each condition.

This time, we do see a significant effect of reading, ($p < 0.05$), with the distractor NP reading being dispreferred by a factor of 0.27 over the bound reading for binding (non-crossover) sentences. As for *wh*-crossover, we see a clear, significant effect of pronoun-before-quantifier on the bound reading. This decreases the odds of a high rating by a factor of 0.12 ($SE = 1.55$, $p < 0.05$). We also see a significant positive effect of pronoun-before-gap with the distractor reading (compare columns 3 and 4), which increases the odds of a high rating by a factor of 52.34 ($SE = 1.88$, $p < 0.05$). In other words, we find that across secondary strong and weak crossover combined, we do indeed see that the crossover (pronoun before quantifier) configuration significantly reduces the availability of coconstrual.

We fit a second ordinal mixed effects model on just the bound reading of pronoun-before-quantifier (crossover) items to quantify the effect of secondary strong vs. weak crossover, with the same random effects as before, shown in Figure 3b. Unlike for *wh*-crossover, we find no significant difference between strong and weak quantificational crossover ($p = 0.69$). In fact, there is even a (non-significant) tendency for weak crossover to be rated slightly *worse* than strong crossover.[11]

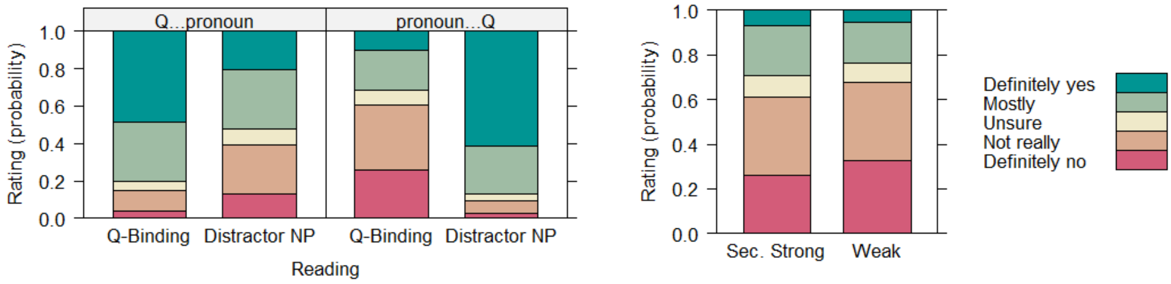
[9]We also tested "true strong" crossover involving nested sentences and no possessive pronouns, in parallel with Experiment 1. However, quantifier scope restrictions rule out coconstrual in these cases independently of crossover. We were largely unable to design "true strong" quantificational crossover sentences that did not violate scope restrictions within the confines of the experiment paradigm (which must not use reflexives to preserve the ambiguity between readings), but did include one set of "snake" sentences (Rooryck and Vanden Wyngaerd 2011 i.a.), which use locative prepositions following particular verbs (we use perception verbs).

(i) The wildlife expert$_j$ said that **they**$_{i/j}$ spotted a stick insect in front of **every visitor**$_i$ eventually.

Snake sentences are said to contain a small clause, not a full clause (Bryant 2022), though the ability of the quantifier to scope out of it has not been tested experimentally.

[10]The full set of experimental items (30 sentences) is available on OSF at `https://osf.io/dh2qb`

[11]For snake sentences, where we can construct "true" strong crossover as well as secondary strong crossover, we



(a) Effect of quantifier/pronoun order on reading (b) Secondary strong vs. weak crossover

Figure 3: Results for Experiment 2. We see a significant effect of crossover (columns 1 and 3 of (a)), but no significant effect of strong vs. weak crossover.

3.3. Discussion

Experiment 3 creates a controlled comparison between *wh*-crossover and quantifier crossover in English. The ratings for the coconstrued reading of the quantificational crossover sentences are strikingly similar to the *wh*-setting, which is especially surprising given the variation in stimuli used and the seeming superficial difference between *wh*-words and quantifiers. We find, however, that the two differ in two respects. First, in sentences where the *wh*-word c-commands (could bind) the pronoun, the bound reading is typically dispreferred compared to the distractor NP reading, while it is significantly preferred for quantifiers. This has no bearing on our theoretical concerns but remains a point of curiosity.

Second, we find a statistically significant difference between strong and weak crossover only for *wh*-crossover. This supports the early work on crossover and coining of the term by Wasow (1972), who worked on *wh*-crossover, but raises questions about why quantificational crossover behave differently – current theoretical accounts typically treat them identically. We believe our experiment used sufficient participants and a sufficiently granular scale to detect a difference, but a replication may help settle this.

4. Impact on theories of crossover

First and foremost, our results lay a baseline quantifying the strength of crossover violations in the two standard cases of *wh*-crossover and quantificational crossover in English. While the fact that crossover has a significant effect on pronoun coconstrual obviously does not come as a surprise to the theoretical community, our results and experimental methodology allow for future comparison of these two standard cases against the more contested cases discussed in the introduction, including other languages and other constructions such as relative clauses and coreference with proper names.

Our strikingly similar results for *wh*-crossover and quantificational crossover in English (when

do find a significant effect of strong vs. weak crossover, however it is in the opposite direction to what the theory predicts. Judging by the norming study, we believe this is because the coconstrued reading for the weak crossover sentence was simply rather implausible (unfortunately the only item in the experiment where we could not come up with a truly equiplausible scenario), so this is open for more work. Nevertheless, we do find a significant effect of crossover overall for snake sentences.

viewed as weak and strong crossover combined) support the long-held theoretical view that the two should be treated in parallel (Chomsky 1976). Our results on strong vs. weak crossover are harder to interpret. In so far as we know, no theory makes a distinction between quantifier vs. *wh*-binding. The lack of difference between strong and weak crossover for quantifiers may be due to insufficient experimental power or other experimental flaws, or perhaps due to processing effects related to linear order or embedding depth (see Kush et al. 2017 and references therein for effects of crossover on processing). Further experiments will have to probe this in more detail. For *wh*-crossover, where we find a clear difference, theories of crossover can be divided into three broad camps along these lines. One camp subsumes all crossover under a single principle (Safir 2004). An example of this is Safir's *Independence Principle* .

(6) *Independence Principle* (Safir 2004)
If x depends on y, then x cannot c-command y.

Under Safir's definition of *depends*, both *they* in (1a) (strong crossover, repeated below) and *their project topic* in (1c) (weak crossover) c-command the trace of the *wh*-word while also depending on it. Safir argues extensively against the strong/weak crossover distinction based on various cases of resumptive pronouns, weakest crossover and other related constructions.

(1) a. *The teacher couldn't remember **which**$_i$ of the students **they**$_i$ said __ didn't need to hand in the essay.
c. *?The teacher wondered **which**$_i$ student **their**$_i$ project topic frustrated __ the most.

A second camp holds that weak crossover is governed by an entirely different principle (Koopman and Sportiche 1982; Safir 1984). For example, Koopman and Sportiche's *Bijection Principle* is applied only to weak crossover, while they derive strong crossover from their definition of variable alongside Principles A and B.

(7) *Bijection Principle* (Koopman and Sportiche 1982)
There is a bijective correspondence between variables and Ā positions.

The third camp uses an overarching crossover principle but holds that strong crossover violates some additional principle such as Principle C (Reinhart 1983; Grodzinsky and Reinhart 1993; Ruys 2000; Shan and Barker 2006; Chierchia 2020). Reinhart's classic c-command-based binding theory defines co-indexation such that only bound variables can be interpreted when coindexed. This rules out strong and weak crossover alike as uninterpretable since they fail to bind the pronoun. Principle C or the Chain Condition (Reinhart and Reuland 1993) is then invoked in addition to incur a "double" violation for strong crossover.

(8) a. *Binding* (Reinhart 1983)
A node α is bound by a node β iff α and β are coindexed and β c-commands α.
b. *Translation definition* (Reinhart 1983)
An NP is a variable iff either (i) it is empty and Ā-bound, or (ii) it is A-bound and lacks lexical content. Other cases of NP coindexation are uninterpretable.

Only the latter two camps support an explanation for our difference between strong and weak *wh*-crossover, and only the third camp explicitly captures that strong crossover is "stronger" (the second camp would need to stipulate that violating their weak crossover principle is less severe). That said, the issue of the absence of a strong/weak contrast for quantificational crossover remains open, and in light of that, it also remains an open question whether capturing differences in severity should be a responsibility of semantic/syntactic theories, or rather whether this is the responsibility of other domains such as pragmatics or processing.

5. The relationship between binding and coreference

We turn now from standard crossover to a case study showcasing how our method can be applied to other phenomena related to crossover which have been difficult to resolve with appeal to intuition. Specifically, we will focus on anaphora and cataphora involving proper names. The following sentences parallel crossover syntactically, though they involve coreference between referential expressions instead of binding:

(4) Constraints on coreference (cataphora with proper names)
  a. *He$_i$ claimed that **Daniel**$_i$ was an amazing chef.
  b. *The chef knew that **he**$_i$ was disappointed by the soup **Daniel**$_i$ made.
  c. ?The chef$_j$ knew that **his**$_i$ soup had disappointed **Daniel**$_i$.

Judgements on sentences of this form vary: while sentences likes (4c) are often reported as acceptable in the literature (Chomsky 1976; Lasnik and Stowell 1991; Ruys 2004), especially with appropriate supporting context (consider: *Sue is not a popular girl, but **her**$_i$ mother loves **Sue**$_i$ unconditionally*[12]), they seem to be somewhat degraded compared to the reversed order *Sue's mother loves her*. Further, Chomsky (1976) argues that such sentences are unacceptable when the proper name bears focus, though this condition has been shown to be too simplistic (Bianchi 2009; Moulton et al. 2018). Experiment 4 uses our meaning availability design to probe the relative severity of violation (or absence thereof) in these two cases of proper name cataphora. We will call the sentence configuration of (4c) "weak" in parallel with weak crossover, and refer to the c-command configuration in (4a) and (4b) as "strong" (collapsing the distinction between strong and secondary strong).

These sentences are examples of coreference between the proper name and the pronoun, not binding (at least under most accounts), and yet there is a striking parallel between these and cases of binding. This connection is capitalised on by Reinhart's Rule I (Grodzinsky and Reinhart 1993), which essentially states that you cannot have coreference between two NPs if you would have got the same meaning by one binding the other:

(9) *Rule I* (Grodzinsky and Reinhart 1993)
  NP A cannot corefer with NP B if replacing A with C, C a variable A-bound by B, yields an indistinguishable interpretation.

Rule I hinges on Reinhart's definition of binding, which involves c-command. Thus, it does not apply to cases like (4c). While we can get bound interpretations in configurations like (4c) and many other cases of "indirect binding" (see Barker (2012) for an overview), these must involve some other mechanism for achieving that reading, such as e-type pronouns, dynamic approaches, or a revision of the definition of c-command (the strategy chosen by Reinhart in her 1983 book). The parallel for (4c) are simple possessor binding sentences:

[12]There may be an important difference to be made between supporting contexts that mention the proper name in advance of the pronoun, allowing coreference between the pronoun and the previously mentioned name, and ones which do not (genuine cataphora). We will not investigate this further in this paper, though we are careful not to mention the proper name before the pronoun in all our experimental items.

(10) Every boy's mother thinks he's a genius. *(adapted slightly from Higginbotham 1980)*

Grodzinsky and Reinhart's paper on Rule I makes no mention of the extended version of c-command adopted in Reinhart (1983), and so we will treat Rule I as using the classical definition of c-command, and thus not covering these "weak" cases. If it does extend to possessor binding, then it makes the prediction that sentences such as (4c) should be ungrammatical; otherwise, they should be grammatical. Since intuitive judgements in this area vary, this makes it ripe for experimental study.

6. Experiment 3: Backwards cataphora with proper names

6.1. Method

We apply the same meaning availability design as used for the crossover experiments, taking advantage of the fact that these pronouns too may refer to some distractor NP other than the target proper name. We use a 2x2 design which crosses proper name and pronoun order with "strong" and "weak" (possessive) configurations, balanced for pronoun gender. We investigate these sentences in their most simple form, without special focus on the proper name and without previous mention of the proper name or any other description of its referent in the context.[13] We use six sets of examples, including the following (repeated from the introduction):[14]

(11) a. The chef$_j$ knew that **Daniel**$_i$ was disappointed by the soup **he**$_{i/j}$ made.
b. The chef$_j$ knew that **Daniel**$_i$'s soup had disappointed **him**$_{i/j}$.
c. The chef$_j$ knew that **he**$_{i/j}$ was disappointed by the soup **Daniel**$_i$ made.
d. The chef$_j$ knew that **his**$_{i/j}$ soup had disappointed **Daniel**$_i$.

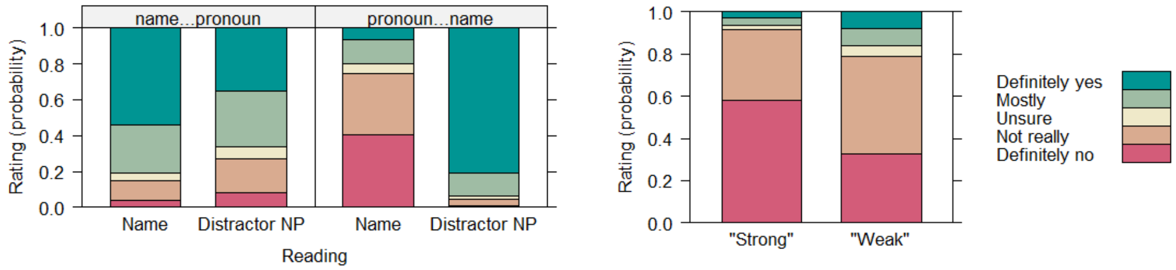
We preregistered this study on OSF.[15] We recruited 48 self-reported native English speakers on Prolific, of which we excluded 1 due to failed attention checks. Participants saw 6 target items and 6 fillers in random order.

6.2. Results

We fit an ordinal mixed effects model with an interaction between name/pronoun order and reading, as well as random effects for participant ID, participants' tendency to notice ambiguity in fillers, and scenario (in lieu of plausibility ratings). The results are shown in Figure 4a. As for *wh*-crossover, we see no significant effect of the reading alone ($p = 0.08$) but a significant effect of pronoun-before-name on the name reading, which decreases the odds of a high rating by a factor of 0.06 ($p < 0.05$). We again see a significant effect of pronoun-before-name with the distractor reading, which increases the odds of a high rating by the large factor of 133.76 ($p < 0.05$). This shows that just like for crossover, cataphora sentences like (11c) and (11d) are only unacceptable on the cataphoric (crossover) reading.

These results are aggregated across the strong and weak configurations, following our analysis for Experiments 1 and 2. To split them apart, we fit an ordinal mixed effects model with just a fixed effect of strength and random effects as before. We see a significant effect of "strong"

[13]Moulton et al. (2018), by contrast, sets up their contexts such that the proper name, or its referent, is always assumed to be already known in the discourse by the time the cataphor is produced.
[14]The full set of items (24 sentences) is available on OSF at `https://osf.io/dh2qb`
[15]`https://osf.io/w28vt`



(a) Effect of name/pronoun order on reading (b) "Strong" vs. "weak" proper name cataphora

Figure 4: Results for Experiment 3. We see a significant effect of crossover (columns 1 and 3 of (a)) and a significant effect of "strong" vs. "weak".

vs. "weak" in Figure 4b, which increases the odds of a high rating by 2.90 ($p < 0.05$). This is roughly 1.5x the size of the weak/strong crossover effect. That said, simply looking at Figure 4b shows that weak cataphora readings are still rated quite low in this setting: 71.4% of items are rated "Not really" or "Definitely no" (for strong cataphora, the figure is 88.7%).

6.3. Discussion

Given the many reports in the literature that "weak" cataphora like (11d) are not just better but genuinely acceptable, the results from Experiment 3 are surprising. A natural response is that this must be the fault of the experiment design. One objection is that the distractor NP, in matrix subject position, may simply be too prominent and cause participants to not perceive the theoretically possible cataphor reading. While this is possible, we note that when the name precedes the pronoun (anaphora), this prominence does not prevent coconstrual of the pronoun with the target proper name (in fact, this coconstrual is preferred over coconstrual with the distractor). This was also not an issue for binding in Experiments 1 and 2. Nevertheless, to address this, we are planning a future experiment with no distractor NP, where the second paraphrase simply involves "someone else". Another objection is that we did not support these cataphor sentences with proper context. This is an interesting objection, especially as it is unclear whether a "proper context" includes the proper name in advance (as in e.g. Moulton et al. 2018). Do we expect a difference between (12a) and (12b), and if so, should that be accounted for by syntax/semantics or rather by discourse structure (pragmatics)? If cataphora are disfavoured without proper support, does that mean we should see no effect at all of our theory (e.g. Rule I) without a proper context, or just a smaller effect?

(12) a. Once upon a time there was a teacher called **Maria**$_i$. **Her**$_i$ students always emailed **Maria**$_i$ about the homework that she assigned. So she ...
b. Let me tell you a story: **Her**$_i$ students always emailed **Maria**$_i$ about the homework that she assigned. So she ...

With this in mind, there are two possible interpretations of these results, depending where we draw the line between grammatical and ungrammatical. If we take the results as showing that both "strong" and "weak" cataphor sentences are in general ungrammatical (on that coconstrual), then we need to revise Rule I or any derivative theory such as Marty (2017) to apply to cases of indirect binding (or at minimum, to possessives) as well as direct binding. This would predict that cataphora are ruled out if and only if some kind of binding between the two positions is possible – an interesting and testable prediction. We might also stipulate that Rule I with indirect binding results in a weaker violation than Rule I applied to direct (c-command) binding, to explain the statistically significant difference found in Experiment 4.

Alternatively, we might argue that we are primarily interested in is the difference between "strong" and "weak" cataphora, rather than their absolute ratings, which are difficult to interpret at the best of times. Perhaps there is a pragmatic principle militating against cataphora of any kind (supporting arguments about needing the right context) which decreases the ratings of both strong and weak crossover in an experiment like this. Pragmatic principles such as focus, topic and salience have indeed been shown to increase or decrease coconstrual availability for weak proper name cataphora (Gordon and Hendrick 1997; Moulton et al. 2018; Gor and Syrett 2019; Gor and Syrett to appear). In this case, the fact that "strong" c-command cataphora are significantly more deviant supports leaving Rule I as is, and suggests that direct (c-command) and indirect binding are very different creatures with different effects on coreference. Moreover, this experiment gives us a baseline allowing us to compare future experiments on other configurations of cataphora (such as *when*-clauses or conjunction) to these two standards, and in turn sharpen our definition of what must count as direct vs. indirect binding. For example, if sentences such as (13), which appear to be sharply ungrammatical, can be shown to pattern with c-command (strong) cataphora, this may suggest a revision of what counts as binding to include conjunction, as in dynamic semantic frameworks such as Chierchia (2020).

(13) *$\textbf{He}_i$ walked in and $\textbf{John}_i$ sat down.

7. Conclusion

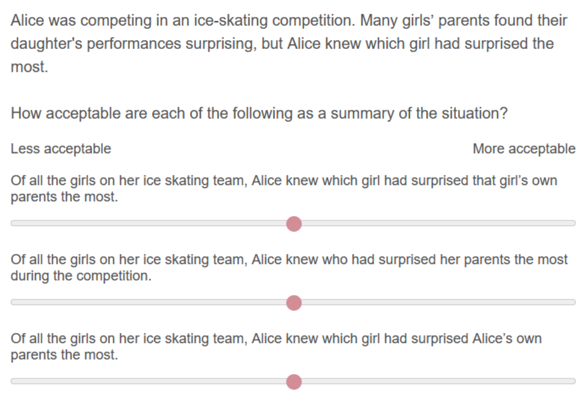
We present a novel experimental paradigm to measure strong and weak crossover, and more broadly any phenomenon involving multiple possible coindexations or readings. We show that for binding phenomena, the side-by-side presentation of multiple unambiguous paraphrases is more effective than trying to fix these readings using a context paragraph. We find a significant difference in meaning availability between strong and weak *wh*-crossover in English, contra Kush (2013) who did not find a difference using acceptability judgements. Taken at face value, this supports theories which distinguish strong and weak crossover such as Koopman and Sportiche (1982), Safir (1984), Grodzinsky and Reinhart (1993) or Ruys (2000). Unified accounts such as Safir (2004) must rely more heavily on their argument that such differences do not need to be accounted for by the theory. However, we do not find such a difference for quantificational crossover, raising questions as to how these two kinds of crossover may differ. We further find that proper names display a significant crossover effect similar to *wh*-crossover, supporting Rule I (Grodzinsky and Reinhart 1993) and its derivatives. This is significantly less severe in weak configurations, but these are still quite degraded under our experimental setup, leaving an open question as to how they should be handled theoretically. More broadly, we propose a robust, adaptable methodology to test disputed cases of crossover and cataphora, including relative clauses (Postal 1993), variation in weak crossover across languages (Bresnan 1998 and many others) and cataphora over conjunction.

Appendix

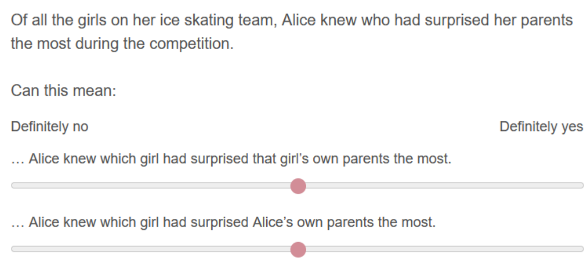
A. Experiments 4a and 4b: Comparing response types

We directly compare a classic acceptability task (Experiment 4a) to our meaning availability design, which is inspired by the unambiguous paraphrases commonly used in syntax/semantics teaching (Experiment 4b). We study the effect of each design on the ratings for the bound reading of *wh*...[gap]...pronoun sentences (the standard binding configuration). Since crossover is a case where binding fails, to study crossover it is crucial that an experiment be able to capture binding success and thus (perhaps) differentiate crossover. For each design, we use the same experimental items and the same 2x2 cross, varying only the response type. We cross two structural configurations of binding which parallel secondary strong and weak crossover with two potential readings.[16] An even split of masculine and feminine pronouns is used.

We recruited 100 self-reported native English speakers on Prolific for Experiment 4a and another 100 for Experiment 4b. Participants saw 8 target items and 16 fillers in random order (Experiment 4a) and 4 target items and 8 fillers in random order (Experiment 4b). We preregistered this study on OSF[17] and carried out the analysis exactly as planned, with the exception of excluding participants due to attention checks, which turned out to be impractically strict.



(a) Screenshot of Experiment 4a.



(b) Screenshot of Experiment 4b.

Figure 5: "Weak" binding sentence in the sentence acceptability design (Experiment 4a) and in the meaning availability design (Experiment 4b). In (a), the context describes the bound reading. The middle sentence is the target sentence, the top sentence is an unambiguous paraphrase of the bound reading, and the bottom sentence is an unambiguous paraphrase of the "distractor NP" reading. We expect the top two sentences to receive high ratings, with the target sentence receiving the bound reading. In (b), the first paraphrase represents the bound reading; the second represents the "distractor NP" reading. We expect both to get high ratings.

A.1. Experiment 4a: Sentence acceptability design

This experiment follows a traditional experimental semantics design by presenting participants with a short context paragraph describing a situation where exactly one of the readings (*wh*-

[16]The original experiments also included items using the *wh*...pronoun...[gap] order (corresponding to crossover), but we will not analyse those here.
[17]`https://osf.io/g4z52`

binding or distractor NP) holds. Participants are then given the target sentence, as well as two control sentences, and asked to rate on a sliding scale from 0 (less acceptable) to 100 (more acceptable) how acceptable each sentence is as a description of the situation. The control sentences are identical to the unambiguous paraphrases used in Experiment 4b, and serve as checks that the participant is interpreting the context paragraph in the way we expect. A screenshot of an experiment item is shown in Figure 5a.[18]

A.2. Experiment 4b: Meaning availability design

We compare the sentence acceptability design with the "meaning availability" design described in Experiment 1. The only difference from Experiment 1 is the use of a slider bar from 0 (definitely no) to 100 (definitely yes) instead of Likert scale (discussed in the Results section). A screenshot of an experiment item is shown in Figure 5b.

A.3. Results

For each experiment, we fit a mixed effects beta regression with an interaction between strong vs. weak and *wh*-binding vs. distractor NP reading, as well a random effect for participant ID, using the `glmmTMB` (Brooks et al. 2017) package. We use a beta regression since we have many ratings at the ends of the scale (0 or 100) and so a linear regression results in a poor fit. For the sentence acceptability design, we focus here only on the ratings of the target sentences, setting aside the data on the two unambiguous paraphrases, which showed that the contexts were generally interpreted as expected.

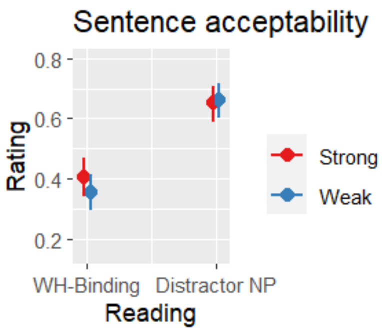
In the traditional sentence acceptability design of Experiment 4a, we found a significant effect of reading/context ($p < 0.05$), with the target sentences in the Distractor NP context being rated substantially higher than the same sentences in the *wh*-binding context for both "strong" and "weak" cases, shown in Figure 6a. This is unexpected given that *wh*-binding reading of these sentences should be perfectly possible according to the theory, and so should be available in the case where the context describes the bound reading. We found no significant effect of "strong" vs. "weak" ($p = 0.25$), as expected, and no interaction ($p = 0.32$).

In the meaning availability design of Experiment 4b, we also found a significant effect of reading ($p < 0.05$), as well as a significant effect of "strong" vs. "weak" and an interaction between reading and "strong" vs. "weak" (both $p < 0.05$), shown in Figure 6b. Importantly, however, unlike the sentence acceptability design, bound readings for the "weak" binding sentences are rated high, similar to the ratings for the Distractor NP reading, showing that participants do allow the bound reading for at least these binding sentences.

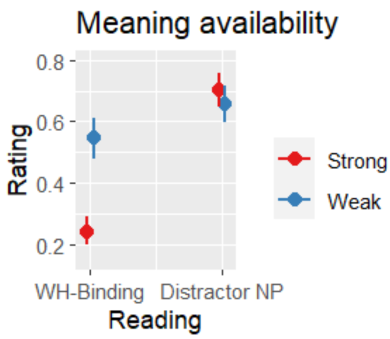
A.4. Discussion

Experiments 4a-b show that the sentence acceptability design, at least in the form used here, does not yield results consistent with prior observations of binding sentences. Since the availability of binding of this sort is not a controversial phenomenon, we take this to be an issue with the experimental design. Moreover, since crossover is a case where binding fails, to study crossover it is crucial that an experiment be able to capture binding success and thus (perhaps)

[18] The paraphrases used in this set of items are somewhat stilted; we improved on this and the general target item quality substantially in subsequent experiments (Experiments 1, 2 and 3 above).



(a) Experiment 4a: Sentence acceptability



(b) Experiment 4b: Meaning availability

Figure 6: Ratings for binding sentences across response types (Experiments 4a and 4b).

differentiate crossover. While the meaning availability design also shows some signatures of low ratings for "strong" binding, this seems to be an artifact of specific sentences used: in one of the three scenarios used here, the strong bound reading is simply much less plausible than the distractor NP reading. This same issue is not present for the "weak" sentences (or in Experiments 1 and 2 above), and we see correspondingly high ratings in the meaning availability design. In subsequent experiments (Experiments 1, 2 and 3), we significantly improved the quality of the target sentences and ensured that both readings were similarly plausible.

We believe that the main flaw behind the sentence acceptability design is that reading a context paragraph describing one coconstrual does not appear to (sufficiently) dispose participants towards giving the target sentence that particular reading. Participants appear to have interpreted the pronoun as coconstrued with the distractor NP regardless of the context, and thus rated the sentence as a poor description of the context describing coconstrual with the *wh*-word. Since no obvious way of rephrasing or restructuring this design appears to avoid this issue, we settled on the meaning availability design for the remainder of our experiments.

In addition, we observed that the sliding scale from 0-100 caused participants to overwhelmingly use the endpoints 0 and 100, resulting in a lack of granularity of responses. Subsequent experiments thus used a 5-point Likert scale and drew participants' attention to the option of using the intermediate points during the training period.

B. Effect of pronoun gender on binding

As part of Experiment 1, we investigate whether pronoun gender has any effect on binding. We fit a mixed effects ordinal regression on just the binding sentences of Experiment 1, with an interaction between reading and pronoun gender and the same random effects as in Experiment 1, shown in Figure 7. We find significant effects of masculine and feminine pronouns which decrease the odds of a high rating for the bound reading by a factor of 0.54 and 0.61 respectively ($p < 0.05$, $SE = 1.25$ for both), compared to the ratings for singular *they*. Moreover, each has an interaction with the reading, with each substantially increasing the odds of a high rating for the distractor reading compared to the bound reading for that pronoun (a factor of 4.96 for *he* and 2.07 for *she*; $SE = 1.39$ and 1.37 respectively, $p < 0.05$). By contrast, singular *they* (treated as the base case in the model) has no significant effect of reading, meaning that its readings are rated similarly to each other. Quantitatively, singular *they* has the highest ratings for bound readings given otherwise identical sentences, as well as the best balance between bound and distractor NP ratings. This supports the use of singular *they* for experiments detecting binding.

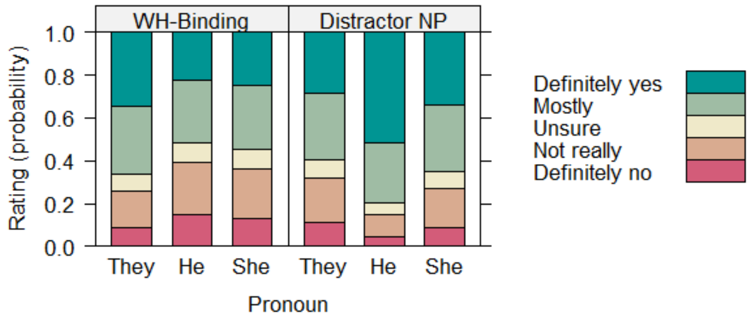


Figure 7: Effect of pronoun choice on reading

We further fit a mixed effect ordinal regression on just the singular *they* binding sentences with participant age group as a fixed effect (interacting with reading and pronoun gender) to investigate whether perhaps only younger participants view singular *they* as an appropriate pronoun. We find that there are no significant interactions of the age group with any of the other factors, supporting Balhorn (2004) and others in suggesting that this epicene use of singular *they* is not a new phenomenon.

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On the semantics of *wh-*[*]

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Abstract. It is argued that a theory of the semantics of *wh*-expressions, and *wh*-pro-forms in particular, should not only fit the semantics of *wh*-interrogatives. It should also provide a simple and unified cross-categorial semantics for *wh*- which takes into account the semantics of morphologically and cross-linguistically plausible paradigm-mates, while deriving rather than stipulating the correct types for traces/variables, and allowing *in-situ* interpretation. Accordingly, it is proposed that *wh*-pro-forms are variants of demonstratives, with *wh*- a proximity value next to PROXIMAL or DISTAL (or rather: their unvalued counterpart). The familiar phenomenon of deferred reference with demonstratives is taken to underlie the cross-categorial semantics of demonstratives, hence that of *wh*-expressions as well. *Wh*-expressions end up functioning as unselectively bound, presuppositionally restricted variables.

Keywords: *wh*-expressions, demonstratives, *wh*-questions, deferred reference, indeterminate pronouns

1. Introduction

The question of motivating a particular semantics for *wh*-expressions is usually approached from the perspective of a theory on the semantics of interrogative clauses. Given such a theory, it is natural to adopt whatever semantics for *wh*-expressions best facilitates the desired composition of the clause. This has resulted in two general approaches to the semantics of *wh*-expressions. Some authors treat *wh*-expressions as operators that bind a variable in the question nucleus. Others assume that the *wh*-expressions themselves are variables in the question nucleus, bound by a separate operator at the clausal edge.

The first approach, which takes *wh*-expressions to be variants of existential quantifiers, wrapped in a mechanism that fits them into the semantic make-up of the interrogative clausal edge, goes back to Karttunen 1977 (and further, to Katz & Postal 1964, a.o.) and was developed by Higginbotham 1993, Heim 1994, Cresti 1995, and later work. Under this approach, a *wh*-expression like *who* can be characterized as in (1):

(1) $[\![\ \textit{who}\ ]\!] = [\![\ \textit{wh-}\ \ \textit{someone}\ ]\!] = \lambda R_{\langle e,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}\ \exists x[\ \text{person}(x) \wedge R(x)(p)\ ]$

The basic idea is that C_{+wh} has the denotation in (2a): it combines with the proposition expressed by the IP (the question nucleus) to yield the set of propositions (“proto-question”) in (2b).[1] Abstracting over the trace/variable left by *who* yields (2c); this combines with *who* in (1) to yield (2d). Note that it is the existential quantifier provided by *who* that ends up binding the variable in the question nucleus.

[*] I thank Patrick Brandt, Silvia Terenghi, and audiences at Sinn und Bedeutung 27 and InSemantiC 2022 for their helpful comments. Naturally, all errors are my own.

[1] For the sake of simplicity I omit from (2a) the restriction to true propositions.

(2) $[_{CP}$ who$_i$ $[_{C'}$ $[_{C+wh}$ did] $[_{IP}$ Mary kiss t_i]]]?

a. $\lambda q_{\langle s,t\rangle}\ \lambda p_{\langle s,t\rangle}\ .\ p=q$

b. $\lambda p_{\langle s,t\rangle}\ .\ p=$^Mary kiss x

c. $\lambda x_e.\ \lambda p_{\langle s,t\rangle}\ .\ p=$^Mary kiss x

d. $\lambda p_{\langle s,t\rangle}\ .\ \exists x[$ person(x) $\wedge$ p=^Mary kiss x]

The second approach, which I will end up advocating here, and which treats *wh*-expressions as unselectively bound (sorted or presuppositionally restricted) variables goes back to Hausser & Zaefferer (1979); it was developed later by Rullmann (1995), Cresti (1998), Rullmann & Beck (1998), Kratzer & Shimoyama (2002), and others. (3) illustrates Rullmann & Beck's (1995) proposal. A fronted *wh*-expression undergoes reconstruction, yielding (3b), and is then interpreted as a definite DP (with the associated presuppositions) containing a free variable unselectively bound from the clause edge, resulting in (3c):

(3) a. $[_{CP}$ [which woman]$_i$ $[_{C'}$ $[_{C+wh}$ did] $[_{IP}$ Mary kiss t_i]]]

b. $[_{CP}$ $[_{C+wh}$ did] $[_{IP}$ Mary kiss [the woman x_j]]]

c. $\lambda p\ \exists x_j$ [p = ^Mary kissed the (λy.woman(y) $\wedge$ y = x_j)]]

The present paper approaches the semantics of *wh*-expressions from the opposite starting point. We look at the syntactic and morphological properties of *wh*-expressions, considering how they fit into the adverbial and pronominal paradigms they belong to, and how *in-situ wh*-expressions and *wh*-traces function. We argue that a simple and independently motivated semantics for *wh*-expressions can be developed by identifying them as denatured demonstratives, unvalued for PROXIMAL, MEDIAL or DISTAL. This analysis in turn supports the unselective binding approach to interrogative clauses.

2. Some desiderata for a variable theory of *wh*-expressions

In this section, I outline the issues surrounding the interpretation of *wh*-expressions that the semantics I will be proposing is designed to explain. By way of illustration, I will sketch in each case to what extent the existential quantifier approach manages to meet these desiderata. This will also serve to motivate my choice for the variable approach in section 3.

2.1. *In situ wh*-phrases

As observed by Heim (1994), the assumption that *wh*-phrases are not pure existential quantifiers but carry with them the mechanism needed to fit them into the interrogative clause edge, as in (1), implies that they are only interpretable in that position, and not *in situ*.[2] For

[2] Von Fintel & Heim (2020) propose a simplified semantics for *wh*-expressions by which they denote "bare" existential generalized quantifiers. Fitting this GQ into the clausal edge is achieved by postulating that C adjoins to CP, creating just the necessary lambda-chain. In essence, this is a return to Karttunen (1977), who also analyzed *wh*-expressions as generalized quantifiers, fitted into the clause edge by a dedicated composition rule. While this expedient renders *wh*-expressions interpretable *in situ*, it does not of course yield the correct semantics for *wh*-in-situ. E.g., in (6a) below *which senator* cannot be replaced salva veritate by *some senator.*

most instances of *wh-in-situ*, such as English (4) and Chinese (5) (from Bayer & Cheng 2017, q.v. for a literature review), this problem can be overcome by the classical assumption that the *in situ* operator undergoes *wh*-raising at LF.

(4) who said what?

(5) Húfēi mǎi-le shénme — Mandarin Chinese
Hufei buy-PRF what
'What did Hufei buy?'

However, the literature also contains many examples like (6) (from Hankamer 1975:67:(33)) where *wh*-raising is implausible (see Dayal 2016 for an overview of the literature):

(6) a. In order to foil this plot, we must find out which agent has [$_{NP}$ bats that are trained to kill which senator]
b. * We must find out which senator$_i$ Philby has [$_{NP}$ bats that are trained to kill t$_i$]
c. $\lambda R_{\langle e,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}\ \exists x[\ senator(x) \wedge R(x)(p)\ ]$

Which senator in (6a) is contained in a strong (CNPC) island, which blocks overt extraction in (6b). Although movement analyses for such cases have been proposed (e.g., Huang's 1982a proposal that LF movement is not subject to Subjacency, or the Pied Piping analysis of Nishigauchi 1990 and later work; but see Von Stechow 1996 for critical discussion), allowing covert movement to differ crucially from overt movement undermines the hypothesis that covert movement can be characterized as movement at all, hence the concept of LF as a syntactic level of representation. The more cautious approach to such examples has been to assume that at least some *wh-in-situ*, *which senator* in (6a) among them, remain *in situ* at LF and are interpreted there. This approach has been implemented by the (further) development of unselective binding theories of *wh-in-situ* (going back to Baker 1970; including Pesetsky's 1987 treatment of such cases), which have successfully focused on languages with indeterminate pronouns (Kuroda 1965). In addition, one well-known proposal (Cole and Hermon 1998) holds that in some (*in-situ*) languages *wh*-expressions are variable containing open sentences, whereas in other (*wh*-movement) languages, including English, they include an operator as in (1) (but see Bruening 2007 for critical discussion). This is not the place to relitigate the literature on this topic; what is relevant for our purposes is that even languages like English, with data like (6), present a serious challenge for theories that treat *wh*-expressions as (modified) existential quantifiers. The proposal in section 3 below addresses this problem by treating all *wh*-expressions as non-operators.

2.2. Paradigmatic status: morphology

If *wh*-expressions were built on existential quantifiers with an interrogative "wrapper", we would expect this to be reflected in their morphology. In particular, we would expect that *wh*-pro-forms (pronominals, pro-adverbs) would often be transparently derived from their existential siblings in the relevant pronominal paradigms. However, this is not the case.

Haspelmath's (1997) typological survey shows that, cross-linguistically, existential quantifiers are quite often built on *wh*-expressions (that is, with the opposite morphological structure from the expected one), as in (7), or Polish (8):

(7) somehow, somewhere
(8) ktoś 'someone', coś 'something' etc.

Many times, *wh*-expressions and existentials are homophonous, as indeterminate pronouns:

(9) a. Da kommt wer. German (Haspelmath 1997:171)
there comes who
'there comes someone'
b. Wer kommt da?
who comes there?
(10) a. Jan heeft snel wat opgeschreven. Dutch (Postma 1994: 193)
John has quickly what written
'J. has quickly written something down'
b. wat heeft Jan snel opgeschreven?
what has John quickly written
'what did J. quickly write down'

But *wh*-pronominals are "virtually never" built on existential pronouns (Haspelmath 1997:27; the observation goes back to Moravcsik 1969). Furthermore, Bruening's (2007) survey shows that the pattern of indefinite pronouns being identical to *wh*-pronominals, or being derived from them, but not the other way around, extends to overt *wh*-movement languages (as (7)–(10) illustrate), cutting across Cole & Hermon's (1998) operator/non-operator parameter for *wh*-expressions. While these patterns are problematic for the quantificational analysis of *wh*-expressions, they are in accordance with my proposal in section 3 below, which follows Diessel (2003) in relating *wh*-pro-forms to demonstratives rather than indefinites.

2.3. A unified cross-categorial semantics for *wh*- ?

Although the literature is mostly confined to nominals, *wh*-pro-forms, like indefinite pronouns (and demonstratives), exist across syntactic and ontological categories. The challenge is to define their commonality, i.e., a semantics for the *wh*-feature that distinguishes interrogatives from their non-interrogative paradigm-mates. Consider the sample in (11):

(11)

person	who	< someone ?
thing	what	< something ?
manner	how	< somehow ?
locative	where	< somewhere ?
allative	whither	< somewhither[3] ?
ablative	whence	< somewhence ?

[3] Interestingly, the Google Books Ngram viewer shows (rare) *somew(h)ither* peaking during the mid-19th century, when *whither* was already in decline.

time	when < sometime ?	
degree	how < somewhat ?	
amount	kiek	(Lithuanian)
quality	kakoj	(Russian)

A concrete proposal based on the hypothesis that *wh*-expressions are modified existentials was offered by Cresti (1995): *who* is derived from *someone* by addition of the *wh*-feature in (12b).[4]

(12) a. $[\![$ someone $]\!]$ = $\lambda P_{\langle e,t\rangle}\ \exists x[\ \text{person}(x) \wedge P(x)\ ]$
b. $[\![$ *wh-* $]\!]$ = $\lambda P_{\langle et,t\rangle}\ \lambda R_{\langle e,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}\ .\ P(\lambda x_e.R(x)(p))$
c. $[\![$ who $]\!]$ = $[\![$ *wh-* someone $]\!]$ = $\lambda R_{\langle e,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}\ \exists x[\text{person}(x) \wedge R(x)(p)]$

The obvious problem is that (12b) will only work for DPs, which denote generalized quantifiers. Can the other *wh*-pro-forms in (11) be semantically related to the corresponding existential pro-forms in the same way? Consider, e.g., the manner adverbial *how*, and assume, for concreteness, that manner adverbials denote sets of events (type $\langle v,t\rangle$). To achieve the result in (13c), we would need the modified *wh*-feature in (13b) (setting aside the fact that *somehow* is not a plausible source for *how* for morphological reasons, as discussed above, as well as having a "widening" aspect to its semantics that is not covered by (13a)).

(13) a. $[\![$ somehow $]\!]$ = $\lambda P_{\langle\langle v,t\rangle,t\rangle}\ \exists x_{\langle v,t\rangle}[\ \text{manner}(x) \wedge P(x)]$ [v for event]
b. $[\![$ *wh'-* $]\!]$ = $\lambda P_{\langle\langle\langle v,t\rangle,t\rangle,t\rangle}\ \lambda R_{\langle\langle v,t\rangle,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}\ .\ P(\lambda x_{\langle v,t\rangle}.R(x)(p))$
c. $[\![$ how $]\!]$ = $[\![$ *wh'-* somehow $]\!]$ = $\lambda R_{\langle\langle v,t\rangle,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}.\ \exists x_{\langle v,t\rangle}[\ \text{manner}(x) \wedge R(x)(p)]$

This is not to say that a generalization is not possible. If we allow ourselves a type-flexible generalized feature wh_g- of type $\langle\langle\langle\alpha,t\rangle,t\rangle,\langle\langle\alpha,\langle st,t\rangle\rangle,\langle st,t\rangle\rangle\rangle$ as in (14), it will combine with an existential quantifier of any type $\langle\langle\alpha,t\rangle,t\rangle$ to yield the corresponding interrogative (assuming it leaves a trace that functions as a variable of type α – see the next section).

(14) $[\![\ wh_g\text{-}\ ]\!] = \lambda P_{\langle\langle\alpha,t\rangle,t\rangle}\ \lambda R_{\langle\alpha,\langle st,t\rangle\rangle}\ \lambda p_{\langle s,t\rangle}\ .\ P(\lambda x_\alpha.R(x)(p))$

My objection to this approach is not that it will not work technically. In fact, there is no technical requirement under the quantificational approach that *wh*-expressions be derived from indefinite pro-forms at all. One might give up on postulating a transparent semantic relation between *wh*-expressions and their indefinite counterparts, and simply assume that each of the *wh*-expressions in (11) sits in the lexicon with whatever unanalyzed semantics we need in order to arrive at the desired semantics of interrogative clauses. However, if we want to explain how *wh*-expressions come to have the semantics they have, how they are semantically related to their paradigm-mates, and how we can semantically characterize the structure of the pronominal paradigm, then the existential approach appears to lead us to a *wh*-feature along the lines of (14). Either way, from an explanatory standpoint it seems implausible that such simple morphemes as *who* or *how*, and especially such a simple feature

[4] For *which man*, Cresti considers two options: that the *wh*-feature has applied to *some*, or to *some man*.

as *wh*-, should have such complex denotations and types; and this raises the question why such complicated expressions would universally or near-universally appear in the lexicon.

Technical problems do arise, furthermore, once when we take pied-piping structures such as those in (15) into account. There is no space here to do the topic justice (see Reich 2001 for early discussion of many relevant semantic issues involved), but I want to briefly sketch in what way pied piping affects the issue.

(15) a. [how many books]$_k$ did Mary read t_k?
b. whose books$_k$ did Mary read t_k?

How can *wh*-expressions, given their supposed specialized semantics, be interpreted in these constructions where they are neither in Spec,CP nor inside the question nucleus? There are two basic approaches one can take.

The first one, which goes back to Higginbotham (1993), is to extract the *wh*-element from the pied-piped constituent and adjoin it to CP by itself:

(16) a. [$_{CP}$ how$_i$ [$_{C'}$ [t_i many books]$_k$ [$_{C'}$ did Mary read t_k]]]
b. [$_{CP}$ whose$_i$ [$_{C'}$ [t_i books]$_k$ [$_{C'}$ did Mary read t_k]]]?

This is the primary analysis entertained by Cresti (1995), followed by Ruys (2015); it is still being advocated in von Fintel & Heim's (1997–2020) lecture notes. The obvious advantage is that the *wh*-element can be interpreted in the regular way, while the pied-piped constituent undergoes (syntactic or semantic) reconstruction. The obvious disadvantage is that it involves a movement operation that all overt evidence tells us is not available:

(17) a. * how$_i$ did Mary read [t_i many books]?
b. * whose$_i$ did Mary read [t_i books]?

While it is true that some languages allow some extractions of this type, it would be a considerable burden to demonstrate that all pied piping structures allow this treatment cross-linguistically.

The second approach is to leave the *wh*-element (somewhere) inside the pied-piped constituent, and raise its type so as to allow it to be interpreted there (another option considered by Cresti 1995; see also Reich 2001). As an illustration, consider Cresti's (1995:101) treatment of *how-many* questions in (18):

(18) a. [$_{CP}$ [$_{DP}$ how λx_i [x_i many books]] λP [$_{C'}$ did ${}^{\vee}P(\lambda y.\text{Mary read } y)$]]]
b. $[\![$ how $]\!]$ = $[\![$ *wh''*- some_number$]\!]$ =
$\lambda P_{\langle e,ett\rangle}\, \lambda R_{\langle\langle s,ett\rangle,\langle st,t\rangle\rangle}\, \lambda p_{\langle s,t\rangle}\, \exists n[\, \text{num}(n) \wedge R({}^{\wedge}P(n))(p)\,]$
c. $[\![$ *wh''*- $]\!]$ = $\lambda Z_{ett}\, \lambda P_{\langle e,ett\rangle}\, \lambda R_{\langle\langle s,ett\rangle,\langle st,t\rangle\rangle}\, \lambda p_{\langle s,t\rangle}\, .\, Z(\lambda n.R({}^{\wedge}P(n))(p))$

In this analysis (see Cresti:1995:fn. 20 for yet additional options) *how* is left-adjoined to its host DP, perhaps a syntactically slightly less implausible option than the extraction in (16a).

As before, this instance of *how* is the *wh-* variant of a hypothetical existential generalized quantifier ranging over numbers. However, *how* now needs to take an additional argument: first, the DP it is adjoined to, and then the C' the DP is the specifier of. This entails that the *wh*-feature in *how*, defined in (18c), can no longer be treated as a version of the generalized wh_g- feature in (14): we have drifted further away from finding a common semantics that relates *wh*-pro-forms to their paradigmatic siblings. I suspect any solution for pied piping along these general lines will face similar challenges. The analysis in section 3 below on the other hand provides a relatively simple semantics for the feature *wh-* that extends to pied piping structures (see Sternefeld 2001a, 2001b for earlier non-operator treatments).

2.4. Trace typing

It is standardly assumed that downstairs, deleted copies in a movement chain function as variables. However, there is precious little discussion in the literature on the question of deriving the correct types for these variables, and hence, accounting for how they compose. The usual procedure is to simply stipulate that the trace has whatever type is needed to end up with the desired result for the containing clause.[5] One of my goals here is to work towards a solution that helps develop a principled theory on how traces come to have the types they have.

I want to follow the general approach I advocated in Ruys (2015). Under the copy theory of movement, the type of a trace-copy is determined by its internal composition in the usual way. All copies of a constituent are subject to the same rules of composition, which lead to a particular type and denotation (note that a trace constituent may be of unlimited size, so that its possible trace status is not detectable "down inside"). Once a constituent is recognized as a downstairs copy it is taken to function as a variable; but the type arrived at in the composition process still determines its type. There are various options here: my specific proposal is that the trace may either function as a variable of the full type arrived at in the composition process (which will lead to the semantic reconstruction phenomena discussed in Ruys 2015), or default to a basic type (e, or d).

Depending on the implementation, a quantificational type for *wh*-expressions, with an interrogative wrapper, can stand in the way of a motivated theory of trace typing along these lines. Consider again the supposed denotation of manner-*how* in (13c) (repeated as (19a)):

(19) a $[\![\text{how}]\!] = \lambda R.\lambda p.\exists x[\text{manner}(x) \wedge R(x)(p)]$, type $\langle\langle\langle v,t\rangle,\langle st,t\rangle\rangle, \langle\langle s,t\rangle,t\rangle\rangle$
b. $[\![\cancel{\text{how}}_i]\!]^g = g(x_i)$, type $\langle v,t\rangle$

[5] The apparently simple options turn out not to be. For instance, allowing the trace to have whatever type permits local composition to proceed opens up an infinity of options, most of which are only filtered out at the tree root when the variable runs out of options for finding a binder (assuming it must be bound) – if we want to avoid unlimited backtracking, as is desired from a minimalist perspective, this is not an optimal solution. Conversely, forcing the trace to take the lowest possible type (that fits its environment) is not only incompatible with theories of semantic reconstruction for operator-type expressions; it fails, e.g., for displaced VP modifiers. These could not leave traces of, say, type $\langle v,t\rangle$ that combine with VP of the same type via intersection, as the option would be blocked by type v, unless, again, look-ahead were allowed.

Given this denotation, I see no non-stipulative way of arriving at the desired type of the trace in (19b). Observe, that this problem arises not only for manner-*how* but also for other modifier-type *wh*-pro-adverbs, such as locatives.

One way of dealing with the issue is to modify the desired type of the trace. For instance, one could adopt Landman & Morzycki's (2003) proposal that manners are event kinds. The trace of *how* could then default to a basic type (that of event kinds), more or less in accordance with the above proposal. A rule that shifts a kind to the set of its realizations would then allow the trace to combine with VP in the usual way. But it is unclear whether such an approach could be extended to locative and other modifier *wh*-expressions.

Alternatively, one could extend the trace typing procedure outlined above with the option to allow the trace type to be derived by some simple functions from the full type of the trace constituent; in particular, say that any trace constituent of quantificational type $\langle\langle\alpha,t\rangle,t\rangle$ may function as a variable of type α. This will not solve the problem for wrapped quantificational *wh*-denotations, as in (19a), but if we assume in addition that *wh*-expressions are bare existential quantifiers, with the embedding in the interrogative clausal edge taken care of in some other way, as in von Fintel & Heim (2020) (cf. footnote 2), the trace type might be derived without further stipulation. It is not clear to me at this point whether this approach is tenable.

Again, finding such solutions becomes harder once we take pied-piping structures into account, but I will not elaborate on this here. My proposal in the next section will deal with trace typing in a straightforward manner.

The preceding sections have shown that on the existential operator analysis, *wh*-pro-forms are odd ducks, with no semantic or morphological relation to their supposed paradigm-mates, and puzzling properties *in situ* as either traces or unmoved operators. The next section argues that we can address these issues by treating *wh*-pro-forms as demonstratives.

3. A proposal

The discussion in the previous section leads to the following desiderata for a theory on the semantics of *wh*-expressions, and *wh*-pro-forms in particular. We want to provide a unified cross-categorial semantics for *wh*- that is simple, and which takes into account the semantics of paradigm-mates, while deriving (not stipulating) the correct types for traces/variables and allowing *in-situ* interpretation.

My point of departure is Diessel's (2003) finding that cross-linguistically, interrogative pro-forms are most closely related to demonstrative pro-forms, which he observes are similar in various respects. They occupy the same syntactic categories, they are subject to the same morphological derivations, sometimes allowing forms of affixation that do not occur with other categories, and they can be marked for the same semantic features.

In many languages, *wh*-expressions are clearly morphologically related to demonstratives. This can be illustrated with the following paradigm from Lezgian (from Haspelmath 1993:188; via Diessel 2003):

(20)

	demonstratives	**interrogatives**
person/thing	im	him / wuž
place	inag	hinag
place:at	ina	hina
place:on	inal	hinal
place:in	inra	hinra
direction:to	iniz	hiniz
direction:from	inaj	hinaj
amount	iq’wan	hiq’wan
quality	iˆ xtin	hiˆ xtin
manner	ik’	hik’ (a)

At the same time, Diessel argues that demonstratives and interrogatives are generally not derived from each other, either synchronically or diachronically (although the Lezgian data would allow such an analysis). His explanation for their similarities is that they serve similar pragmatic functions, and that in addition they are neither functional nor lexical items, but belong to a third category that they are unique to.

I propose instead that the reason why interrogative pro-forms and demonstrative pro-forms are similar is that interrogatives are in fact in fact demonstratives. Consider the compound paradigm in (21), which illustrates two familiar observations. First, demonstratives, like interrogatives, occur across syntactic categories and denote across ontological domains. Secondly, demonstratives usually allow between one and three feature values, such as proximal or distal, marking proximity to the interlocutors.

(21)

<table>
<tr><th></th><th>proximal</th><th>medial</th><th>distal</th><th>u/wh</th><th></th></tr>
<tr><td>thing</td><td>this</td><td colspan="2">that</td><td>what</td><td></td></tr>
<tr><td>locative</td><td>here</td><td colspan="2">there</td><td>where</td><td></td></tr>
<tr><td>allative</td><td>hither</td><td colspan="2">thither</td><td>whither</td><td></td></tr>
<tr><td>ablative</td><td>hence</td><td colspan="2">thence</td><td>whence</td><td></td></tr>
<tr><td>time</td><td colspan="3">then</td><td>when</td><td></td></tr>
<tr><td>degree</td><td colspan="3">yay</td><td>how</td><td></td></tr>
<tr><td>person</td><td colspan="3">der</td><td>wer</td><td>(German)</td></tr>
<tr><td>amount</td><td colspan="3">tiek</td><td>kiek</td><td>(Lithuanian)</td></tr>
<tr><td>quality</td><td colspan="3">takoj</td><td>kakoj</td><td>(Russian)</td></tr>
<tr><td>manner</td><td>kō</td><td>sō</td><td>ą</td><td>dō</td><td>(Japanese)</td></tr>
</table>

My proposal is that *wh-* be regarded as an additional possible proximity value, next to proximal, medial and distal. If this is so, we understand why demonstratives and interrogatives behave so similarly, as observed by Diessel (2003). In addition, we understand why interrogatives tend not to be marked for proximal, medial or distal, as observed by Diessel: these features are in complementary distribution.[6]

[6] This does not preclude of course that a deictic expression is adjoined to a *wh*-pro-form, as in *who here wants ice cream?* Perhaps this might explain the exception noted by Diessel: Amele (Papua) has *ai* ‘where proximal’ vs. *ana* ‘where distal’ (Roberts 1987).

The most important point for our purposes is that like *wh*-expressions, demonstratives denote across ontological domains, with a common semantic core (deixis). If we find a solution for the cross-categorial semantics of demonstratives, we may automatically solve the cross-categoriality problem for *wh*-expressions, as well. I will briefly discuss my proposal for the semantics of demonstratives, and then return to interrogatives.

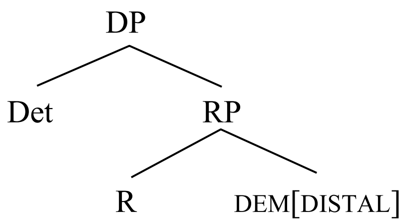
3.1. A cross-categorial semantics for demonstratives

This section summarizes the approach to the cross-categorial semantics of demonstratives proposed in Ruys (2022, in prep). We start from Nunberg's (1993) phenomenon of deferred reference. Consider (22) and (23):

(22) [pointing at a recovered patient, to refer to the medication that cured him:]
That (molecule) worked great!

Nunberg argues that in analyzing such examples, where the speaker gestures at one thing while intending to refer to another, we need to distinguish between the *index* (a feature of the utterance context; in (22): the patient) and the *referent* (in (22): the medication). These are mediated by a relation R (here: a function from patients to the medication they took) that the interlocutors need to construct from context and world knowledge. Elbourne (2008) implements this by postulating a free variable R in the internal syntax of the demonstrative, which I adapt as follows:

(23) *that:*



(24) a. $[\![\ \text{DEM[DISTAL]}\ ]\!]^{g,c} = (\lambda x{:}\text{far from speaker}(x).x)(\delta_c)$
$\equiv \delta_c$ [with presupposition δ_c is distal]

b. $[\![\ \text{R DEM[DISTAL]}\ ]\!]^{g,c} = g(R)(\delta_c)$

c. $[\![\ \text{Det}\ ]\!]^{g,c} = \lambda P.\iota x[P(x)]$ [7]

d. $[\![\ \text{Det [R DEM[DISTAL]]}\ ]\!]^{g,c} = \lambda P.\iota x[P(x)](g(R)(\delta_c)) \equiv \iota x[g(R)(\delta_c)(x)]$

I assume in Ruys (2022) that the demonstrative feature DEM refers to the demonstratum in the utterance context (written as δ_c), subject to a presupposition triggered by the proximity value: (24a). R is a free variable, its value constructed from context and world knowledge but constrained by its sister and the head that selects for it. The function denoted by R applies to δ_c (24b); its output in the case of DP demonstratives must be a set of individuals, for the definite determiner Det to be able to apply to it (24c). The DP ends up denoting the unique object x that has the salient relation R with the demonstratum, as in (24d). I assume further

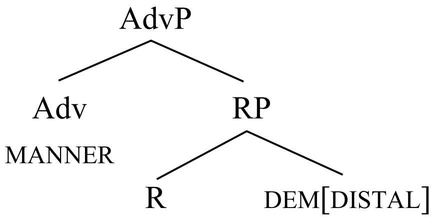
[7] I follow the notational convention from Elbourne 2008 that uses ι to denote the presuppositional definite determiner meaning.

that R may either default to IDENT ($\lambda x \lambda y.y=x$), as proposed by Elbourne 2008, in which case reference is not deferred but (24d) = δ_c, or it may take on any other value the interlocutors construct, e.g., a function from patients to the medications they took.

The presence of R in turn explains why demonstratives can exist cross-categorially, with a shared demonstrative core. Ruys (2022, in prep) argues that in the case of manner demonstratives, quality demonstratives, and even locative demonstratives, the demonstratum in the utterance context (the target of a gesture or a mental directing of attention) is never itself the denotation of the demonstrative. E.g., with manner demonstratives, one gestures at an individual involved in an event taking place in a particular manner, or perhaps at the event itself, while the demonstrative denotes a (salient) manner in which that event is taking place: the manner is not a possible demonstratum (briefly, because a manner cannot be proximal or distal; see Ruys (2022, in prep) for further discussion). The fact that one can use manner demonstratives at all is thus due to the presence of R which mediates between demonstratum and referent. (26) from König & Umbach (2018) illustrates this for the Japanese distal manner demonstrative *ą* (see also Coulmas 1982):

(26) Hanako-wa ạ odor-u.
Hanako-TOP thus (distal) dances-PRS

(27) *ą*:



(28) a. $[\![$ DEM[DISTAL] $]\!]^{g,c}$ = $(\lambda x\text{:far from speaker}(x).x)(\delta_c)$
$\equiv \delta_c$ [with presupposition δ_c is distal]

b. $[\![$ R DEM[DISTAL] $]\!]^{g,c}$ = $g(R)(\delta_c)$

c. $[\![$ $[_{Adv}$ MANNER] $]\!]^{g,c}$ = $\lambda x_{\langle v,t\rangle}\text{:manner}(x).x$ [*v* for events]

d. $[\![$ $[_{Adv}$ MANNER] [R DEM[DISTAL]] $]\!]^{g,c}$ = $(\lambda x\text{:manner}(x).x)(g(R)(\delta_c)) \equiv g(R)(\delta_c)$
[with presupposition that value of R applied to δ_c yields a manner]

With the DP demonstrative *that* in (23) we saw that the definite determiner can only combine with RP if R yields a set of individuals as value; in (27), R's output type and properties are constrained by categorial and other features of the adverbial head in the same way. The MANNER-feature in particular requires its complement to have the type and properties of a manner. This forces the speaker/hearer to supply a value for R that is a function from the demonstratum δ_c to a manner, e.g., a function that takes an individual and yields a salient manner in which the salient event that individual is involved in is taking place. The interested reader is referred to Ruys (2022, in prep) and Ruys (2023) for further discussion.

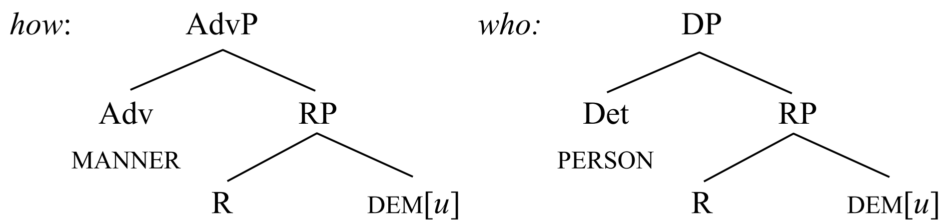
3.2. Application to *wh*-demonstratives

The basic intuition underlying my treatment of *wh*-pro-forms as demonstratives is that they signal an unspecified proximity value: by asking *what* (thing, person, manner, etc.), one indicates that the choice between *this* (thing, person, manner, etc.) and *that* (thing, person, manner, etc.) is undecided. Technically, I propose to implement this by the following pair of assumptions. First, *wh*- is actually the unvalued state of the demonstrative feature: DEM[*wh*-] is DEM[*u*]. Second, (constituents containing) unvalued features function as variables. This second assumption, borrowed from Ruys (2015), is illustrated in (29):

(29) a. $\text{John}_{[\text{Case[nom]}]}$ [$_{\text{T}}$ was] kissed $\cancel{\text{John}}_{[\text{Case[u]}]}$
b. (John) λx. [$_{\text{T}}$ was] kissed x

Following Chomsky (1998), we assume that *John* is first merged with an unvalued Case-feature, which renders it visible for attraction by the probe T. We assume in addition that while T values this Case feature as NOM, the Case feature on the downstairs copy of *John* remains unvalued, and this is what marks it (or some dominating node, depending on the conditions on pied piping, which I cannot address here) as a downstairs (trace) copy that needs to be interpreted as a variable (of type e, if that is the type of the DP *John* under its regular interpretation). We extend this account by postulating that interpretable features (such as demonstrative features) can also be unvalued, in which case they also function as variables.

Consider now the English manner and person interrogatives in (30):

(30)


(31) a. $[\![\ \text{DEM}[u]_i\ ]\!]^{g,c} = g(x_i)$
b. $[\![\ \text{Adv MANNER}\ [\ \text{R DEM}[u]_i]\ ]\!]^{g,c} = g(R)(g(x_i))$
presupposing that $g(R)(g(x_i))$ is a manner
c. $[\![\ \text{Det PERSON}\ [\ \text{R DEM}[u]_i]\ ]\!]^{g,c} = (\lambda x{:}\text{person}(x).x)(\lambda P.\iota x[P(x)](g(R)(g(x_i))))$
$\equiv \iota x[g(R)(g(x_i))(x)]$, presupp. it's a person

The unvalued DEM feature functions as a variable: (31a). Its type is determined as before: since a demonstrative feature is regularly of type e, so is the variable. The rest of the composition proceeds as before, as well. The adverbial head in *how* coerces R into a function from individuals to manners. The definite determiner in *who* forces R to yield a set of individuals. Since φ-features (not indicated here) and presuppositional features such as

PERSON are features of D or of higher projections, they apply to the referent (the output of R), not to the index, as observed by Nunberg (1993).[8]

Consider this derivation with *who*:

(32) a. $[_{CP}\ \text{who}_k\ [_{C'}\ \text{did Mary kiss}\ \cancel{\text{who}}_k\ ]]$
b. $[\ \text{Det PERSON}\ [\ \text{R dem}[u]_i]\ ]_k$ did Mary kiss $[\ \text{Det PERSON}\ [\ \text{R dem}[u]]\ ]_k$
c. $[\![\ \cancel{[\ \text{Det PERSON}\ [\ \text{R dem}[u]_i\ ]]}_k\ ]\!]^{g,c} = g(\ x_{k,e}\ )$
d. $[\![\ C'\ ]\!]^{g,c} = \lambda x_k\ .\ \text{Mary kiss}\ x_k$
e. $[\![\ [\ \text{Det PERSON}\ [\ \text{R dem}[u]_i\ ]]\ ]\!]^{g,c} = \iota x[g(R)(g(x_i))(x)]_e$
f. $[\![\ \text{who C'}\ ]\!]^{g,c} = (\lambda x_k\ .\ \text{Mary kiss}\ x_k)\ (\iota x[g(R)(g(x_i))(x)])$
$\equiv \text{did Mary kiss}\ \iota x[g(R)(g(x_i))(x)]$
g. $[\![\ CP_{wh}\ ]\!]^{g,c} = \lambda p\ \exists x_i\ [\ p = {}^\wedge\ \text{Mary kiss}\ \iota x[g(R)(x_i)(x)]]$
h. $[\![\ CP_{wh}\ ]\!]^{g,c} = \lambda p\ \exists x_i\ [\ p = {}^\wedge\ \text{Mary kiss}\ x_i\ ]$

(32a) contains two copies of *who*, shown in detail in (32b). Both copies have the same internal structure, yielding the interpretation in (31c) above. However, as the lower copy is recognized as a trace it functions as a variable of the same type as its regular interpretation: see (32c). This trace is λ-bound at the C' level in (32d), e.g. with the familiar mechanism from Heim & Kratzer (1998) that splits off the index, which in turn triggers lambda-abstraction. The upstairs copy of *who* in (32e) composes with this predicate. Since the *wh*-expression does not have an operator semantics it cannot apply to C' and bind the variable. Instead, the C' predicate applies to *who*: *who* undergoes semantic reconstruction, yielding (32f).[9] I have no specific proposal to make about the mechanics of the subsequent operations, namely the process of unselective binding itself, and the procedure that lifts the CP-denotation to a set of propositions. The reader may consult Rullmann & Beck (1998), Kratzer & Shimoyama (2002), Cable (2010) a.o. for possible approaches. The outcome should be that the CP_{wh} yields the set of propositions given in (32g), where existential closure binds the DEM[*u*] variable. Finally, we assume as before that R can default to IDENT (no deferred reference), which results in (32h) (still with the presupposition that the value of x_i is a person).

The derivation with manner-*how* is different mainly in that R cannot default to IDENT:

(33) a. $[_{CP}\ \text{how}_k\ [_{C'}\ \text{did Peter kiss John}\ \cancel{\text{how}}_k\ ]]$
b. $[\text{Adv MANNER}\ [\ \text{R DEM}[u]_i]]_k$ did Peter kiss John $[\text{Adv MANNER}\ [\ \text{R DEM}[u]_i]]_k$
c. $[\![\ \cancel{[\text{Adv MANNER}\ [\ \text{R DEM}[u]_i]]}_k\ ]\!]^{g,c} = g(\ x_{k,\ \langle v,t\rangle}\ )$
d. $[\![\ C'\ ]\!]^{g,c} = \lambda x_k\ .\ \text{Peter kiss John}\ x_k$
e. $[\![\ [\text{Adv MANNER}\ [\ \text{R DEM}[u]_i]]\ ]\!]^{g,c} = g(R)(g(x_i))$ /presupposed a manner

[8] The demonstrative counterpart of *who* is spelled out as *he* or *she* in English: see Ahn (2022), Ruys (2023).
[9] Unlike Lechner (2013), I follow Cresti (1995) in assuming that semantic reconstruction is, or at least can be, intensional.

f. $[\![$ how C' $]\!]^{g,c}$ = $(\lambda x_k$. Peter kiss John $x_k)$ $(g(R)(g(x_i)))$
$\equiv$ Peter kiss John $g(R)(g(x_i))$

g. $[\![$ CP_{wh} $]\!]^{g,c} = \lambda p\ \exists x_i\ \exists R$ [p = ^Peter kiss John $R(x_i)$]

The derivation proceeds much as in (32). Manner-*how*, like the manner adverbial in (27), has the type of a VP modifier, say ⟨*v*,t⟩ (which combines with VP via predicate modification, i.e., intersection). As a result, its trace has this type as well. The upstairs copy of *how* also has this non-operator type, so like *who* it undergoes semantic reconstruction. However, the MANNER feature forces R to lift the uninterpretable DEM-feature (a type e variable) to the type of a manner modifier, so R cannot default to IDENT.[10] Instead, absent a salient function of the required type, R must also undergo existential closure, resulting in (33g) (where $R(x_i)$ is presupposed to have the properties of a manner).

Independent evidence for this analysis comes from island effects. In general, adjuncts cannot be extracted from weak islands. We can attribute this to a ban on binding other than e-type variables across islands (Frampton 1999). Likewise, adjuncts cannot remain *in situ* inside islands, since this would require binding the R-variable across an island. The fact that arguments are interpretable inside islands (see example (6a) above) is in line with our analysis, since with e-type *wh*-expressions R can default to IDENT.[11] This analysis holds the promise of explaining a known but puzzling exception, exemplified here by (34) from Huang (1982b) (see also Kiss 1993, Bayer 2006): *wh*-adverbials inside islands are acceptable, in case the interlocutors can conceptualize them as object-denoting. Those circumstances would allow R to remain a free variable mapping object to modifier, so that only the object-denoting variable DEM feature is bound across the island.

(34) $[_{CP}$ ni xiang kan $[_{DP}$ $[_{CP}$ ta shemeshihou pai de] dianying]]?
you want see he when film DE movie
'you want to see movies that he filmed *when* ?'

4. Conclusion

I have offered a semantics for *wh*-pro-forms that meets the desiderata outlined in section 2. By postulating that *wh*-expressions are unvalued uninterpretable variants of demonstratives, we account for their semantic and morphological relation to these paradigm-mates. The cross-categoriality of *wh*-pro-forms is analyzed by the same mechanism that allows regular demonstratives to function cross-categorially; there is independent evidence for this mechanism from the phenomenon of deferred reference. By treating *wh*-pro-forms as non-operator expressions, the correct types for trace-variables follow automatically from the simple mapping principle proposed in Ruys (2015). For the same reason, *in-situ* interpretation of *wh*-pro-forms is unproblematic; consequently, pied piping allows the same treatment if followed by reconstruction.

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[10] Note that here, as well in the treatment of regular demonstratives, we must allow R to have a flexible type. This is achieved in Ruys (2015) by making the type of a variable dependent on the assignment function.

[11] Given our approach it is plausible to treat *which*, the *wh*- counterpart of determiner *that*, as being of type e, with the lexical NP as an appositive (triggering a conventional implicature).

Given the extensive literature on *wh*-expressions, there are bound to remain many more open questions than I have provided answers. To mention just a few: more work is needed to explore from the perspective I have offered the treatment of pair-list and functional readings, the analysis of relative clause operators, free relatives, and determinatives, and the treatment of indeterminate pronouns in other positions, especially in view of the implementation of unselective binding, among many other issues.

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Clause-internal coherence: A look at deverbal adjectives[1]

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Abstract. Hobbs (2010) introduced the term *Clause-Internal Coherence* ('CIC') to describe inferences such as that in, 'A jogger was hit by a car,' where the jogging is understood to be implicated in the car-hitting event. Cohen & Kehler (2021) motivate an account of CIC using tools familiar from discourse coherence research. An outstanding question is how to compositionally derive CIC from coherence relations. We propose that CIC can arise as a byproduct of presupposition resolution, couching our analysis in *Segmented Discourse Representation Theory* (Asher & Lascarides 1998) and providing motivation from experimental findings. Our findings suggest: (i) attributive adjectives, both deverbal and non-deverbal, can trigger CIC; (ii) attributive adjectives trigger weaker causal inferences, but stronger non-causal inferences, than their predicative counterparts; (iii) non-deverbal adjectives are weaker causal inference triggers than deverbal adjectives. We argue that attributive adjectives are presupposition triggers, and that they give rise to CIC inferences as a result of presupposition resolution. Thus, CIC with deverbal adjectives arises via Background (non-causal inference) or, depending on word order, Elaboration or Continuation (causal inference). For non-deverbal adjectives, non-causal inferences also arise via Background, but causal inferences arise via Explanation or Result. Finally, we show how some of the interpretative preferences observed in our studies can be modeled as interactions between independently motivated default axioms for choosing between coherence relations. Our research sheds new light on how presupposition relates to anaphora resolution and coherence, while also contributing to recent work on adjectival meaning in discourse.

Keywords: clause internal coherence, discourse coherence, presupposition, anaphora, SDRT, experimental pragmatics

1. Introduction

The sentences below exemplify what Hobbs (2010) terms *Clause-Internal Coherence* ('CIC') inferences: instances of the inferences that characterize discourse (i.e., multi-clausal) interpretation that are 'special' by virtue of arising from a single clause.[2]

For example, (1) gives rise to a causal inference: by sticking a knife into her husband, the described subject became a widow.

(1) A widow stuck a knife into her husband. (Anscombe 1979)

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[2]Hobbs (2010) and Cohen and Kehler (2021) also use 'CIC' to describe multi-clausal sentences like those in (i). Here, we only consider instances of CIC that, at least prima facie, involve a single clause.

(i) a. The company fired the manager who was embezzling money.
b. The company fired the manager who was hired in 2002.
c. The company fired the manager who has a long history of corporate awards. (adapted by Cohen and Kehler (2021) from an example of Rohde et al. (2011)).

In (2a), it is natural to infer that jogging led to a car accident, but in (2b), we do not make the analogous inference that teaching led to a car accident.

(2) a. A jogger was hit by a car last night in Marina del Rey.
b. A teacher was hit by a car last night in Marina del Rey. (Hobbs 2010)

Cohen and Kehler (2021) argue that CIC cannot be accounted for by familiar pragmatic tools including Grice's (1975) implicatures, Bach's (1994) implicitures, and various forms of local pragmatic strengthening proposed by Levinson (1987), Recanati (2010), and others. Instead, they motivate a novel type of enrichment, *eliciture*, that is characterized by its non-local nature, which is familiar from research on the coherence of intersentential discourse.[3] Beyond this, clause-internal coherence has received little formal attention; one of many outstanding questions is how to compositionally derive clause *internal* coherence from clause *external* coherence relations. In this paper, we introduce one possible approach to answering this question.

Clause-internal coherence has not yet received much experimental attention either; another aim of this paper is to deepen our empirical understanding of the phenomenon. In §2, we present the results of four offline experiments that probe the strength, salience, and overall availability of the causal inferences triggered by deverbal and non-deverbal adjectives. As shown in (3), we considered deverbal adjectives like *drenched* and non-deverbal adjectives like *wet* in discourse contexts vs. clause-internal contexts, and in cause/effect vs. effect/cause orders.[4]

(3) a. *Discourse effect-cause*: A child was **drenched/wet**. She got hit by a big water balloon.
b. *Discourse cause-effect*: A big water balloon hit a child. She was **drenched/wet**.
c. *Clause effect-cause*: A **drenched/wet** child got hit by a big water balloon.
d. *Clause cause-effect*: A big water balloon hit a **drenched/wet** child.

Our findings are consistent with the hypothesis that attributive (i.e., DP/NP-internal) adjectives can trigger clause-internal coherence inferences that correspond to discourse coherence inferences triggered by predicative adjectives. Specifically, the results suggest that attributive adjectives are weaker triggers of causal inferences, but stronger triggers of non-causal inferences, than their predicative counterparts. We observed this pattern for both deverbal and non-deverbal adjectives, suggesting that the trigger of a CIC inference need not necessarily be event-describing or derivationally related to a verb. However, these characteristics do seem to have some effect on coherence inferences more broadly: the causal inferences triggered by non-deverbals were both less salient and less available overall than those triggered by deverbals.

Subsequently, in §3, we propose a formal analysis that captures the experimental findings. Specifically, we explore the possibility of extending an analysis of presupposition in *Segmented Discourse Representation Theory* (SDRT, Asher and Lascarides 1998). This account hinges on the argument that CIC can arise as a presupposition, whose trigger is an attributive adjective. Evidence for the presupposition is provided in (4), which shows that *drenched* and *wet* both trigger an inference that projects out of negative, interrogative and suppositional contexts. In

[3] For recent overviews of this research, see, e.g., Kehler (2019), Jasinskaja and Karagjosova (2020), Altshuler and Truswell (2022: Ch.6).
[4] See Appendix for more sample stimuli.

particular, both adjectives presuppose the described state (of being drenched and wet, respectively), with the deverbal adjective also presupposing that the state is caused by some event.

(4) a. It is not the case that a {drenched/wet} child got hit by a big water balloon. She was pushed into the pool.

b. A: Did a {drenched/wet} child get hit by a big water balloon?
B: No, she was pushed into the pool.

c. A few children at Camp Hope showed up to dinner {drenched/wet}. If a {drenched/wet} child got hit by a big water balloon, then someone smuggled such balloons into the camp.

The analysis we propose treats presupposition as a species of anaphora resolution (Van der Sandt 1992; Krahmer 1995). We show how CIC inferences follow from the resolution of a coherence relation that binds the presupposed information and an attachment point that allows for projection. We argue that, when distinct inferences are available, the relative salience of each inference follows from the interaction of independently motivated, default axiom schemata for inferring particular coherence relations.

Finally, in §4, we summarize our contributions and questions for further research.

2. Experimental support for clause-internal coherence

2.1. Experiment 1: Rating causal inference strength

We focused first on deverbal adjectives because we hypothesized that, if clause-internal coherence is a robust phenomenon, deverbals would be more likely to give rise to it than non-deverbals. This is because discourse coherence is largely based on relationships between clausal eventuality descriptions. Although deverbal adjectives are not overtly clausal, they are derivationally related to verbs and describe events.

As such, we began our investigation by employing a Likert-scale task to gauge the relative strength of the causal clause-internal inferences triggered by attributive deverbal adjectives, compared to the causal discourse inferences triggered by their predicative counterparts. We focused on causal interpretations because naive speakers' interpretations of them are fairly straightforward to probe (Singer et al. 1992). Based on informal judgments, we hypothesized that (i) attributive deverbal adjectives give rise to causal CIC inferences, and (ii) the strength of these inferences is modulated by the linear order of the cause and effect descriptions.

2.1.1. Design, Methods, and Predictions

Design. We used a 2x2 design crossing Inference Domain {DISCOURSE, CLAUSE} with Cause/Effect Order {CAUSE-EFFECT, EFFECT-CAUSE} for 40 items, as in (3) above. 42 filler items were balanced between discourse and clause inference domain and for causal inference strength (strong/medium/weak). (For more sample stimuli, including fillers, see the Appendix.)

Participants. Participants were 65 UK-based, native English speakers recruited via Prolific. Participants in all the experiments reported here were also Prolific workers in the same demographic categories.

Task. On a 1–4 scale (*Not at all likely–Extremely likely*), participants responded to a question of the form, *How likely do you think it is that the child was drenched because she got hit by the big water balloon?*

Analysis. Data were analyzed in R with maximal Bayesian cumulative link mixed effects models using the `brms` package (Bürkner 2017; Carpenter et al. 2017).

Predictions. We predicted a main effect of Inference Domain such that CLAUSE conditions would receive more 3–4 ratings than 1–2 ratings, but that they would still be rated lower/less likely than DISCOURSE conditions. Following informal judgments, we also predicted an interaction such that CAUSE-EFFECT would be rated lower than EFFECT-CAUSE for CLAUSE conditions, but not DISCOURSE conditions.

2.1.2. Results and Discussion

The distribution of ratings for experimental stimuli is plotted in Figure 1a. We found the predicted main effect of Inference Domain: causal inferences in DISCOURSE conditions were rated more likely than in CLAUSE conditions (2.33, [1.79, 2.89]). We also found an interaction: between the two DISCOURSE conditions, ratings were higher for the CAUSE-EFFECT order than for EFFECT-CAUSE (0.49, [0.04, 0.94]), while the opposite held between the two CLAUSE conditions $(-0.72, [-1.10, -0.36])$.

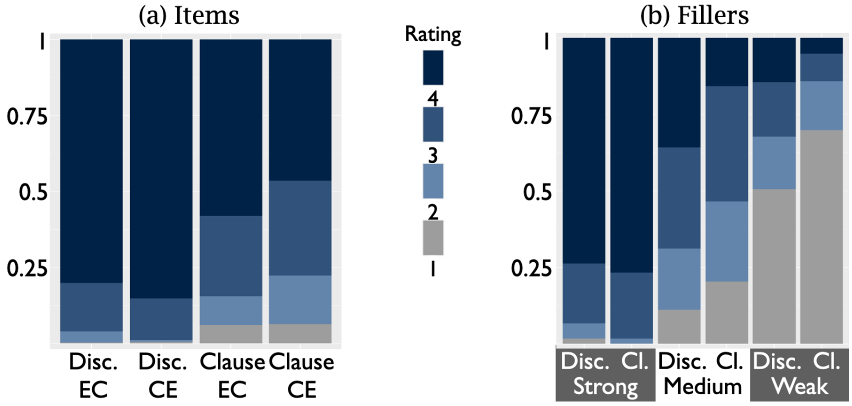

Figure 1: Proportions of ratings for deverbal adjectives, Expt. 1

Ratings were high across the experimental stimuli, but, crucially, this does not seem to have been an experiment-wide pattern. As shown in Figure 1b, the ratings for fillers spanned the full scale, and tracked with the intended strong/medium/weak causal inference strength categories.

The results of this experiment were largely in line with our predictions, thus providing some support for the hypothesis that clause-internal coherence inferences may be reliably and robustly triggered by attributive deverbal adjectives.[5] One open question is what may be driving the observed Inference Domain effect. We begin to address this in Experiments 2 and 3.

2.2. Experiment 2: One-stage forced choice

We hypothesized that, in Experiment 1, the relative weakness of the causal inferences in CLAUSE contexts compared to DISCOURSE contexts was due to a competing inference in the

[5]We do not undertake a full by-items analysis here, but see §4 for further discussion.

former. Specifically, we posited that this was a non-causal, temporally overlapping inference.[6]

2.2.1. Methods and Predictions

We used the same design and stimuli as in Experiment 1. Participants (n = 64) responded to a forced choice question of the form in (5). Our linking assumption was that the task would provide an estimate of the relative salience of each interpretation.

(5) **A drenched child got hit by a big water balloon.**
Which is the most accurate description of what happened?
a. *The child was drenched because she got hit by the big water balloon.*
b. *The child was already drenched when she got hit by the big water balloon.*

We predicted that the non-causal inference (e.g., (5b)) would be chosen more frequently in CLAUSE contexts than DISCOURSE contexts. We also predicted that the non-causal inference would be chosen more frequently for the CLAUSE EFFECT-CAUSE condition than the CLAUSE CAUSE-EFFECT condition. Data were analyzed with maximal Bayesian logistic mixed effects regression models.

2.2.2. Results and Discussion

The rates of non-causal choices are plotted in Figure 2. In line with our predictions, the non-causal interpretation was chosen more frequently for CLAUSE conditions than DISCOURSE conditions (3.77, [2.76, 4.95]). Further, we found an interaction such that, between the two CLAUSE conditions, the non-causal interpretation was chosen more frequently for CAUSE-EFFECT order than for EFFECT-CAUSE order $(-0.41, [-0.78, -0.07])$ (i.e., the *causal* interpretation was chosen *less* frequently for CE order); no difference obtained between the DISCOURSE conditions.

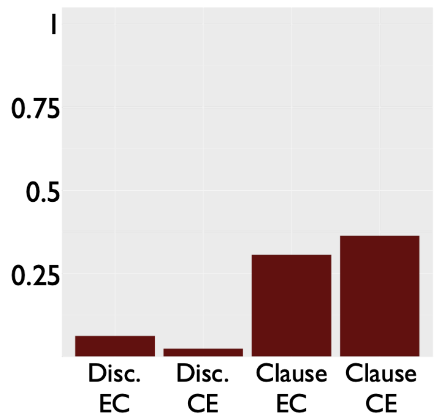

Figure 2: Rates of non-causal interpretations for deverbal adjectives, Expt. 2

These results suggest that a causal inference and non-causal inference may be in competition in clause-internal contexts. That is, although the causal inference still tends to be the more salient, the non-causal inference can win out more readily than in discourse contexts. However, this method does not show, for a given trial, whether the option that was not chosen was not

[6]In SDRT, this inference is often characterized by the coherence relation Background (Asher et al. 2007). See §3 for more discussion.

chosen because it was an unavailable interpretation, or simply because it was less salient or less plausible, though still available. We sought to address this in Experiment 3.

2.3. Experiment 3: Two-stage forced choice

Based on informal judgments, we hypothesized that the non-causal interpretation would have lower overall availability in discourse contexts than in clause-internal contexts, on top of the lower salience we observed in Experiment 2.

2.3.1. Methods and Predictions

We tested this hypothesis with a two-stage forced choice task, using the same design and stimuli as the previous experiments. The first stage was the same as that in Experiment 2. The second stage was then presented on the same screen. Participants (n = 48) responded 'Yes' or 'No' to the question, *Is the other option also a reasonable description of what happened?*. As in Experiment 2, we made the linking assumption that the first stage response gauges the relative salience of each interpretation. We further assumed that the two stages combined provide an estimate of the overall availability of each interpretation.

We expected that the first choice responses would be consistent with the Experiment 2 findings. We also predicted a main effect of Inference Domain on the total non-causal choices, such that this interpretation was chosen more overall in CLAUSE conditions than DISCOURSE conditions. Data were analyzed with maximal Bayesian mixed effects logistic regression models.

2.3.2. Results & Discussion

The proportions of causal and non-causal choices are plotted in Figure 3. In DISCOURSE conditions, compared to CLAUSE conditions, the causal interpretation was a more frequent first choice (3.89, [2.78, 5.16]) and more available overall (2.65, [1.21, 4.33]). In contrast to Experiments 1 and 2, we found no interaction in the first choice data. There was also no interaction with respect to the overall availability of the causal interpretation.

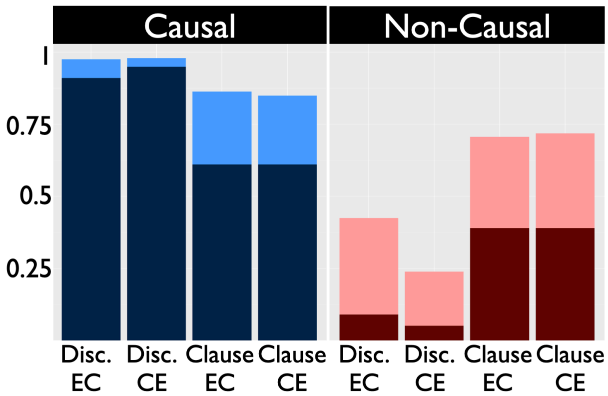

Figure 3: Rates of interpretative choices for deverbal adjectives, Expt. 3. The lower segment of each bar represents the first choice rate; the upper bar, the second choice rate.

We turn now to the overall availability of the non-causal interpretation.[7] There were re-

[7]Note that the first choice results are the complement of the causal first choice results.

liable main effects of both factors: overall availability was higher for CLAUSE than DISCOURSE $(-2.54, [-3.16, -1.97])$ and higher for EFFECT-CAUSE order than CAUSE-EFFECT $(-0.53, [-0.82, -0.24])$. There was also an unexpected, but reliable, interaction such that, between the two DISCOURSE conditions, the non-causal reading was more available for the EFFECT-CAUSE order than the CAUSE-EFFECT order $(-1.18, [-1.56, -0.82])$, but no difference obtained between the CLAUSE conditions.

In sum, we found that, for all four conditions, the causal interpretation was both more salient and more available overall than the non-causal interpretation. We also observed higher salience and availability of the causal interpretation in discourse contexts, compared to clause-internal ones; this is in line with Experiments 1 and 2. As for the non-causal interpretation, we found that it was less available overall in discourse contexts than in clause-internal ones. We leave it to future work to unpack which factors, such as temporal iconicity, may be driving the unanticipated effect of Cause/Effect Order in discourse contexts.

2.4. Experiment 4: Two-stage forced choice with non-deverbal adjectives

2.4.1. Design, methods, and predictions

In Experiments 1–3, we focused on deverbal adjectives because, as noted in §1, we hypothesized that deverbals would be more likely to give rise to CIC inferences than non-deverbals. The results suggest that deverbal adjectives can give rise to CIC inferences, but do not indicate the extent to which this effect depends on the adjectives' relation to verbs and event-describing nature. As such, in Experiment 4, we tested whether non-deverbal adjectives can also trigger CIC inferences, particularly causal ones. We hypothesized that non-deverbals would be less likely do this than deverbals because they are not event-describing, but not that they would be altogether unable to do so, given the psycholinguistic evidence for a causal preference or default in discourse comprehension (Mandler 1986; Zwaan et al. 1995; Briner et al. 2012: a.o.).

The design was the same as in the previous experiments, but the stimuli featured non-deverbal adjectives—for instance, *wet* instead of *drenched* in (3).[8] The task (n = 60) and analysis were the same as in Experiment 3. We predicted the causal interpretation would be more salient and more available overall in DISCOURSE conditions. We also predicted this main effect would be larger here than in Experiment 3.

2.4.2. Results and discussion

The rates of causal and non-causal choices are plotted in Figure 4. With respect to the first choice data, we found that the causal interpretation was chosen more frequently in DISCOURSE conditions than CLAUSE conditions [3.29, (2.70 3.92)]. This is in line with the results of Experiments 1–3, but the gap was larger in this experiment than the others. For the attributive non-deverbals, the non-causal interpretation was the first choice over half the time; this was not the case among the attributive deverbals. There was also a reliable interaction such that, between

[8]Of the 40 experimental items, 29 had a minimal or near-minimal partner in the deverbal stimuli: minimal partners simply had a non-deverbal adjective in place of the critical deverbal adjective, and near-minimal partners also had a different passive verb (e.g., 'got' instead of 'was') to preserve acceptability. The remaining 11 stimuli were altered more substantially in order to maintain acceptability and causal inference strength (based on our own judgments). Preliminary descriptive analysis does not suggest that these changes had systematic effects on the task results, but passive type is discussed further in §4.

the DISCOURSE conditions, the causal first choice was more frequent for the CAUSE/EFFECT order (0.65, [0.11, 1.26]), but the CLAUSE conditions did not differ from one another.

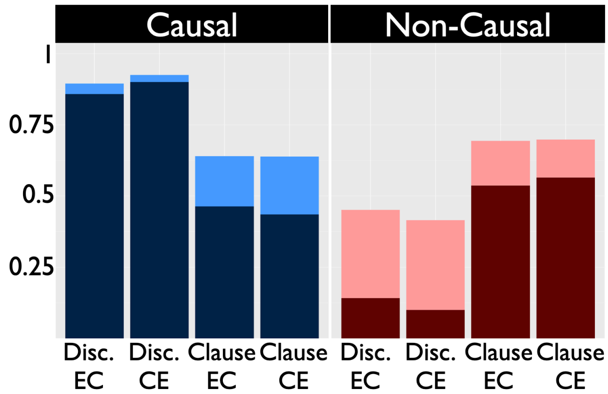

Figure 4: Rates of interpretative choices for non-deverbal adjectives, Expt. 4. The lower segment of each bar represents the first choice rate; the upper bar, the second choice rate.

The causal interpretation was more available overall for the DISCOURSE conditions than CLAUSE conditions (2.55, [1.99, 3.17]). Meanwhile, the non-causal interpretation was more available overall in the CLAUSE conditions than the DISCOURSE conditions $(-1.40, [-1.76, -1.04])$. These findings track with those of Experiment 3, but unlike in Experiment 3, we observed no effect of Cause/Effect Order, and no interaction.

We also compared deverbals and non-deverbals by analyzing the combined results of Experiments 3 and 4, with Adjective Type as an additional factor. We found an effect of Adjective Type such that the causal interpretation was the more frequent first choice (1.16, [0.44, 1.94]) and more available overall (2.03, [1.23, 2.91]) with deverbals. Thus, our results suggest that non-deverbal adjectives can trigger coherence inferences in both discourse and clause-internal contexts. However, regardless of context, the causal inferences triggered by non-deverbals seem to be both less salient and less available overall than those triggered by deverbals.

2.5. Summary of experimental results

Finally, let us take stock of the main findings of all four experiments, so we can see what our formal analysis ought to account for. First, across all the experiments, the causal interpretation was more dominant in the DISCOURSE conditions compared to the CLAUSE conditions (i.e., rated more likely in Expt. 1 and chosen more frequently in Expts. 2–4). In Expts. 2–4, this means that the first-choice (and only choice, in Expt. 2) non-causal relationship was the opposite. In Expts. 3 and 4, we further found that the non-causal interpretation was more available overall in the CLAUSE conditions than the DISCOURSE conditions. In Expt. 3, we observed an unexpected main effect of Cause/Effect Order on the overall availability of the non-causal interpretation, but a reliable interaction also obtained here.

The interactions we found across the experiments were driven by simple effects of Cause/Effect Order. In this paper, we will not offer an analysis of these effects, and leave it to future experimental work to better determine their robustness. However, as we will see, the observed differences seem to be consistent with one another, rather than multiple distinct or contradictory patterns. We summarize the relevant pairwise comparisons here. First, in line with our intuitive predictions, CLAUSE EFFECT-CAUSE received higher causal inference ratings (Expt. 1) and more causal interpretation choices (Expt. 2) than CLAUSE CAUSE-EFFECT. Second, in a tidy reversal, DISCOURSE EFFECT-CAUSE received lower causal inference ratings (Expt. 1) and fewer first-choice causal interpretations (Expt. 4) than DISCOURSE CAUSE-EFFECT. In addition, the overall availability of the *non*-causal interpretation was *higher* for DISCOURSE EFFECT-CAUSE than DISCOURSE CAUSE-EFFECT in Expt. 3; this is consistent with the other DISCOURSE effects, if not as directly matching.

In §3, we present our account of how the causal and non-causal interpretations arise across the four experimental conditions. We aim in particular to capture the experimental observations that (i) the causal interpretation was more dominant in discourse contexts than clause-internal contexts, and (ii) within clause-internal contexts, the causal interpretation was dominant for deverbal adjectives, but the *non*-causal interpretation was dominant for non-deverbal adjectives.

3. Formal proposal

We propose a formal account of clause-internal coherence in the SDRT framework (Asher 1993; Lascarides and Asher 1993; Asher and Lascarides 2003). Specifically, we argue that CIC can arise as a presupposition, and can therefore be captured in SDRT via an independently motivated analysis of presupposition (Asher and Lascarides 1998). We further argue that this analysis is compatible with our experimental findings.[9]

3.1. Coherence with deverbal adjectives

3.1.1. Establishing discourse coherence

We first consider how discourse coherence is established in (6).

(6) A child was drenched. She got hit by a big water balloon.

The asserted content of π_a is that there is a child x who is in a drenched state s. On top of that we propose that, when used predicatively, the deverbal adjective may contribute to the assertion that the drenched state was caused by some event e.[10] The asserted content of π_b is that there is a water balloon y, which was used in a hitting event e', whose theme is some individual z. These contents are represented in (7), using the standard DRT box notation.[11]

(7)
$$
\begin{array}{|ll|}
\hline
\pi_a & \\
\hline
\pi_a: & \begin{array}{|l|}
\hline
x, s, e \\
\hline
\texttt{child}(x) \\
\texttt{drenched}(s) \\
\texttt{in}(s,x) \\
\texttt{cause}(e,s) \\
e \ = \ ? \\
\hline
\end{array} \\
\hline
\end{array}
\qquad
\begin{array}{|ll|}
\hline
\pi_b & \\
\hline
\pi_b: & \begin{array}{|l|}
\hline
y, z, e' \\
\hline
\texttt{water.balloon}(y) \\
\texttt{hit}(e') \\
\texttt{with}(e',y) \\
\texttt{theme}(e',z) \\
z \ = \ ? \\
\hline
\end{array} \\
\hline
\end{array}
$$

[9]We do not, however, argue against any alternative accounts, whether in SDRT or another framework. Our aim here is only to demonstrate one viable option for modeling CIC.
[10]We are agnostic here about what syntactic structure would lead to such an interpretative possibility, though note that the structure of deverbal adjectives varies between its participial and non-participial ('true-adjectival') uses (cf. *drenched*, which is often participial vs. *punched*, which rarely is). Thanks to John Gluckman (p.c.) for a helpful discussion of this distinction, which we hope to explore in future studies.
[11]For an introduction to DRT, see, e.g., Kamp et al. 2011.

The causal interpretation results from establishing the coherence relation, Elaboration, between π_a and π_b. The semantics of Elaboration dictates that the second argument provides more information about the same event described by the first argument (Asher and Lascarides 2003). This requirement ensures that e is resolved to e' and z is resolved to x.[12] Elaboration is a non-causal relation in and of itself, but because $\texttt{cause}(e,s)$ is asserted in π_a, establishing Elaboration here entails a causal link between π_a and π_b. The resulting paraphrase is, 'A drenched state that some child was in was caused by some event; that event is a water-balloon hitting event.'

It is reasonable to expect that we would have derived this causal interpretation via Explanation, an inherently causal relation. However, because we propose that deverbal adjectives semantically contribute $\texttt{cause}(e,s)$, establishing Explanation here would result in the bizarre interpretation, 'The water balloon hitting event is the cause of a drenched state being caused by the water balloon hitting event.' Thus, Explanation is not the best-fitting relation in this case, but, as we will show in §3.2, it is crucial for deriving a causal interpretation when the lexical semantics does not contribute $\texttt{cause}(e,s)$.

We turn now to the non-causal interpretation of (6), which can be paraphrased as, 'A water balloon hit an already drenched child; some other event brought about the drenched state.' This interpretation follows from establishing the Background coherence relation, which entails that the eventualities described by its arguments overlap in time (Lascarides and Asher 1993). For (6), Background ensures that s overlaps e' and that e is bound. Crucially, however, e is not resolved to e' in this case.

In Experiments 1–3, we found evidence to suggest that, for (6), the causal interpretation was more salient and overall more available than the non-causal interpretation. We propose to capture this with an independently motivated axiom for choosing among potential coherence relations. The axiom, defined in (8), states a preference for resolved *discourse referents* (drefs).

(8) *Resolve drefs*: Establish the relation that produces the least unresolved drefs.

Elaboration, which establishes the causal interpretation, produces no unresolved drefs; the non-causal Background produces one. In accordance with (8), then, we correctly predict the preference for Elaboration. We note, though, that at least one other factor is likely in play here: an interpretative default to infer a causal link between adjacent eventualities whenever possible. We discuss this further in §3.2.1.

Let us now consider the discourse in (9).

(9) A child got hit by a big water balloon. She was drenched.

In this case, we have the same representational content as for (6), but π_b is interpreted before π_a. In this order, the event causing the drenched state is resolved anaphorically, instead of cataphorically. This means that the second sentence of (9) does not provide further information about the water balloon hitting event, but instead describes its result state. Elaboration, therefore, is not available here. Instead, we propose that the Continuation coherence relation is established.[13] Continuation, like Elaboration, is non-causal, but it entails a causal link in this

[12]Here we assume that establishing coherence relations and resolving the interpretation of a context sensitive expression are correlated tasks (see, e.g., Hobbs 1979; Kehler et al. 2008; Kaiser and Cherqaoui 2016; Stojnić 2016; Stojnić and Altshuler 2021).

[13]Establishing Result here would lead to the same bizarre interpretation that Explanation would for (6).

context because it supports an anaphoric resolution in which the event causing the drenched state is identified with the water balloon hitting event.[14] Finally, the non-causal inference can arise via Background, as it does for (6), regardless of the flipped order.[15] As is the case for (6), this relation is dispreferred for (9) because it results in an unresolved dref, while Continuation does not result in any.

3.1.2. Establishing clause-internal coherence

We hypothesize that attributive deverbal adjectives are presupposition triggers (recall the projectional evidence in (4)). In treating them this way, we can extend Asher and Lascarides' (1998) SDRT analysis of presupposition to derive clause-internal coherence in (10).

(10) a. A drenched child got hit by a big water balloon.
b. A big water balloon hit a drenched child.

Building on Van der Sandt (1992), Asher and Lascarides propose that the grammar introduces at least two underspecified elements in a presupposition. The first is a coherence relation $\boldsymbol{R}$, which binds the presupposed information; the second is an attachment point $\boldsymbol{u}$, which captures the projectional behavior of presuppositions. Presupposition introduction and resolution are thus part of the usual SDRT discourse update procedure, which ensures that discourse structure and world knowledge can influence the scope of presuppositions.

We first consider the causal interpretation of (10a), represented in (11).

(11)

$$\begin{array}{|l|}\hline \pi_a \\ \hline \pi_a: \begin{array}{|l|}\hline x, y, e \\ \hline \texttt{child}(x) \\ \texttt{water.balloon}(y) \\ \texttt{hit}(e) \\ \texttt{with}(e, y) \\ \texttt{theme}(e, x) \\ \hline \end{array} \\ \hline \end{array} \qquad \begin{array}{|l|}\hline \pi_b, R, u \\ \hline \pi_b: \begin{array}{|l|}\hline z, s, e' \\ \hline \texttt{drenched}(s) \\ \texttt{cause}(e', s) \\ \texttt{in}(s, z) \\ z = ? \\ e' = ? \\ \hline \end{array} \\ R(\pi_b, u) \\ R = ? \\ u = ? \\ \hline \end{array}$$

The asserted content in π_a is that there is an event e of being hit by a water balloon and a child x is the theme of e. The attributive deverbal contributes the presupposed content of π_b, namely, that there is a drenched state s, which was caused by an event e', and which holds of an individual z. Following our analysis of (6), we can resolve R to Elaboration or Background, with u being resolved to π_a in either case.[16] As it does for the discourse-level cases, establishing Elaboration entails a causal link and resolves all the drefs, while establishing Background leads to a non-causal interpretation, but leaves e' unresolved.

[14]For discussion of Continuation, see Asher and Lascarides (2003), Altshuler and Truswell (2022: §6.5).

[15]Unlike Elaboration, Background is well defined regardless of the ordering of its arguments, e.g., both the discourses below exemplify Background.

(i) a. A man was sitting on a bench. A woman walked over to him.
b. A woman walked over to a man. He was sitting on a bench. (Asher et al. 2007)

[16]π_a is thus either a cataphoric presupposition or a postsupposition. We are agnostic about which. See, e.g., Bott and Solstad (2022) for discussion of the former and Brasoveanu and Szabolcsi (2013) for a discussion of the latter.

The representation of (10b) is nearly the same as that of (10a). The crucial difference is in π_b (see (11)): the first argument of R is u, not π_b. Thus, as it is in the discourse case, Elaboration is ruled out, but we can resolve R to either Continuation or Background. As before, Continuation leads to a causal interpretation, while Background leads to a non-causal one. Assuming the *Resolve drefs* axiom in (8), we can capture the preference for causal CIC inferences over non-causal ones observed in Experiments 2 and 3. Our proposal does not presently capture the experimental finding that non-causal inferences are more available overall in clause-internal contexts than discourse contexts; we leave this for future work.

3.2. Coherence with non-deverbal adjectives

3.2.1. Establishing discourse coherence

As mentioned in §3.1.1, causal coherence must be derived differently when $\texttt{cause}(e,s)$ is asserted than when it is not. We propose that, while predicative deverbal adjectives semantically contribute $\texttt{cause}(e,s)$, predicative non-deverbal adjectives do not. The representational content of (12), therefore, is as shown in (13).

(12) a. A child got wet. She got hit by a big water balloon.
  b. A child got hit by a big water balloon. She got wet.

(13)

$$\begin{array}{|l|}\hline \pi_a \\ \hline \pi_a: \begin{array}{|l|}\hline x,s,e \\ \hline \texttt{child}(x) \\ \texttt{wet}(s) \\ \texttt{in}(s,x) \\ \hline \end{array} \\ \hline \end{array} \qquad \begin{array}{|l|}\hline \pi_b \\ \hline \pi_b: \begin{array}{|l|}\hline y,z,e' \\ \hline \texttt{water.balloon}(y) \\ \texttt{hit}(e') \\ \texttt{with}(e',y) \\ \texttt{theme}(e',z) \\ z\ \texttt{= ?} \\ \hline \end{array} \\ \hline \end{array}$$

The absence of $\texttt{cause}(e,s)$ in π_a clears the path for deriving the causal inferences for (12a) and (12b) via causal coherence relations—Explanation and Result, respectively. The non-causal inference in both cases can be derived by establishing Background. In contrast to the predicative deverbal cases, though, the Backgrounds here do not result in any unresolved drefs. Explanation and Result also resolve all drefs (i.e., z to x), so we must make an additional assumption in order to capture the experimental finding that, with predicative non-deverbals, the causal interpretation is more salient and more available than the non-causal interpretation.

This brings us to the causal default we gestured to in §3.1.1, namely, to infer a causal relationship between adjacent eventualities whenever possible. This seems to be a robust default, as established by much work in experimental psychology and psycholinguistics (Graesser et al. 1994; Zwaan et al. 1995: a.o.). We port this insight into our SDRT analysis by adopting Schlöder's axiom (Schlöder 2018: Ch.7):

(14) *Schlöder's causal axiom*: Given a pair of eventuality descriptions α, β:
  a. if it is possible that the eventuality described by α caused the eventuality described by β, establish Result(α, β).
  b. if it is possible that the eventuality described by α was caused by the eventuality described by β, establish Explanation(α, β).

This allows us to formally model the preference for Explanation/Result interpretations.

3.2.2. Establishing clause-internal coherence

Finally, let us consider attributive non-deverbal adjectives. We assume, as we do for predicative non-deverbals, that attributive non-deverbals do not contribute $\texttt{cause}(e,s)$. However, we assume that attributive non-deverbals are like their deverbal counterparts in presupposing the described state (recall (4)). Thus, we propose to represent (15a) as in (16).

(15) a. A wet child got hit by a big water balloon.
b. A big water balloon hit a wet child.

(16)
$$\begin{array}{|l|}\hline \pi_a \\ \hline \pi_a: \begin{array}{|l|}\hline x,y,e \\ \hline \texttt{child}(x) \\ \texttt{water.balloon}(y) \\ \texttt{hit}(e) \\ \texttt{by}(e,y) \\ \texttt{theme}(e,x) \\ \hline \end{array} \\ \hline \end{array} \quad \begin{array}{|l|}\hline \pi_b, R, u \\ \hline \pi_b: \begin{array}{|l|}\hline z,s \\ \hline \texttt{wet}(s) \\ \texttt{in}(s,z) \\ z\ =\ ? \\ \hline \end{array} \\ R(\pi_b\ , u) \\ R\ =\ ? \\ u\ =\ ? \\ \hline \end{array}$$

The asserted content in π_a is that there is a child x who is the theme of a water balloon hitting event e. The presupposed content in π_b is that there is a state s of being wet that holds of an individual z. In parallel to our proposal for predicative non-deverbals, Elaboration is not a possible value of R here because there is no presupposed $\texttt{cause}(e,s)$, but its absence makes Explanation possible, without the bizarre interpretation that occurs with deverbals. The non-causal interpretation can be derived via Background.

The content of (15b) is almost identical to that in (16). The only difference is that, in the representation of π_b, the first argument of R is u. Thus, the causal reading is derived by resolving R to Result, and the non-causal reading arises in the now familiar way, via Background.

Finally, we consider how to bring our formal proposal and our experimental findings into concord. The Explanation and Result resolutions respect Schlöder's axiom, while Background violates it.[17] This would predict that the causal interpretations win out, but recall that, in Experiment 4, we found that the *non*-causal interpretation was the more salient and more available reading for (15). Thus, we propose one more axiom, as defined in (17).

(17) *Constraint on presuppositions*: If possible, resolve R with Background.[18]

We propose that this axiom tends to outweigh Schlöder's axiom.[19] This yields a formal outcome that aligns with the experimental observations of Experiment 4. However, attributive deverbal adjectives are also presupposition triggers, so the axiom in (17) is also active when they are involved. We must therefore ensure that we can derive both the causal preference for attributive deverbals and the non-causal preference for attributive non-deverbals. The latter arises from our proposal that the *Constraint on presuppositions* axiom tends to outweigh Schlöder's axiom. To capture the former, then, we propose that the *Resolve drefs* axiom tends to outweigh the *Constraint on presuppositions*. The three axioms tend to be weighted as follows:

[17] The *Resolve drefs* axiom in (8) is not in play, as none of these relations produce unresolved drefs.

[18] This axiom is motivated by the independently-attested intuition that presuppositions are not-at-issue or backgrounded content (see, e.g., Abrusán (2022) and references therein).

[19] For more discussion of Schlöder's axiom, including other constraints that it competes with, see Altshuler (2021).

(18) *Resolve drefs > Constraint on presuppositions > Schlöder's axiom.*

This is consistent with our experimental findings that the non-causal (Background) interpretation tends to lose out to the causal (Elaboration) interpretation for attributive deverbals, and that the opposite occurs for attributive non-deverbals.

4. Conclusion

We have offered some experimental support for the existence of clause-internal coherence. In our set of offline studies, we found evidence to suggest that attributive (non-)deverbal adjectives can trigger the same causal inferences within clauses that their predicative counterparts can trigger across clauses, albeit more weakly. We also found some support for the hypothesis that a non-causal inference is a more salient competitor to the causal inference when an attributive adjective is involved, compared to a predicative adjective. With these findings, we hope to have contributed to recent work on adjectival meaning in discourse (e.g., Kaiser and Wang 2021). However, we note that our findings do not indicate that attributive adjectives necessarily give rise to CIC inferences, even in the contexts we tested. This is because, in the present experiments, we probed whether speakers accept an interpretation that is spelled out for them (Expt. 1), or which interpretation they preferred, with no option to reject both (Expts. 2–4). That is, we do not yet know which interpretation(s) speakers might independently infer, nor if their preferred interpretation involves a coherence inference. Future experiments will investigate what kinds of coherence inferences, if any, speakers draw in the absence of explicit prompting.

Among our other lines of our ongoing inquiry, we will investigate whether CIC inferences are modulated by the *be*-passive/*get*-passive/*become* distinction. We used both in the current studies to maximize the naturalness of individual stimuli (as shown in the Appendix), but did not explicitly manipulate or control for this factor. We are also conducting by-items analysis of the current studies as a means of informing future investigation of the role lexical semantics may play in CIC. Our descriptive analysis of Expt. 1, for instance, suggests at least one pattern of interest for future systematic testing: for eight of the 40 stimuli, the causal inference strength ratings were nearly identical across the four conditions. The critical adjectives in all eight were derived from psych predicates, including *stunned*, *frustrated*, and *relieved*. However, other stimuli featuring psych adjectives (e.g., *scared*, *elated*, and *annoyed*) patterned similarly to the experiment-wide results.

We have also proposed a formal approach to clause-internal coherence, crucially arguing that attributive adjectives are presupposition triggers. Thus, we were able to use existing tools in SDRT to derive both causal and non-causal CIC inferences, in addition to their discourse counterparts. Then, we showed that some of the robust interpretative preferences observed in the experiments can be modeled as interactions between three independently motivated default axioms for choosing between possible relations. In future work, we will seek to provide a similar account of another seemingly robust finding, namely, the higher overall availability of the non-causal interpretation in clause-internal contexts vs. discourse contexts (Expts. 3–4). Through this and future experimental work, we will continue to test the viability of this approach to modeling clause-internal coherence.

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5. Appendix: Sample stimuli

Deverbals (Expts. 1–3)

(19)
a. Disc. EC: A tennis pro was stunned. He was beaten by an amateur player.
b. Disc. CE: An amateur player beat a tennis pro. The tennis pro was stunned.
c. Clause EC: A stunned tennis pro was beaten by an amateur player.
d. Clause CE: An amateur player beat a stunned tennis pro.

(20)
a. Disc. EC: A barista got overwhelmed. He was bombarded with orders by an afternoon rush of customers.
b. Disc. CE: An afternoon rush of customers bombarded a barista with orders. The barista got overwhelmed.
c. Clause EC: An overwhelmed barista was bombarded with orders by an afternoon rush of customers.
d. Clause CE: An afternoon rush of customers bombarded an overwhelmed barista with orders.

(21) a. Disc. EC: An editor was impressed. She was shown a great novel by a young author.
b. Disc. CE: A young author showed a great novel to an editor. The editor was impressed.
c. Clause EC: An impressed editor was shown a great novel by a young author.
d. Clause CE: A young author showed a great novel to an impressed editor.

(22) a. Disc. EC: A cat got scared. It got chased by a brown dog.
b. Disc. CE: A brown dog chased a cat. The cat got scared.
c. Clause EC: A scared cat got chased by a brown dog.
d. Clause CE: A brown dog chased a scared cat.

(23) a. Disc. EC: A bicyclist got annoyed. She was cut off by a truck driver.
b. Disc. CE: A truck driver cut off a bicyclist. The bicyclist got annoyed.
c. Clause EC: An annoyed bicyclist was cut off by a truck driver.
d. Clause CE: A truck driver cut off an annoyed bicyclist.

(24) a. Disc. EC: A river got polluted. It got toxic waste dumped into it by a shady oil company.
b. Disc. CE: A shady oil company dumped toxic waste into a river. The river got polluted.
c. Clause EC: A polluted river got toxic waste dumped into it by a shady oil company.
d. Clause CE: A shady oil company dumped toxic waste into a polluted river.

(25) a. Disc. EC: A hiker was relieved. He was found by a patrolling park ranger.
b. Disc. CE: A patrolling park ranger found a hiker. The hiker was relieved.
c. Clause EC: A relieved hiker was found by a patrolling park ranger.
d. Clause CE: A patrolling park ranger found a relieved hiker.

Non-deverbals (Expt. 4)

(26) a. Disc. EC: A tennis pro was speechless. He was beaten by an amateur player.
b. Disc. CE: An amateur player beat a tennis pro. The tennis pro was speechless.
c. Cl. EC: A speechless tennis pro was beaten by an amateur player.
d. Cl. CE: An amateur player beat a speechless tennis pro.

(27) a. Disc. EC: A barista was distraught. He was bombarded with orders by an afternoon rush of customers.
b. Disc. CE: An afternoon rush of customers bombarded a barista with orders. The barista was distraught.
c. Cl. EC: A distraught barista was bombarded with orders by an afternoon rush of customers.
d. Cl. CE: An afternoon rush of customers bombarded a distraught barista with orders.

(28) a. Disc. EC: An editor was enthusiastic. She was shown a great novel by a young author.
b. Disc. CE: A young author showed a great novel to an editor. The editor was

enthusiastic.
c. Cl. EC: An enthusiastic editor was shown a great novel by a young author.
d. Cl. CE: A young author showed a great novel to an enthusiastic editor.

(29) a. Disc. EC: A cat was nervous. It got chased by a brown dog.
b. Disc. CE: A brown dog chased a cat. The cat was nervous.
c. Cl. EC: A nervous cat got chased by a brown dog.
d. Cl. CE: A brown dog chased a nervous cat.

(30) a. Disc. EC: A bicyclist got furious. She was cut off by a truck driver.
b. Disc. CE: A truck driver cut off a bicyclist. The bicyclist got furious.
c. Cl. EC: A furious bicyclist was cut off by a truck driver.
d. Cl. CE: A truck driver cut off a furious bicyclist.

(31) a. Disc. EC: A river was filthy. It got toxic waste dumped into it by a shady oil company.
b. Disc. CE: A shady oil company dumped toxic waste into a river. The river got polluted.
c. Cl. EC: A filthy river got toxic waste dumped into it by a shady oil company.
d. Cl. CE: A shady oil company dumped toxic waste into a filthy river.

(32) a. Disc. EC: A chocolate bar got gooey. It was left in a hot car by a little kid.
b. Disc. CE: A little kid left a chocolate bar in a hot car. It got gooey.
c. Cl. EC: A gooey chocolate bar was left in a hot car by a little kid.
d. Cl. CE: A little kid left a gooey chocolate bar in a hot car.

Fillers (Only Expt. 1 rating prompt shown.)

(33) Strong causal link:
a. After an intense training session, the figure skater was very sore. | How likely do you think it is that the skater was sore because the training session was intense?
b. Jake's refrigerator was smelly. It had a rotting onion in it. | How likely do you think it is that the refrigerator was smelly because there was a rotting onion in it?

(34) Medium causal link:
a. Martin adopted a dog, who was quite elderly. | How likely do you think it is that Martin adopted the dog because it was elderly?
b. A little boy pinched his sister on the arm. She poked him in the stomach. | How likely do you think it is that the boy's sister poked him because he pinched her?

(35) Weak causal link:
a. A shy bartender saw a tabby cat in her back garden. | How likely do you think it is that the bartender saw the tabby cat because she was shy?
b. Celia was a keen baker. She also loved to knit. | How likely do you think it is that Celia was a keen baker because she loved to knit?

An Algebra of Thought that predicts key aspects of language structure[1]

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Abstract. The Meaning First Approach hypothesizes that humans can form complex non-linguistic representations in an 'Algebra of Thought' independent of any language used in communication. Since the Algebra of Thought and language nevertheless must be related, one research program is to reverse engineer the Algebra of Thought from what is known about language. In this paper, we focus on universal structural properties of human languages. We investigate an Algebra of Thought fragment containing logical conjunction, a part-whole relationship and two cognitive efficiency requirements that exclude redundancies. We show that at least three universal structural properties of languages follow from these assumptions: cartographic hierarchies, the obligatory decomposition of non-symmetric binary predicates, and the obligatory lexical content of dependent elements in binding dependencies.

Keywords: structure, efficiency, conjunction, adjectives, decomposition, binding, predication

1. Introduction

Humans are capable of forming complex thoughts and of communicating these to each other using complex sentences. One goal of research on this ability of our species is to understand what the primitive elements and relations forming complex thoughts and sentences are. We approach these questions within the Meaning First Approach (MFA) of (Sauerland and Alexiadou, 2020).

Two assumptions are central to the MFA: For one, structures are built not in a language but in the *Algebra of Thought*. The primitives are concepts; mathematical objects, that only contain information needed for interpretation. Except for a finite inventory of logical core concepts discussed in the remainder of the paper, we take both primitive and the denotations of complex concepts to properties of *Event Models (EMs)*. EMs are set entities from a mereological structure formed to partially represent perceived or imagined sensory states. Formally we take an EM e to be a finite subset of a semilattice $\langle W, \oplus \rangle$ with $\oplus e \in e$. While primitive concepts are just their denotation,

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complex concepts have a structure and a denotation. The Algebra of Thought (or *Generator* in Sauerland and Alexiadou 2020) provides complex concepts structures as the closure of the set of primitive concepts under a commutative binary algebraic operation – i.e is the set of all binary trees formed from the primitives. In the following, we call a structure generated by the Algebra of Thought a *Conceptual Representation*, abbreviated as *CR*. Well-formed CRs denote concepts as discussed in the bulk of this paper. Also, at least some CRs can be articulated (or externalized) with the goal of communication. The articulation process involves linking parts of the CR to the morphemes of a specific language (or sometimes multiple languages) and imposing a linear order on the morphemes. We assume that linearization generally respects the constituency of CRs by mapping CR constituents to contiguous strings. Furthermore, we assume that speakers compress as much as possible given what they want to convey if multiple articulations of the CR are possible in a language. Especially logical elements that connect content words tend to be predictable and so wouldn't be pronounced. For example, while in English 'Three or four friends came' is perfectly well-formed, its German counterpart is literally 'Three four friends came' (*Drei vier Freunde sind gekommen*) without an explicit disjunction *oder* ('or'). In other cases, many primitive concepts are bundled into a single articulated morpheme for communication. If speakers choose not to compress, this generally results in a manner implicature.

In the MFA model, language provides us quite a direct window to the mind since the structure of a CR and that of the corresponding sentence closely match one another. Only compression makes it difficult to determine the CR of a sentence. If we want to reverse engineer the human mind, we need research strategies to develop models of the Algebra of Thought (AoT) and explore their predictions. Four criteria that can decide between different models of the AoT are listed in (1).

(1)
a. Expressivity: AoT should match the expressivity of language.
b. Simplicity: A simple AoT is preferred.
c. Homophonies: An AoT should capture as many homophony relations of logical words as possible.
d. Constituency: The AoT structures should be constrained so as to predict the constituency of natural languages.[2]

A special source of evidence are cases of undercompression—cases like that of *or* above, where you see that one language realizes a concept but another doesn't when you line up two languages. Undercompression is particularly striking when children undercompress in comparison to the adult language in their environment (some cases are mentioned below, also see Guasti et al. 2023).

The constituency criterion (1d) is the one we mostly explore in this paper. Specifically, we develop an AoT calculus that derives a constituency without syntactic categories or uninterpreted formal features. In addition, we forego any calculus of semantic types since types are frequently used as an alternative formalization of syntactic categories (Montague 1974 and others). The Algebra of Thought that we explore in this paper consists of operations that have already been in use in formal semantics. The central algebraic operations are conjunction and the part-whole relationship. In addition, we adopt (and adapt) two notions of cognitive efficiency, namely exhaustification and minimality. But we seek to avoid other common formal concepts such as function application and

[2]We leave open the possibility that some valid CRs can be ineffable, but expect any language to be able to express almost all valid CRs derived from the core and acquired primitive concepts.

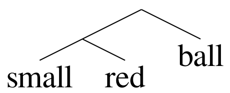
even variable binding. Section 2 shows how exhaustification and conjunction derive a restriction to ‘cartographic’ trees. Section 3 introduces the part-whole relationship and a notion of minimality to derive ‘non-cartographic’ trees, but also predicate-argument relationships from ‘∃-Union’ and minimization. Section 4 discusses how ‘∃-Union’ can derive non-local copredication in configurations commonly analyzed as involving variable binding. In section 5, we conclude with a review and an outlook on the remaining expressivity gap.

2. Conjunction and Cartography

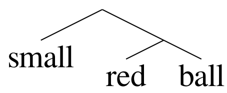
Conjunction is generally assumed to be one semantic composition principle (Davidson, 1967; Heim and Kratzer, 1998; Pietroski, 2018). There seem to be three good reasons to assume that conjunction is available to the human mind. First of all, conjunction in a broad sense is a necessity for remembering any information—when the immune system remembers to produce antibody A for virus α and antibody B for virus β, we describe that state as a conjunction. Secondly, conjunction is present in animal communication and intersententially. And thirdly, logical systems where conjunction is not a primitive seem not suited for the Algebra of Thought.[3]

But bare conjunction cannot be the sole composition principle of the Algebra of Thought if our goal is to predict phrase structure. Conjunction, as it stands, would not even predict sentence boundaries. More generally, the associativity of conjunction entails that conjunctive composition would not predict any restrictions on constituency at all, as is easy to see. Recall that associativity means that for any p, q, and r that can be conjoined, $p \wedge (q \wedge r) = (p \wedge q) \wedge r$. But the constituent structure of language does not exhibit associativity. For example, evidence from prosodic phrasing (Chomsky and Halle, 1968) and other sources argues that the phrase *small red ball* can only have the structure in (2b).

(2) a.



b.



We will refer to this as the *Associativity Problem* of meaning composition by conjunction. Associativity does not arise as a problem if constituency is captured by a syntactic calculus such as a phrase structure (Chomsky, 1957) or a categorial grammar (Ajdukiewicz, 1935). But associativity gets in the way of any attempts to reduce as much of constituency as possible to other properties of grammar. Specifically, the core assumption of the MFA that structure generation takes place in the AoT independent of language.

How can we overcome the associativity problem? We adopt the well-established idea that a type of cognitive efficiency—exhaustification—is obligatorily imposed on certain parts of a complex structure (Magri, 2009; Chierchia, 2013; Meyer, 2013). We understand exhaustification at this point broadly as a requirement that the contribution of a substructure P to the whole must not

[3]Specifically, lambda calculus with identity can represent conjunction as (i) (Tajtelbaum [Tarski] 1923). But even though Tarski's result is mentioned in a classic linguistic paper by Montague (1974), it has remained without influence in linguistics. We cannot address a different thread here of reducing one of conjunction or disjunction to the other (Zimmermann 2000; Meyer 2013; Bowler 2015; Singh et al. 2016; Tieu et al. 2017).

(i) $\lambda x \in D_t\ \lambda y \in D_t\ ((\lambda f \in D_{tt}\ [f{=}f]) = (\lambda f \in D_{tt}\ [x{=}[f(x){=}f(y)]]))$

be replaceable by any alternative equally or less complex substructure Q (Katzir, 2007). Specifically, we propose to impose a requirement to invoke a form of exhaustification on one of the conjuncts, but never the other. This asymmetry between the two conjuncts renders conjunction non-associative, thus solving the associativity problem.

(3) A complex CR $[\alpha\ \beta]$ can be interpreted conjunctively only if exactly one of α or β is exhaustified.

The further technical implementation of our proposal we discuss in the context of a concrete case of composition that is frequently understood to be conjunctive: the cartography of adjectives. Dixon (1977), Cinque (1994) and others have argued that across languages the hierarchical order of multiple adjectives exhibits universal preferences. For example, the order in (4a) is preferred in English over the one in (4b).

(4) a. the small red ball
b. #the red small ball

The same preference is present in all other languages, but importantly it is a hierarchical preference, not a linear one. Therefore in languages like Mokilese (Harrison, 1976) where the noun is initial, the preferred order of adjectives is the opposite of that in English:[4]

(5) pwo:la wa:ssa siksikko
ball red small-DET

We follow recent work by Scontras et al. (2 01, 2019) that argues that the preferred hierarchical order of adjectives is determined by semantic properties of the adjectives. Scontras et al. (2 01) establish experimentally for English that the order in (6) holds and that the order preference correlates with the subjectivity of the adjectives as independently tested by faultless disagreement and other subjectivity criteria. The generalization is that the more objective description an adjective provides, the closer to the underlying noun position it occurs.

(6) dimension $\ll$ value $\ll$ age $\ll$ physical $\ll$ shape $\ll$ color $\ll$ material

It is important to note that the English linear order of adjectives is unhelpful for efficient communication. For example, if the listener's task is viewed as identifying the noun phrase referent, the listener would more rapidly identify the correct referent intended by a speaker given the information provided by *red* compared to the information provided by *small*, since speaker and hearer are

[4]A third type of language reported noun-initial, but the adjective order is that of English as illustrated by Gaelic (Sproat and Shih, 1991, 587). We follow the cartographic literature and assume that in such languages the noun is also related to the final position and its initial position is due to the mechanism frequently referred to as *movement* (see also the next footnote).

(i) liathroid bheag bhui
ball small yellow

more likely to agree on which objects are *red* than *small*.[5]

Scontras et al. (2019) show that the cartography of adjectives can be derived from a mechanism that implements a form of cognitive efficiency, but their mechanism is *ad hoc* for adjective cartography. We suggest instead that the essence of Scontras et al.'s proposal can and should be embedded within general principles of cognitive efficiency, specifically exhaustification.

Recall from above that we assume conjunction is inherently asymmetric in that one of the conjuncts must be exhaustified. Concretely, we assume that exhaustification is marked by **exh** which satisfies the following condition:[6]

(7) The CR [**exh** p] has the inferences that EM-property p is true and that any other *salient* EM-property q that is false or a *worse descriptor*.

What is a *salient* EM-property and what a *non-worse descriptor*? We assume that at least all properties q occurring in the same algebraic conceptual representation as an occurrence of **exh** are salient (Katzir, 2007). Furthermore, we assume that a property is a *non-worse descriptor* than another if it is more objective and also if it is more informative. Since the likelihood of two speakers choosing the same entity increases with logical strength and also increases with objectivity, we restate this unification slightly more formally as in (8). Adjectives of a semantic class such as shape, color, material and others behave the same. We adopt the term *domains of jurisdiction* from (Paillé, 2022) for these classes, and propose that how good a descriptor a EM-property is determined only by its domain of jurisdiction to capture the order.[7]

(8) $p \geq q$ (i.e. p is a *non-worse descriptor* than q) if and only if, on average, for any two individuals s_1 and s_2, the expected likelihood of s_1 and s_2 choosing the same entity x given a description from the domain of jurisdiction of p is not lower than when given a description from the domain of jurisdiction of q.

Consider how these assumptions derive the basic case in (4). A complex conceptual representation conjoining the three concepts **red**, **small**, and **ball** must contain two occurrences of **exh**. Here and in the following we use a special font for concepts that are not fully logical. One possible CR that could be articulated as *small red ball* is the following:

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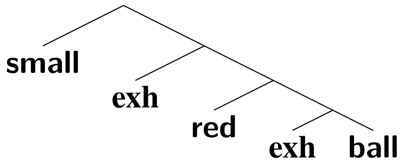
[5] That the English order is ill-suited for communication may explain why languages like Gaelic exist (see footnote 4), while we don't find any reports of counterparts with the reverse linear order of Gaelic: noun-final noun-phrases, but with the Mokilese adjective order. It is possible to derive this from the assumptions that 1) the position of the noun is determined in the same way as the order of adjectives, but nouns are inherently more objective than adjectives, and 2) linear orders deviating from the universal hierarchical order can be present in a language only if they improve communicative efficiency.

[6] We tacitly assume the presuppositional version of **exh** of Bassi et al. 8 17 since it makes it easier to handle some case where **exh** might otherwise scopally interact with other operators.

[7] In future work, we hope to derive the role of the domains of jurisdiction from a decomposition of adjectives into logical and experience-based components and the proposal that cognitive efficiency is only sensitive to logical properties (Gajewski, 2002; Chierchia, 2013).

(9)

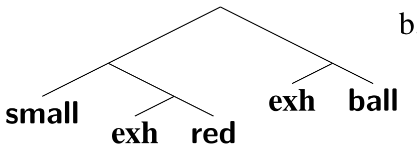


We now show that CR (9) is predicted to be possible by our approach. By the condition on salience, the alternatives to the sister of each **exh** are at least **small**, **red** and **ball**. In addition, any complex constituent that occurs in the structure is also a salient alternative for exhaustification.

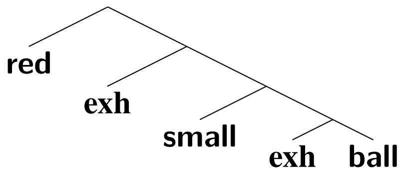
First consider only the three alternatives **small**, **red**, and **ball**. Since we assume that nominal concepts are always better descriptors than adjectives,[8] the constituent '**exh** ball' doesn't exclude the worse descriptors **small** and **red**.[9] For the complex CR '**exh [red exh ball]**', we need to determine how good a description complex CRs are. One corollary of (8) is that if $p \geq q$ then also $p \wedge r \geq q$ since $p \wedge r$ is more informative than p. Therefore, **small** $\leq$ **red** $\wedge$ **ball** holds, and **small** is not excluded by the exhaustification of [**red** [**exh ball**]].

Consider now why the two CRs in (10) are excluded. For (10a), the constituent **exh red** is predicted to exclude the alternative **ball**, which is a better descriptor. At the same time, **exh ball** has the inference that **ball** holds. As a result, the entire CR (10a) is a logical contradiction: **ball** is predicted to not hold and hold simultaneously. Therefore (10a) cannot underlie the articulation of *small red ball*, and only CR (9) is available.

(10) a.



b.



The CR (10b) would in English be articulated with the marked word order in (4). Consider the exclusions arising for the constituent **exh [small [exh ball]]** in (10b). If **red** $\wedge$ **ball** is a better descriptor than **small** $\wedge$ **ball**, **red** $\wedge$ **ball** and consequently **red** is predicted to be excluded by **exh [small [exh ball]]**, making (10b) contradictory. To capture the general cartographic order preference, we assume that the following independence assumption is a general default for complex concepts.

(11) For any three EM-properties p, q, r from different domains of jurisdiction: If and only if $q \geq r$, also $q \wedge p \geq r \wedge p$ holds.

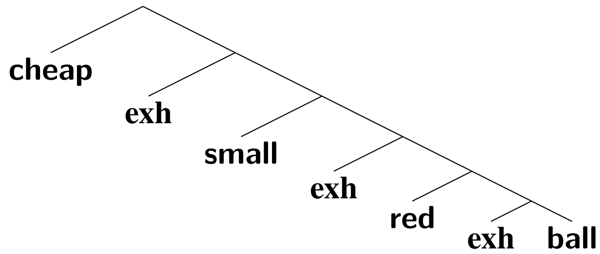
If the independence equivalence is satisfied at least in the rightward 'if' direction, it follows that no contingent CR could lead to the word order *red small ball* in English (4). In sum, the only contingent CR that can be formed from the three concepts **small**, **red**, and **ball** is (9).

[8] At this point, we do not know of any prior work claiming this, but it seems intuitive as for example the noun *French* is more specific than the adjective *French*.

[9] We assume that both nominal and adjectival concepts are decomposed into a idiosyncratic meaning part and at least one core concept characteristic of the category, such as possibly **object** for some nouns (as in current work within Distributed Morphology, cf. Borer 2005).

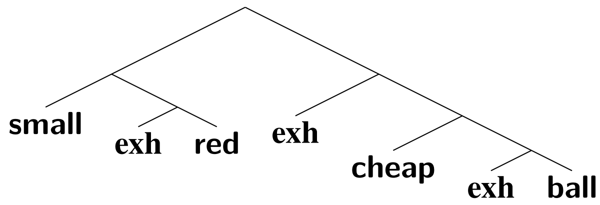
The result that only a single CR is possible generalizes also to conjunctions of more than three predicates. Consider the example of adding **cheap** to the previous three concepts. CR (12) is predicted to be contingent, correlating with the possible English phrase *cheap small red ball*.

(12)



But any other structure is predicted to lead a contradictory exclusion. Consider the potential CR in (13), where for example the constituent **[exh cheap [exh ball]]** excludes **red** and **small** leading to a contradiction.

(13)



We refer to CRs like (12) as cartographic structures and contrast them with non-cartographic structures like (13). Generally, cartographic structures are binary trees where any node has at most one branching sub-node. Let us assume furthermore that any two predicate concepts, p and q, are either mutually exclusive when they belong to the same domain of jurisdiction[10] or, if p and q belong to different domains of jurisdiction, either $p > q$ or $q > p$ must hold. Then the system of conjunctive composition we developed in this section can be described as follows: Any CR where all composition is conjunctive must have a cartographic structure; namely the one where the c-command structural order is the inverse of the total order provided by the $>$ relation.

The general result has some desirable implications as cartographic structures have also been argued for in other domains such as adverbs and complex clauses (Alexiadou 1997, Cinque 1999, and others). But there are also cases where non-cartographic structures must be possible as we discuss in the next section.

3. Parts and Predicate-Argument Relations

In this section, we explore one idea to allow non-cartographic trees which involves introducing the part-whole relationship into the algebra. Let us consider an example that, as far as we know, uncontroversially has a non-cartographic structure:[11]

(14) Small grandmas eat grey wolves.

[10] Paillé 2022 argues that the mutual exclusivity is derived from lexical exhaustivization.

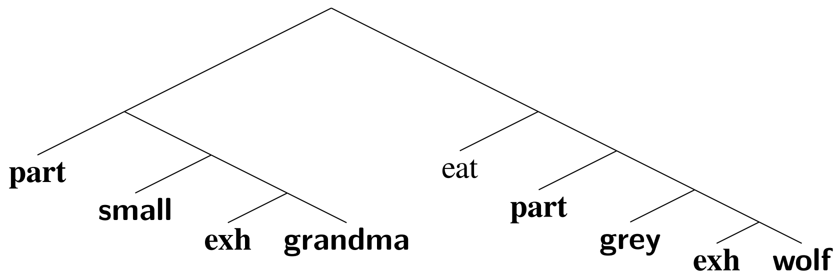
[11] To better focus on structural properties of interpretation, we disregard the obligatory expression of nominal number and verbal aspect of English here and in the following.

Our suggestion to capture this is to argue that CRs can contain the part-whole operator **part** in (15). Like **exh**, **part** is a logical primitive concept. Both **exh** and **part** combine with their sister not by conjunction, but by function application.

(15) For any CR X denoting the EM-property p, [**part**X] is a CR and denotes the EM-property $\lambda x\ \exists y \in \text{EM} \subseteq x\ .\ p(y)$.

For concreteness, we understand the properties in (15) to be properties of EMs that our cognitive system can form. We assume that, at some level, (14) involves an EM of eating that has at least two elements: one that satisfies the properties **small** and **grandma** and another that satisfies the properties **wolf** and **grey**. The introduction of **part** allows non-cartographic structures because properties of a part and the whole or another part are not logically related. For example, the possible CR underlying (14) in (16) contains the constituent **small [exh grandma]**. One alternative that **exh** in this constituent excludes is the concept **wolf**. Crucially this exclusion does not lead to a contradiction because it is possible that one part of a model is a wolf, while another part isn't.

(16)



At this point, we are not aware of any motivation to restrict the distribution of **part** extrinsically. But **part**'s distribution is intrinsically restricted if total predicates are always better descriptors than partial ones, i.e., for any $p, q,\ p >$ **part**q. It then follows that **exh** in (17a) will exclude p and therefore always be contradictory. Only (17b) will be generally possible. For (17c), a contradiction arises at least if **part**$p \geq$ **part**q since **part**p would be excluded, while cases with **part**$p <$ **part**q are predicted to be contingent.[12] In the following, we only make use of the configuration in (17b).[13]

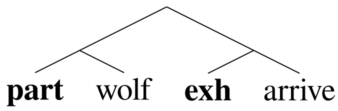
(17) a. *$p \wedge$ **exh part**q
b. **part**$p \wedge$ **exh** q
c. **part**$p \wedge$ **exh part**q

[12] The prediction changes though if the deactivation (i.e. pruning) of some alternatives is assumed to be possible. (Paillé, 2022) proposes that applying **exh** to a partial property as in (17c) renders it total. This follows from his assumption that all other partial predicates from the same domain of jurisdiction are excluded, and that the domain of jurisdiction is a partition of the possible states and objects. But he allows pruning in coordinations such as *the yellow and black fur* to derive the effect that the describe fur is partially yellow, partially black, and of no other color. His account is however not fully compatible with ours. Specially, we predict that **exhpart**q should always exclude the total predicate q.

[13] The restriction to (17b) raises the possibility to model the Algebra of Thought using *lists* as implemented in the programming language LISP instead of binary trees.

We have seen that adding the **part** primitive makes non-cartographic structures possible. But the predicted semantics are at this point too weak: the meaning predicted for (17) requires neither the small grandmas nor the grey wolves to play any particular part in the eating. Even a model of children eating cookies in the presence of small grandmas and grey wolves would be sufficient. The same problem arises even in less complex sentences like (18) for which we show a possible underlying CR to its right.

(18) Wolves arrive.



We assume that the concept **arrive** can be semantically specified as in (19); i.e. roughly as true of EMs in which someone/thing arrives.

(19) **arrive** = $\lambda m\ \exists x \in m\ .\ \oplus m$ is an arrival of x

The CR in (18) will however be true even of EMs where grandmas arrive at the wolves place and a wolf just happens to be present at its home. We see that (18)'s meaning needs in some way to require more than just the EM containing some wolf and someone/thing arriving: it needs to require that some wolf is arriving.

A straightforward way of strengthening the semantics of (18) in an appropriate way is to require that EMs be minimal in the way that the following **min** operator captures:

(20) For any CR A, [**min**A] is a valid CR and [**min**A] is true only of those EMs m that satisfy A and contain the smallest possible number of elements.

We assume that application of **min** is obligatory in some positions, which need to be specified in future work. For now consider the effect **min** exerts when it applies to the CR of (18) as in (21).

(21) **min**[[**partwolf**] $\wedge$ [**exh arrive**]]

Above we considered as problematic a scenario of a grandma arriving at a location where a wolf happens to be present. Any model of such a scenario contains at least three entities: a grandma, a wolf and arrival. But a model with only two entities can also satisfy CR (18); namely, one containing only a wolf and an arrival. But since no other entities are contained in such a model, the wolf must be responsible for the arrival. For this reason, the models satisfying (21) will all be models where a wolf arrives.

We will use the term $\exists$-*Union* for the effect that minimization by **min** has on existential quantification in its scope. We will describe this effect for (21) in a different algebraic system—standard first order logic—as follows. In (21), there are two existential inferences made: one explicit by **part** and another that is implicit in the concept **arrive** (cf. (19)). Using first order logic, we can display the effect of **min** as in (22). It amounts to replacing two existential quantifiers with narrow scope, with a single existential quantifier that takes scope at the position of **min** and binds all the variables the two single quantifiers bound.

(22) $\textbf{min}[\exists x\ \text{wolf}(x) \wedge \exists y\ \text{arrive}(y)] \Longleftrightarrow \exists z\ [\text{wolf}(z) \wedge \text{arrive}(z)]$

Importantly, $\exists$-Union does not rely on the use of indexed variables in CRs even though it derives the effect that coindexation has in first order predicate logic.

Wherever **min** applies, $\exists$-Union affects almost all existential quantifiers in its scope for the conjunctive CRs considered so far. The only exception are two existential quantifiers that express logically inconsistent claims. For example, if we were to replace **arrive** with the negation of **wolf**, then the minimal model containing both a wolf and a non-wolf necessarily contains two entities. Therefore $\exists$-Union would not have the effect it has in (22) with two inconsistent descriptions.

In sum, the introduction of **min** and, with it, $\exists$-Union makes a number of interesting predictions that have consequences for how CRs must be structured to capture different meanings. We are ready at this point to explore some of these predictions and their linguistic consequences. In the remainder of this section we will discuss predictions related to local predication and in the following section we will discuss predictions for non-local predication (or dependencies).

The first consequence we discuss concerns transitive verbs. Specifically, we derive that non-symmetric transitive verbs must be decomposed, as has been proposed in much work within lexical semantics as well as syntactic approaches to the lexicon (see, e.g., Alexiadou et al. 2014 for an overview). This follows from the obligatory reflexivization of binary predicates which we demonstrate using example (23).

(23) Grandmas eat wolves.

We want to show that the meaning of a transitive verb like *eat* cannot be captured by means of a single concept such as (24) within the current set of assumptions.

(24) $\textbf{eat}_1 = \lambda m\ \exists x \sqsubset m\ \exists y \sqsubset m\ .\ x \text{ eats } y \text{ in } m$

Consider first the CR in (25) (we omit obligatory **exh**-operators here and in the following, unless they play an important role). The second **min**-operator in (25) has the effect of reflexivizing the concept $\textbf{eat}_1$: the constituent **min** $[\textbf{eat}_1 \wedge \textbf{part wolf}]$ can only be true in models where a wolf eats itself.

(25) $\textbf{min}[\textbf{partgrandma} \wedge \textbf{min}[\textbf{eat}_1 \wedge \textbf{partwolf}]]$

Therefore (25) doesn't capture the meaning of (23). But the same holds for other conceivable CRs involving the concept $\textbf{eat}_1$. Since wolves can also be grandmas, (26) is predicted to also be reflexivized and can then only be true in models where a wolf-grandma eats itself.

(26) $\textbf{min}[\textbf{partgrandma} \wedge \textbf{eat}_1 \wedge \textbf{partwolf}]$

If we assume that **exh** can apply as in (27), a different but equally unsuitable meaning results. The subscripts on **exh** in (27) notate a salient, non-worse alternative that **exh** excludes. While **exh** thereby prevents the $\exists$-Union of **partwolf** and **partgrandma**, (27) is predicted to allow EMs where wolves eat grandmas or themselves or grandmas eat wolves or themselves.

(27) $\textbf{min}[\textbf{partexh}_{\mathsf{wolf}}\textbf{grandma} \wedge \textbf{eat}_1 \wedge \textbf{partexh}_{\mathsf{grandma}}\textbf{wolf}]$

Reflexivization could also be prevented within the meaning of the transitive verb by the adoption of the concept $\textbf{eat}_2$ in (28).

(28) $\textbf{eat}_2 = \lambda m\ \exists x \sqsubset m\ \exists y \sqsubset m\ .\ x$ eats y in m and $x \neq y$

Obviously, $\textbf{eat}_2$ would struggle to explain actual reflexive uses of the verb *eat*. But even putting that aside, $\textbf{eat}_2$ would also not provide an account of the meaning of (23). For example, the CR in (29) is true of either EMs where a grandma eats a wolf or ones where a wolf eats a grandma.[14]

(29) $\textbf{min}[\textbf{partgrandma} \wedge \textbf{eat}_2 \wedge \textbf{partwolf}]$

In sum, non-symmetric transitive verbs are predicted to be impossible as primitive concepts. We will suggest as a path forward to decompose transitive verbs. Before we do that, we briefly mention another case of reflexivization that supports our contention that minimization can lead to reflexivization. Namely, impersonal existential and reflexive pronouns can be homophonous. This has been reported for Italian *si* (Cinque, 1996), Polish *się* and Slovenian *se* (Rivero and Sheppard, 2003).

(30) a. Tutaj się pracuje sporo. (POLISH)
here REFL work-3s much
'Here people work a lot.' (Rivero and Sheppard, 2003, p. 92)
b. Janek ubiera się.
John dresses self
'John gets dressed.' (Rivero and Sheppard, 2003, p. 99)

Work on Italian child language by Silleresi et al. (2023) indicates that both the existential and the reflexive use of *si* emerge in Italian children's production at the same age (namely 1;8 years). The simultaneous emergence argues further that the homophony of impersonal *si* and reflexive *si* is not accidental. As Silleresi et al. (2023) argue, the homophony can be explained if we assume that the reflexive meaning can be derived from the existential via minimization.

The prediction that transitive verbs must generally be decomposed matches findings from the study of argument and event structure. von Stechow (1996) and Beck and Johnson (2004) argue that particles like *wieder* ('again') provide evidence for a decomposition of transitive and ditransitive verb meanings. Different lines of work propose that each argument must be introduced by a single

[14]Concepts with an inequality requirement like $\textbf{eat}_2$ may provide an account of symmetric relations other than identity such as *similar* and *sister* (Schwarz, 2006).

predicate drawn from a universal inventory (e.g., Parsons 1990; Pylkkänen 2008). Rappaport Hovav and Levin (2001, p. 779) also conclude that 'There must be at least one argument XP in the syntax per subevent in the event structure.' Pietroski (2018) also states the empirical generalization that only unary predicates exist. What is novel in the present approach is that it derives from a theoretical framework that binary predicates are unavailable, with the possible exception of symmetric predicates (see footnote 14).

In the following, we focus only on causation. For causation, evidence from undercompression in child language further supports the decomposition of verbs. Martin et al. (2022) report that *faire* ('make') is used with causative verbs redundantly by French children as in (31):

(31) va le faire couper (Marilyn, 2;9)
go it CAUSE cut
'(I'm) going to cut it.'

Causation is neither an experience-based concept like **wolf** nor is it solely a logical concept like **exh**, **min**, or **part**. Carey (2009) classifies causation as a core concept rooted in a specialized cognitive system not directly related to language. We use a different font for the concept CAUSE to mark this distinction. The contribution of CAUSE to a CR can be captured by non-conjunctive composition as follows:[15]

(32) For any CR A, [CAUSE A] is a valid CR and [CAUSE A] is true only of those EMs m such that there exist $\oplus m', \oplus m'' \in m$ such that m'' makes A true and $\oplus m'$ causes $\oplus m''$ in m.

In addition, we assume that the root meaning of *eat* is captured by the following concept **eaten**:

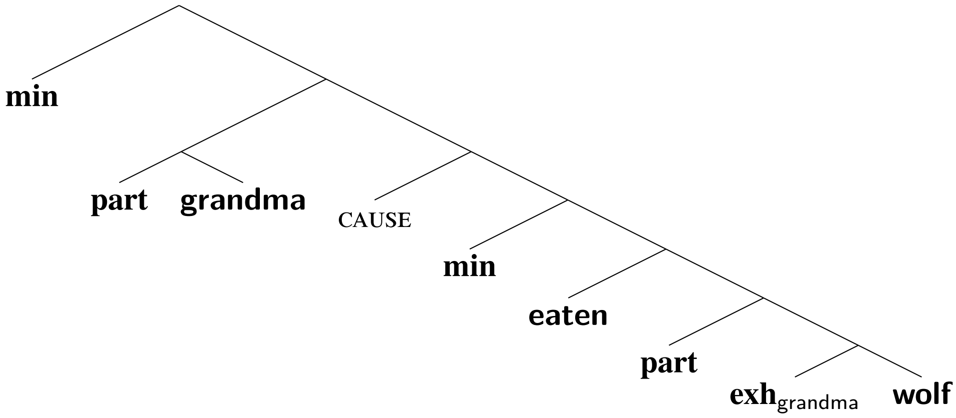
(33) **eaten** $= \lambda m \exists x \sqsubset \oplus m \,.\, x$ is eaten in $\oplus m$

Using the light verb CAUSE, the meaning of (23) can now be captured by the following CR:

[15] It may also be conceivable to capture causation fully by conjunctive composition on the basis of a lexical entry such as (i). But this would require an understanding of how CAUSE$_1$ differs from **eat**$_1$ and **eat**$_2$. To prevent reflexivization, the assumption that the cause x and the caused entity y are different is sufficient and this assumption is plausible for causation. This would lead to a CAUSE$_2$ analogous to **eat**$_2$. Still the problem of restricting CAUSE$_2$ to one direction of the cause leading to the caused entity would remain.

(i) CAUSE$_1$ $= \lambda m \exists m', m'' \subseteq m \,.\, m'$ causes m'' in m

(34)



The constituent **min**[**eaten**[**partwolf**]] in (34) is true only of models containing exactly an eaten wolf and **exh** blocks ∃-union with **grandma**. Therefore, the minimal models containing the causation relation are ones where the concept **grandma** is ∃-unified with the existential quantification over the cause that CAUSE introduces.

The last prediction we mention in this section concerns modification. Consider how a modifier structure as expressed by the sentence in (35) can be captured by a CR.

(35) Wolves similar to grandmas arrive.

Note first that the CR in (36) does not correctly capture the meaning conveyed by (35); we omit **exh** in (36) for perspicuity. There are a number of reasons for this, but one is that there is no asymmetry between **wolf** and **grandma** in (36). Assume for the purposes of this argument that **wolf** and **grandma** were logically inconsistent properties.[16] Then any minimal model for (36) would necessarily contain both a wolf and a grandma. But since the existential quantification in **arrive** is consistent with either **wolf** or **grandma**, (36) is not predicted to require the wolf to arrive. Instead it could also be the grandma.

(36) **min**[[**part**[**partwolf** ∧ **partgrandma** ∧ **similar**]][**arrive**]]

To capture the meaning of (35), a CR akin to (37) is therefore necessary, again omitting any required occurrences of **exh**.

(37) **min**[**min**[**part**[**partwolf** ∧ **partgrandma** ∧ **similar**]] ∧ **min**[**partwolf** ∧ **arrive**]]

At this point, the empirical consequences of this prediction need to be explored in further work. It is noteworthy that the modification structure sketched in (37) resembles the structure of correlatives.

This section started as an exploration of one addition to the inventory of logical concepts, the part-whole relation **part**, with the goal of allowing non-cartographic structures. We saw that though **part** makes non-cartographic CRs possible, to derive the right interpretation of such CRs

[16] Actually the omitted **exh** brings the inconsistency about.

requires further additions: the minimization operator **min** and light verbs like CAUSE. The major novel result accomplished in this section was to derive the almost obligatory decomposition of non-unary predicates. The ratio between assumptions and results in this section therefore does not clearly validate the path we have chosen to explore. But in addition to the decomposition result, the system developed so far has a second major consequence that comes entirely for free that we have so far only hinted at, namely the treatment of dependencies via ∃-Union, which we discuss in the following section.

4. Dependencies with ∃-Union

We mentioned in the previous section that ∃-Union derives an effect on the interpretation of CRs that in predicate logic can be expressed by coindexation of variables. But the Algebra of Thought we are proposing derives this effect without the use of variables or similar mechanisms. In this section, we argue that ∃-union in conjunction with exhaustification provides an empirically superior account of three phenomena frequently analyzed as variable binding: donkey anaphora, bound pronouns, and syntactic movement chains.

Recall the effect of ∃-Union shown in the formalism of predicate logic in (38), repeated from (22).

(38) $\textbf{min}[\exists x \text{ wolf}(x) \wedge \exists y \text{ arrive}(y)] \Longleftrightarrow \exists z\ [\text{wolf}(z) \wedge \text{arrive}(z)]$

In (38), it is possible for the same entity to fulfil the scope of both the existential $\exists x$ and the existential $\exists y$. The **min**-operator therefore requires the two existentials to be verified by the same entity, which derives the equivalence to the wide scope existential with coindexation of variables across the two scopes.

If, however, **exh** applies in both scopes as in (39), ∃-Union is blocked.[17] This follows from the assumption that **exh** excludes all non-worse alternative concepts occurring in the same CR in conjunction with the assumption that **arrive** must be non-worse than **wolf** or vice-versa.

(39) $\textbf{min}[\exists x\ \textbf{exh}_{(\textsf{arrive})}\text{wolf}(x) \wedge \exists y\ \textbf{exh}_{(\textsf{wolf})}\text{arrive}(y)]$

There are two exceptions, though—cases where even if **exh** applies to parts of the scope of two existentials, ∃-Union will nevertheless unify the two. In the first case, the two arguments of **exh** are identical, e.g. both are **wolf**. In the second case, one of the arguments of **exh** with CR α entails the other argument with CR β; α is also more complex than β and the CR of α doesn't contain any subconstituents α' that are of equal or lower structural complexity than a subconstituent β' of β where furthermore α' is a not-worse description than β'. The two examples in (40) illustrate the second case. In both cases, the first occurrence of **exh** does not result in an exclusion of the scope of the second occurrence of **exh**. In (40a), **exh** also causes no exclusion because the full scope, **wolf** $\wedge$ **grey**, is more complex than the first subconstituent, **wolf**, and the second subconstituent, **grey**, is a worse descriptor than the scope of the second **exh**. But in (40b), the second occurrence of **exh** will exclude **wolf** if **wolf** is not more complex than **grey**[18] since **wolf** is a better descriptor

[17] The way **exh** blocks dependencies is reminiscent of the proposal of Chomsky (1980).

[18] Recall than both **wolf** and **grey** may have more internal structure than shown here, though it also remains to be

than **grey**.

(40) a. $\mathbf{exh}[\textsf{\textbf{wolf}} \wedge \textsf{\textbf{grey}}]$, $\mathbf{exh}_{\emptyset}$ $\textsf{\textbf{wolf}}$
b. $\mathbf{exh}[\textsf{\textbf{wolf}} \wedge \textsf{\textbf{grey}}]$, $\mathbf{exh}_{\textsf{wolf}}$ $\textsf{\textbf{grey}}$

Note that the first case above is reducible to a special case of the second. (41) illustrates a case where there is an entailment relation between two scopes that at least seem to be of equal structural complexity, but where $\exists$-union is blocked. In this case, we need to consider **wolf** as a subconstituent of **wolf** that is not a worse descriptor than **grandma** is.

(41) **exh wolf**, $\mathbf{exh}_{\textsf{wolf}}$ **grandma**

The types of structures where long dependencies are uncontroversially attested mostly go beyond the current fragment of the Algebra of Thought. For presentational purposes, we introduce restricted universal quantification into our present model of the Algebra of Thought by means of two novel syncategorematic concepts. The first, ∂ in (42), converts a truth-condition on models into a presupposition adopting a standard trivalent perspective of model properties with the truth values 1, #, and 0.

(42) $$[\partial\, p] = \lambda m : \begin{cases} \# & \text{if } p(m) \neq 1 \\ 1 & \text{otherwise} \end{cases}$$

Furthermore, we add universal quantification on the assumption that bound elements are presupposed by ∂ as follows:[19]

(43) $$[\forall\, p] = \lambda m : \forall m' \sqsubseteq m \,.\, p(m') \neq \# \;\rightarrow\; p(m') = 1$$

We can now give CRs that capture the meaning of some core examples of binding dependencies. We illustrate donkey anaphora with (44).

(44) Always if grandmas eat wolves, they burp.

The CR in (45) contains the constituent [$\mathbf{partexh}_{\textsf{wolf}}$ **grandma**] in a position corresponding to that of the pronoun *they* in (44). The **min**-operator in the immediate scope of $\forall$ $\exists$-unifies the existential quantification introduced by this constituent with the other occurrence of the concept **grandma**.[20]

seen whether this affects structural complexity in the relevant sense.

[19]We put aside for now that the universal quantifier defined here is not persistent in the sense of Kratzer (1989) and therefore would not exert universal force in the scope of **min**.

[20]The exclusion by **exh** must have a modal component to it for the account to be fully satisfactory (see also Sauerland 2007). As it stands, grandmas who are also wolves are predicted to be irrelevant for the truth conditions of (45) because **exh** excludes them.

(45) $[\forall[\mathbf{min}[$
$[\partial[\textsf{\textbf{partgrandma}}[\textsc{cause}[\textsf{\textbf{eatenpartexh}}_{\textsf{grandma}}\textsf{\textbf{wolf}}]]]]$
$\wedge$
$[[\textbf{partexh}_{\textsf{wolf}}\ \textsf{\textbf{grandma}}]\textsf{\textbf{burp}}]]]]$

As far as we can see there is no way of capturing the intended meaning of (44) without involving two occurrences of the **grandma** concept within the Algebra of Thought we proposed here. Heim (1990) and Elbourne (2006) have provided some arguments that donkey anaphora require an account involving compressed content related to the pronoun.

The account for bound pronouns is similar, which we illustrate by means of (46). The interpretation we target is one that requires any grandma x to eat any wolf y in case x and y are similar.

(46) All grandmas eat wolves similar to them.

In the CR in (47), the two entities involved in the concept **similar** are specified further by the concepts **wolf** and **grandma**. The application of **exh** ensures that ∃-Union is blocked from requiring the relevant grandmas to also be wolves. Sauerland (2000, 2008) argues that bound variable pronouns have silent lexical content.

(47) $[\forall[\mathbf{min}[[\partial[\textsf{\textbf{partgrandma}}]] \wedge [\textsc{cause}[[\mathbf{min}[\textsf{\textbf{eaten}}[\textsf{\textbf{partwolf}}]]]$
$\wedge\ \mathbf{min}[\mathbf{part}[\mathbf{exh}_{\textsf{grandma}}\textsf{\textbf{wolf}}] \wedge \textsf{\textbf{partgrandma}} \wedge \textsf{\textbf{similar}}]]]]]]$

The final application of ∃-Union we discuss involves dependencies frequently referred to as syntactic movement chains. There are many subcases of syntactic movement chains, and we can only selectively address the phenomenon here. The most frequently discussed case of syntactic movement chains, constituent questions, is beyond the expressive power of the current proposal because questions are usually modeled as sets of propositions. As discussed above, modification structures may already illustrate one case where syntactic movement chains are claimed to arise, namely the case of relative clauses. For example, only one of the two occurrences of the concept **wolf** in (47) is articulated, as is typical of syntactic movement chains.

We focus now on the relative clause in (48).

(48) Grey wolves that grandmas eat arrive.

The CR in (49) captures the interpretation of (48). In (49), the constituent **grey wolf** occurs twice, and as in the cases discussed above, the present model of the Algebra of Thought requires at least some repetition in order to capture the meaning of (48).

(49) $\mathbf{min}[[\mathbf{min}\ [\mathbf{part}[\textsf{\textbf{grey wolf}}] \wedge \textsf{\textbf{arrive}}]]$
$\wedge\ [\mathbf{min}\ [[\textsf{\textbf{partgrandma}} \wedge [\textsc{cause}\ [\textsf{\textbf{eaten}} \wedge \textbf{partexh}_{\textsf{grandma}}[\textsf{\textbf{grey wolf}}]]]]]]]$

The way movement chains need to be represented in the present system is consonant with evidence that has been given for the syntactic copy theory of traces (Chomsky, 2015; Fox, 1999; Sauerland, 2004; Romoli, 2015). But these accounts invoke indexed variables as in predicate calculus and, if a syntactic requirement to create copies was not invoked, dependent elements could also be represented simply as indexed variable. The present account does not invoke any syntactic theory. The need for dependent elements to be something close to copies is a consequence of the Algebra of Thought we propose.

In (40) we showed that ∃-union allows the unified elements to differ from one another with predictable limits. For instance, an alternative CR for (48) is (50), where one occurrence of **grey wolf** is reduced to **wolf**. As we argued above, though, a reduction to **grey** instead of **wolf** is predicted to be impossible. Related asymmetries have been discussed with the term *late adjunction* in the literature.

(50) $\mathbf{min}[[\mathbf{min}\ [\mathbf{part}[\mathbf{grey\ wolf}] \wedge \mathbf{arrive}]]$
$\wedge\ [\mathbf{min}\ [[\mathbf{partgrandma} \wedge [\textsc{cause}\ [\mathbf{eaten} \wedge \mathbf{partexh}_{\mathsf{grandma}}[\mathbf{wolf}]]]]]]$

In sum, we have seen in this section that the central case of binding dependencies can be reduced to ∃-Union. The resulting mechanism is different from two existing proposals in mathematical logic (predicate logic and combinatorial logic) to model dependencies/co-argument relations.

Our proposal predicts that dependent elements are required to share conceptual content with one another. In the case of movement chains, shared content is often articulated in one place in the adult language. Child languages, however, exhibit undercompression phenomena that support the view developed in this section (Labelle 1990, Hu et al. 2018, Yatsushiro and Sauerland 2018, and others). Example (51) illustrates this type of evidence:

(51) Ich möchte das Mädchen sein, das der Opa das Mädchen umarmt.
I want the girl be who the granddad the girl hugs
'I want to be the girl who the granddad hugs.' (Yatsushiro and Sauerland, 2018)

5. Conclusions

We presented a sketch of an Algebra of Thought based on the Meaning First Approach of Sauerland and Alexiadou (2020). We focused specifically on modeling some of what is known about the constituent structure of language. The model that we presented accounts, at least in part, for three important universal properties of language: cartographic hierarchies as presented in Section 2, the obligatory decomposition of non-symmetric binary predicates as presented in Section 3, and the requirement of lexical content for dependent elements as presented in Section 4.

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Local Accommodation is Also Backgrounded[1]

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Abstract. Two generally agreed upon characteristics of presuppositions are projection and backgroundedness. Yet, presuppositions sometimes fail to project. To derive the necessary local interpretations, standard semantic local accommodation accounts posit an operation that, inside the scope of an embedding operator, turns content lexically marked as presupposed into non-backgrounded content and conjoins it with the clause's entailed content (Heim 1983). Such accounts, as well as syntactic operator accounts descended from them (Beaver and Krahmer 2001), predict that locally accommodated presuppositions differ from projecting presuppositions in lacking not just projectivity, but also the second basic presuppositional property of backgroundedness. Recent pragmatic accounts arrive at a parallel prediction via their claim that all and only backgrounded material projects (Simons et al. 2010; Tonhauser et al. 2018). To date, though, this prediction, that non-projecting presuppositional content is also not backgrounded, has not been systematically tested, perhaps due to challenges in testing embedded material for backgroundedness directly. Using reduced cognitive salience as a proxy for presuppositional backgroundedness in a picture-matching task (Schwarz 2016), we test indirectly for differences in backgroundedness among the locally accommodated presupposition of *also*, its explicit, non-backgrounded conjunction paraphrase as posited by semantic/syntactic accounts, and equivalent non-presuppositional elisions. Standard local accommodation accounts predict equivalence among these three constructions. However, in two experiments, we find, to the contrary, that locally interpreted content contributed by *also* reflects greater presuppositional backgroundedness than equivalent explicit entailed content and, to a lesser degree, than more surface-similar elisions. Our task elicits a similar pattern with examples including global, rather than local, accommodation, supporting parallel backgroundedness across these cases. We briefly discuss the theoretical implications of these findings in general terms.

Keywords: presupposition, local accommodation, backgrounding, psycholinguistics, projection.

1. Introduction

Two generally agreed upon characteristics of presuppositions are projection and backgroundedness. For instance, in (1), 'I have a dog,' the presupposition triggered by the possessive *my*, can project to the global context:

(1) It's not true that I'm obsessed with my dog!

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[1] We are extremely grateful to Jeremy Zehr for his invaluable early contributions to our experimental design. We also thank Philippe Schlenker, Mandy Simons, Alex Goebel, audience members at Sinn und Bedeutung 27 (especially Mats Rooth, Benjamin Spector, Dorit Abusch, and Jad Wehbe), and members of Florian Schwarz's Experimental Study of Meaning lab for helpful discussions.

If the fact that the speaker has a dog is not previously entailed by the context of (1), cooperative hearers may add it, by global accommodation, as part of the background information against which the asserted information that the speaker is not obsessed with her dog will be evaluated (Lewis 1979). However, there are also cases in which the content of felicitous presupposition triggers cannot project to the global context. In (2), projection is blocked by the first clause, leaving the presupposition that the speaker has a dog to be accommodated only locally:

(2) I don't have a dog, so it's not true that I'm obsessed with my dog.

While it is widely acknowledged that presuppositions sometimes fail to project, as in (2), there has been little discussion about whether these non-projecting presuppositions also fail to be backgrounded. This is the question we address in the present study. The usual default answer to this question, though often only implicitly assumed, is no: locally accommodated content is not backgrounded. Rather, it shares the discourse status of ordinary entailed content. The presumed non-backgroundedness of locally accommodated material has been represented in a few different ways. Standard dynamic semantic accounts of local accommodation, following Heim (1983), posit an operation that, inside the scope of an embedding operator, turns content lexically marked as presupposed into non-backgrounded content and conjoins it with the clause's entailed content. In such an account, the meaning of (2) can be accurately paraphrased as in (3a). Taking p to stand for *I'm obsessed with my dog*, and q for *I have a dog*, (3b) informally illustrates the global projection interpretation of the second clause as represented in dynamic semantics (negation removes those worlds in context c where the negated proposition holds). Given the preceding clause in (2), no c-world is such that q holds, so the definedness condition is not met. (3c) shows the locally accommodated variant, where q is added as a further conjunct inside of the scope of negation along with p.

(3) a. I don't have a dog, so it's not true that [I have a dog and I'm obsessed with my dog].
b. $c - (c + p)$, defined iff q holds in all c-worlds
c. $c - ((c + q) + p)$

Subsequent syntactic variants of this type of account accomplish the same effect of turning embedded presuppositions into regular entailed content by inserting an assertoric A-operator at the appropriate embedded level (Beaver and Krahmer 2001):

(4) I don't have a dog, so it's not true that [A [I'm obsessed with my dog]].

Thus, both standard semantic and syntactic accounts predict that locally accommodated presuppositions differ from projecting presuppositions precisely in their lack of the presuppositional property of backgroundedness.

Recent pragmatic accounts arrive at a parallel prediction, albeit from an entirely different direction, and without endorsing the idea that local accommodation is in play. Such accounts aim to derive projection patterns from general pragmatic properties without assuming lexically encoded presuppositions, at least not in general. Central to these accounts is the general claim that all and only backgrounded (or, equivalently, not-at-issue) material projects. From this, it follows that non-projecting presuppositions are expected, in their view as well, to be non-backgrounded (Simons et al. 2010; Tonhauser et al. 2018).

To date, though, the prediction (or, in some cases, implicit assumption) that locally accommodated material is not backgrounded has not been systematically tested. One reason that researchers may not have undertaken such testing is the relative success of the accounts above: The conjunctive translation in (3a) accounts well for the truth-conditional meaning of sentences like (2), independent of whether or not they correctly represent the effects of the discourse status of the presupposed material, which may be subtle. Another factor working against those who wish to adduce experimental evidence bearing on the discourse status of locally accommodated material is that directly testing material embedded under operators for backgroundedness presents considerable challenges. One cannot, for instance, use conversational continuations, which target asserted content (Simons 2019), to test whether a locally accommodated presupposition such as 'I have a dog' in (2) is part of the asserted information or backgrounded. Such a test works as expected when the possessive presupposition is in a position to project globally, as in (5). Both of B's rejoinders in (5) would be taken as targeting the asserted proposition that the speaker is obsessed with their dog and not the possessive presupposition 'I have a dog,' indicating, as expected, that the presupposition is backgrounded.

(5) A: I'm obsessed with my dog.

B: Does your mother know that?
B. That's weird!

However, when we apply the continuation test to the local accommodation context in (2), B's responses target either the first clause (*I don't have a dog.*) or the second (matrix) clause (*It's not true that I'm obsessed with my dog.*). Consequently, the exchanges in (6) give us no opportunity to test, within a local accommodation context, the backgroundedness of the presupposition of *my dog* against that of the entailed content of the embedded clause in which it occurs.

(6) A: I don't have a dog, so it's not true that I'm obsessed with my dog.

B: Does your mother know that?
B: That's weird!

These challenges notwithstanding, determining whether local accommodation is associated with the backgrounding that characterizes globally interpreted presuppositions could shed light on the nature of presupposition in general and on the relation between local and global contexts and (non)-projection and backgroundedness in particular. In order to circumvent the challenges inherent in testing this directly, we developed an experimental design to test the backgrounded status of locally accommodated material indirectly.

We took as our starting point the approaches in Schwarz (2016) and Bacovcin et al. (2018), both of which found evidence for reduced cognitive salience of presupposed information in picture-matching tasks and interpreted this as providing a proxy measure for backgroundedness. Schwarz (2016) offered novel experimental support for the position that the existence condition of definite descriptions is presuppositional and backgrounded: Participants were shown pictures related to accompanying sentences and asked to respond whether each sentence was True or False in the context of the visual stimuli. In some cases, the presupposition of a definite description in the sentence was not met in the picture, and in others the asserted content of the same sentence was falsified. Slower response times were found for responding ‘false’ when the presupposition was unmet in the picture than in cases where the asserted content was not supported visually. A parallel manipulation with indefinite descriptions provided crucial control conditions. In the condition from Bacovcin et al. (2018) most relevant for our purposes, participants were presented sentences such as “Henry came to town for the first time on Tuesday. On Wednesday, he went to the aquarium again.”, and then had to choose between two pictures (presented as calendar strips with iconic representations of activities) that only partly matched the overall information conveyed. One picture choice was consistent with the asserted content (that Henry went to the aquarium on Wednesday), but inconsistent with the presupposition (that he went to the aquarium on Tuesday); the other was inconsistent with the asserted content, with the presupposition left open (the relevant calendar slots being occluded from view). The overwhelming majority of participants chose the former, where the assertion was met, but the presupposition was not, suggesting that asserted material is most salient and important, whereas the presupposition is secondary.

Our design adapts the general idea behind these studies to apply it to our central question. In Experiment 1, we find that, contrary to the standard view, locally interpreted content contributed by the presupposition trigger *also* reflects greater presuppositional backgroundedness than equivalent explicit entailed content and, to a lesser degree, than more surface-similar elisions. Furthermore, the results from Experiment 2 confirm that our task elicits a similar pattern with examples including global, rather than local, accommodation, supporting the idea that parallel notions of backgroundedness are in play across these cases.

2. Experiment 1

2.1. General Design

Building on the general idea of testing whether visual representations are seen as matching a given sentential description, even though they do not accurately depict all of the information expressed by the sentence, our design aims to test the backgroundedness of locally accommodated presuppositions. The explicit, non-backgrounded conjunction paraphrases for such presuppositions posited by semantic/syntactic accounts following Heim (1983), as well as equivalent non-presuppositional elisions that more closely match local accommodation surface forms, serve as key points of comparison. They encode the same truth-conditional meaning as the tested presuppositional sentence, but the information that is expressed as a presupposition in the critical condition is introduced as straightforwardly and uncontroversially asserted content in these two controls.

All else being equal, local accommodation accounts that do not assume the relevant content to have any special backgrounded status align with the Null Hypothesis that the different ways of introducing the information do not affect the extent to which partially matching pictures are seen as accurate depictions of the provided description This is because such traditional local accommodation accounts assume that the information expressed has equivalent, non-backgrounded discourse status across all three constructions. In contrast, if locally accommodated content is backgrounded, we expect the failure of the picture to match the content introduced by the presupposition trigger to be less impactful than a similar failure when the same content is introduced as part of standard asserted content.

Our presupposition trigger of choice for purposes of experiment implementation was *also*. While in the theoretical literature, the notion that *also* does not allow local accommodation or at least strongly resists it is common (e.g., Abusch 2010), prior experimental work has clearly established that such interpretations are perfectly possible (e.g., Jayez et al. 2015; Grubic and Wierzba 2019). One big advantage of *also* for our purposes is the relatively clear conceptual separation between presupposed and asserted content. This is crucial for implementation purposes, given that our sought-after measure of cognitive salience in terms of a participant's willingness to accept illustrations that are missing the presupposed information requires both experimenters and participants to be able to distinguish in pictorial representations what corresponds to the explicit entailed content and what to the presupposed content. Only with this separation will experimenters be able to solicit judgments from participants that hinge upon whether one type of content, namely the presupposed part, is missing from an illustration. For most presupposition triggers, what is presupposed is too closely related to the accompanying entailed information for participants to be able to do this, at least in any straightforward way that we were able to come up with. It is very difficult, for instance, for experimenters to create and for participants to distinguish pictures of someone both having a dog (presupposed information in the embedded clause of (1)) and obsessing over a dog (entailed information in the embedded clause of (1)) from those of someone merely obsessing over a dog (entailed information only). Asserted and presupposed content for definites and factives are similarly closely related; furthermore, it is often theoretically assumed that in these cases, the content introduced as a presupposition is simultaneously present in, and entailed by, the asserted content. Consequently, *also* lent itself as a test case for our purposes, since its presupposition can be illustrated entirely independently of what is asserted in its sentence.

Another choice point for implementation purposes concerned the embedding expressions relative to which the presupposition of *also* could be interpreted locally. We chose *if*-clauses, i.e., the antecedent of conditionals, as our embedding environment because other possible embedding operators, such as negation and questions, often give rise to confounding scope ambiguities. Finally, we wanted to prevent participants, as much as possible, from simply ignoring the presuppositions triggered in our examples. This is a potential concern due to prior claims that at least in some contexts of use, presuppositional content can be ignored (Domaneschi et al. 2014; Tiemann 2014; Tiemann et al. 2015), although Bacovcin et al. (2018) argue against that interpretation of prior findings. Regardless, and to err on the side of caution, we made sure that the final consequent clauses of our items logically require the presupposition triggered in the second clause to hold (see section 2.2 below).

2.2. Materials & Predictions

In light of the general considerations above, we aim to measure the relative cognitive accessibility of exactly the same information presented via local accommodation of the presupposition triggered by *also*, as illustrated in the sample item text in (7), its conjunctive paraphrase, illustrated in (8), and a non-presuppositional elision, illustrated in (9).

(7) This could be wrong, but I heard that Paul might have ice cream; if **he also has chocolate syrup**, we could have sundaes for dessert. [ALSO condition]

(8) This could be wrong, but I heard that Paul might have ice cream; if **he has ice cream and he has chocolate syrup**, we could have sundaes for dessert. [CONJ condition]

(9) This could be wrong, but I heard that Paul might have ice cream; if **he does, and he has chocolate syrup**, we could have sundaes for dessert. [DOES condition]

The piece of information of central interest, which is presupposed in the ALSO condition in (7), is that Paul has ice cream. A global interpretation of this presupposition is in conflict with the preceding context, where the speaker explicitly conveys their uncertainty with regards to whether or not this holds; this constitutes a version of the 'Explicit Ignorance Contexts' of Simons (2001). Consequently, the presupposition introduced by *also* can be interpreted only locally, inside the *if*-clause, truth-conditionally conveying exactly what the standard paraphrase utilized in the CONJ condition in (8) conveys. Note that the consequent *we could have sundaes for dessert* was chosen so as to maximize the likelihood that participants indeed take the presuppositional content that Paul has ice cream into account across all conditions, rather than ignore it, as Paul can serve sundaes for dessert only if he has ice cream.

Another potential issue is that the equivalence between the first two conditions (ALSO and CONJ) predicted by accounts that assume local accommodation is not backgrounded holds only if all else is equal. But one obvious difference between (7) and (8) is that the latter contains the explicit additional wording "he has ice cream and." While the truth-functional content expressed in (7) and (8) is clearly the same, the mere presence only in (8) of the relevant words in the portion of the sentence of interest – the antecedent of the conditional – could well give rise to a difference in the salience of the corresponding information in (7) as compared to (8). Such an effect would constitute a substantive confound for answering our main question of interest, and also potentially be of general theoretical interest as a comparison between explicit and non-explicit content. The DOES condition in (9) was included in order to test the effect of explicitness directly:[2] The *does* elision used in (9) shares the implicitness and anaphoricity of *also*, but lacks *also*'s status as a presupposition trigger. Thus, if we were to find higher rates of acceptance for (7) (ALSO) than for (8) (CONJ) of illustrations that do not include a representation of 'Paul has ice cream,' that could be due to the implicitness confound. However, if we also find higher rates for (7) (ALSO) than for (9) (DOES) of acceptance of illustrations that do not represent the content presupposed in the ALSO condition, such a difference is attributable to *also*'s presuppositional nature, beyond the implicitness in play in both (7) and (9).

[2] We thank Jeremy Zehr for pointing out the importance of including such a condition.

In order to guide participants towards giving the relevant type of judgment, we provided them with an initial screen of instructions, which are shown in the format presented to the participants in (10).[3]

(10) Instructions

Please assume that the remark you will read on the next page was produced by our friend Francine in casual conversation. Francine's remark contains a description of a hypothetical situation, which is **highlighted in green**, and it is followed by an illustration. Please read the whole of Francine's remark, and then click on the answer you choose for each of the three questions that follow it. The questions will be revealed in order beneath Francine's remark; after you answer one question, the next will appear. Please try to answer each question the best you can even if you are not completely confident about your answer.

Click to Continue

Subsequently, two new screens were shown, with a written version of an utterance in the form of one of the conditions (7)–(9), along with a question and (for Question A) a picture.

(11) **Question A:**

FRANCINE:

This could be wrong, but I heard that Paul might have ice cream; if **he also has chocolate syrup**, we could have sundaes for dessert.

QUESTION:

*Do you think that this illustration accurately depicts Francine's description of the hypothetical situation **highlighted** in green?*

Yes **No**

[3] The third question mentioned in the Instructions in (10) aimed to provide another control. It is not discussed here, as it did not yield clearly interpretable results.

(12) **Question B:**

FRANCINE:

This could be wrong, but I heard that Paul might have ice cream; if **he also has chocolate syrup**, we could have sundaes for dessert.

QUESTION:

*Now taking into account **the entirety** of what Francine says in her remark, does Paul definitely, **in reality**, have ice cream?*

Yes **No**

Question A in (11) requires participants to judge whether the provided picture accurately depicts the description in the highlighted part of the relevant utterance. In the critical ALSO condition from (7), illustrated in (11), *also* in the antecedent of the conditional introduces the presuppositional content that Paul has ice cream, but projection is blocked by the explicit ignorance context in the first clause. The picture showing Paul holding a bottle of chocolate syrup represents the non-presuppositionally introduced information that Paul has chocolate syrup, but not the presuppositional content that he has ice cream. The two control conditions in (8) and (9) introduce 'Paul has ice cream' as non-presuppositional content: (8) is the standard accounts' conjunctive paraphrase of the local interpretation, differing from (7) in explicitly mentioning Paul's having ice cream. (9) conveys 'Paul has ice cream' implicitly but non-presuppositionally, using ellipsis.

Building on the linking assumption based on prior work that presuppositionally backgrounded status corresponds to a decreased level of cognitive salience and importance in picture evaluation, we have the following expectation about responses to Question A: We expect participants to answer YES to Question A in the ALSO condition if the presuppositional content that Paul has ice cream is sufficiently non-salient to them, due to its backgroundedness, that, in their judgment, it need not be represented in an illustration of the highlighted clause. Thus, we are able to gauge indirectly, from participants' rate of YES answers to Question A, whether Paul's having ice cream is more or less backgrounded for them in each condition.

Question B in (12) was included to provide a check on whether participants had been attentive to the intentionally emphatic initial explicit ignorance contexts and had, consequently, gotten the intended local interpretation of *also:* participants who answer NO to Question B show that they recognize that (7)–(9) in their entirety do not entail or implicate that Paul definitely, in reality, has ice cream. Thereby, for (7) in particular, with its presupposition trigger *also*, they indicate that they have not globally accommodated the presupposition triggered by *also* that Paul has ice cream. Participants who answer YES to Question B, in contrast, can safely be taken not to have properly digested the overall meaning of the presented text. It is thus hard to interpret their response to Question A, and we therefore exclude them from the relevant analyses.

But for participants who answered NO to Question B, our key prediction can be tested: If the information that Paul has ice cream is less salient in (7), where it is introduced through local accommodation, than in (8) and (9), where ‘he has ice cream’ is introduced as an asserted conjunct (either explicitly or via ellipsis), we expect more frequent YES answers to Question A for (7) than for (8) and (9) (with possible differences between the latter two if explicitness has an independent effect). That is, if information is less salient when introduced by a presupposition trigger than when it is introduced in an asserted conjunct, participants should be more likely to accept as accurate the pictorial representation without the ice cream when it is introduced as in (7), than as in (8) or (9).

In addition to the ice cream sundae item above, we used two further item variants to guard against effects due to accidental specifics of a particular item. The additional items, in their ALSO conditions, are presented with their accompanying illustrations as examples (13) and (14).

(13) This could be wrong, but I heard that Diane might have the violin part for our new piece; if **she also has the flute part**, we could get together and practice the duet before the first official rehearsal.

(14) This could be wrong, but I heard that the Halls might have a son who plays soccer; if **they also have a daughter who plays soccer**, their kids could join our new co-ed soccer league.

2.3. Participants and Procedure

In light of the nature of the overall task, and in particular the necessary explicit check in Question B on whether or not participants had indeed adopted the appropriate local accommodation interpretation in the ALSO condition, it seemed highly likely that the first exposure to any item, along with Questions A and B, would already strongly sensitize participants to the issues at stake and to the purpose of the experiment. This presented a risk that data from repeated trials could include effects of participants' strategically adjusting to perceived expectations about how they should act. We therefore decided to adopt a single-trial design, where each participant saw only a single item in one condition (with accordingly increased numbers of participants). Condition and item variants were varied randomly between subjects, and the picture was uniform across the three conditions for each of our three item variants. For example, a participant randomly assigned to the ALSO condition of the ice cream sundae variant we have illustrated here would see, in sequence, the three screens reproduced in (10), (11) and (12). For participants assigned to the CONJ or DOES conditions, screens (11) and (12) differed only in having (8) or (9) appear in place of (7).

We recruited 479 participants from the University of Pennsylvania's subject pool to participate online via the PCIbex platform for course credit (Zehr and Schwarz 2018). As noted above, we excluded from data analysis those participants who answered YES to Question B, thus indicating that they were not working with the required local interpretation. Participants who identified themselves as non-native speakers of English were removed as well. After removal, data from 401 participants were left for purposes of analysis.

2.4. Results

The proportion of YES answers to Question A exhibited the step-wise pattern in Fig. 1, with the presuppositional ALSO (7) yielding the highest, the explicit conjunctive paraphrase CONJ (8) the lowest, and the elliptical DOES (9) in between. Statistical analysis via a simple logistic regression in R, using the *glm* function from the `stats` package, revealed these differences to be significant (DOES vs. ALSO: $\beta = .90$, SE = .25, $p <. 001$; DOES vs. CONJ: $\beta = -1.77$, SE = .32, $p < .001$). The patterns were similar across the three item variants, ice cream sundaes, duet music, and co-ed soccer.

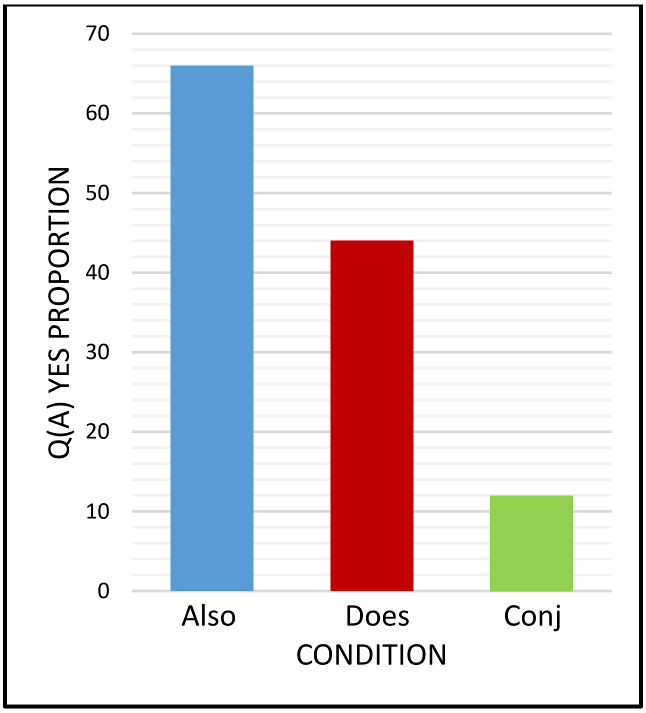

Fig. 1: Q(A) YES Proportion
by Condition in Experiment 1 (n = 401)

The increased rate of YES answers to Question A for DOES relative to CONJ reveals that elision alone, without any change in discourse status otherwise, can reduce salience in a way that affects our task. However, since we find an even higher YES-rate for Question A for ALSO than for DOES, our data confirm an independent effect of the presuppositional nature of the critical information when introduced by *also* that is independent of this elision effect. That is, we see evidence of a further significant decrease in cognitive salience which must be due to the presuppositional nature of *also*, entirely separate from the decrease in salience due to implicitness.

2.5. Discussion

The results of Experiment 1 indicate that presuppositional content exhibits effects suggesting decreased cognitive salience even when the presupposition does not project, and is locally accommodated instead. Taking this reduction in salience as an indication of backgroundedness, we find that the locally accommodated presupposition of *also* shows significant backgrounding as a result of its presuppositional status, contrary to the standard predictions of theories in the literature. In other words, a locally accommodated presupposition displays the typical presuppositional property of backgroundedness, even though it does not project.

Our design broadly adapts prior paradigms whose results arguably indicate parallel effects for presuppositions that are not locally accommodated: The successful use of similar tasks to measure presuppositional backgrounding in Schwarz (2016) and Bacovcin et al. (2018) suggests that reduced cognitive salience in a picture matching task is indeed an indicator of general presuppositional backgrounding. But we do not have a direct comparison at hand showing that the effect of backgroundedness in Experiment 1 is of the same general nature as the backgrounding for globally interpreted presuppositions. In order to strengthen the interpretation of the results in Experiment 1, it would be helpful to demonstrate that the reduction in cognitive salience measured with our picture-matching task reflects presuppositional backgrounding in general, beyond local accommodation. To confirm that our task in particular reflects presuppositional backgrounding in embedded and globally interpreted clauses alike, we designed a second experiment to test items involving global rather than local accommodation.

3. Experiment 2

3.1. Design and Materials

The design and materials for Experiment 2 were the same as for Experiment 1, except that the text for each item variant was altered to allow participants to accommodate the presupposition of *also* globally, rather than locally. Thus, participants in the ice cream variant of Experiment 2 saw (15), (16), or (17) in place of Experiment 1's (7), (8), or (9), and they were asked the minimally revised Questions A and B in (18) and (19), in place of Experiment 1's critical Question A in (11) and the attention and screening Question B in (10). The accompanying picture of Paul holding chocolate syrup was unchanged from Experiment 1. The other two item variants underwent parallel changes.

(15) I called to find out whether Paul has ice cream; it turns out that **he also has chocolate syrup**, so we can have sundaes for dessert. [ALSO condition, Exp. 2]

(16) I called to find out whether Paul has ice cream; it turns out that **he has ice cream and he has chocolate syrup**, so we can have sundaes for dessert. [CONJ condition, Exp. 2]

(17) I called to find out whether Paul has ice cream; it turns out that **he does, and he has chocolate syrup**, so we can have sundaes for dessert. [DOES condition, Exp. 2]

(18) **Question A:**
Do you think that this illustration accurately depicts Francine's description of the situation **highlighted** in green?

(19) **Question B:**
Now taking into account **the entirety** of what Francine says in her remark, does Paul definitely have ice cream?

Assuming the backgroundedness in play across the local and global accommodation variants is of the same type and associated with the same reflexes in measures of cognitive salience, we predict effects in Experiment 2 to be broadly parallel to those in Experiment 1. In particular, we anticipate a stepwise pattern of ALSO, DOES and CONJ in Experiment 2 similar to that in Experiment 1. It is possible, of course, that the changes made to Experiment 1's local accommodation examples ((7)–(9)) in order to create the global accommodation examples for Experiment 2 ((15)–(17)) might independently alter the exact pattern of effects. One concrete possibility for this comes from related results from Experiment 2 of Goebel (2020), showing that participants find a salient antecedent for triggers like *also* more readily when the trigger is no longer embedded in an *if* clause. Our task in Exp 1 includes the trigger *also* embedded in an *if*-clause, so Goebel's result suggests that the salience of extra-clausal material might be reduced in our ALSO condition. Since reduced cognitive salience is our proxy for backgroundedness, such a reduction in salience of potential antecedents for embedded *also* in Experiment 1 could account for some of the backgrounding effect. If that is the case, we would expect that, in the absence of *if*-clause embedding of triggers in Experiment 2, the effect of backgrounding may be attenuated, producing a smaller difference between the presuppositional and asserted conditions. Such potential differences in the extent of the effect notwithstanding, what is crucial in relation to supporting the interpretation we offered for the data in Experiment 1 is that we find an overall parallel pattern in terms of the directions of the effects.

3.2. Participants & Procedure

We recruited 636 participants from the University of Pennsylvania's subject pool to participate online via the PCIbex platform for course credit. As in Experiment 1, participants saw only a single trial of one utterance and picture.

As before, we excluded from data analysis those participants who identified themselves as non-native speakers of English and those who answered NO to Question (B) in (19). In the context of the global accommodation items used, a NO answer to Question B indicated that the participant was not working with the required global interpretation. After removal, we were left with data from 452 participants.

3.3. Results

The results of Experiment 2 are displayed on the right in Fig. 2., with those for Experiment 1 repeated on the left, to facilitate comparison. As predicted, the responses to Question A in (18) in the global accommodation conditions of Experiment 2 exhibit a stepwise pattern parallel to Experiment 1's. While the difference between DOES and CONJ again reaches the level of full statistical significance ($\beta = -1.77$, $SE = .32$, $p < .001$) (*p's* < .001), the difference between DOES and ALSO, while going in the same direction, was numerically smaller than in Experiment 1 and only marginally significant ($\beta = .42$, $SE = .23$, $p = .068$). This may be due to the easier processing and accessing of an antecedent for the unembedded *also* which, in Experiment 2, replaced the *if*-embedded *also* of Experiment 1. However, a pooled analysis of both experiments including Accommodation Type and Condition as interacting predictors found no significant interaction, consistent with an overall parallel impact of backgroundedness for local and global accommodation, as measured by our task via cognitive salience proxy.

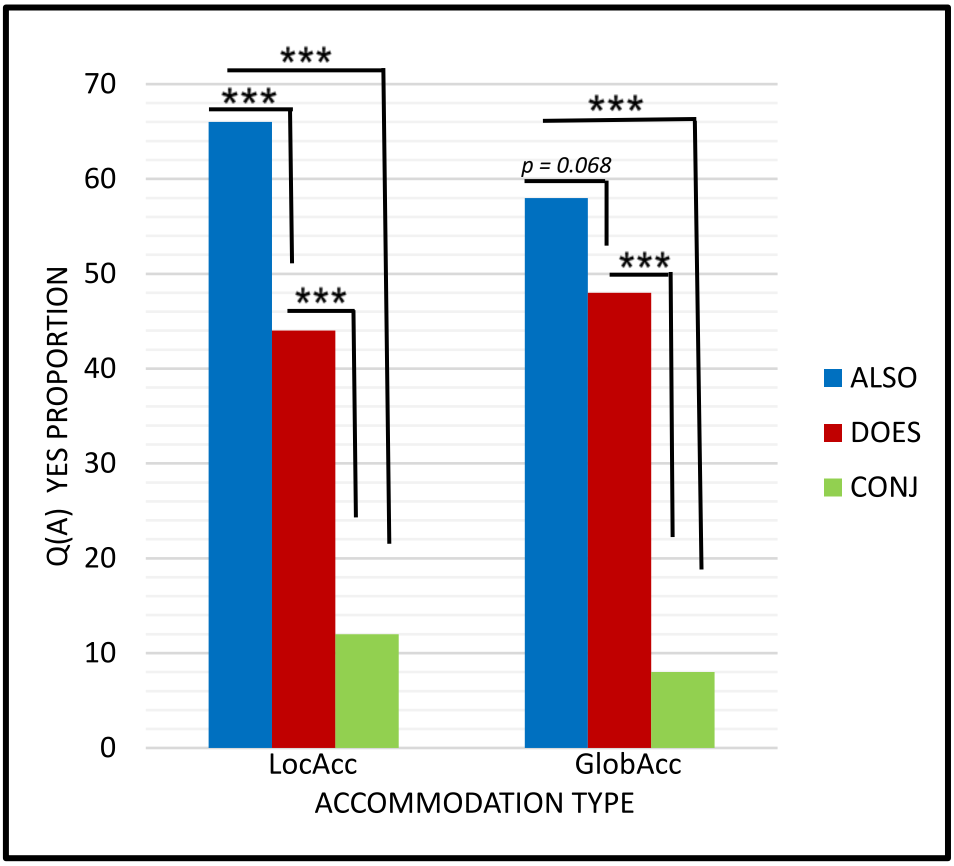

Fig. 2: Q(A) YES Proportion by Condition and Accommodation Type

4. Discussion and Conclusion

In our experiments, we find that the presuppositional content introduced by *also* in our stimuli in the ALSO condition is less cognitively salient than its non-presuppositional, truth-conditionally equivalent counterparts in the assertive control conditions, indicating that it is backgrounded, even when interpreted locally. Our results further indicate that such backgrounding of *also*'s presuppositional content must be lexically encoded in the entry of the presupposition trigger, as opposed to being pragmatically derived from reasoning about the content itself, since it does not emerge to the same degree when identical information is expressed by the content-equivalents of *also* in our DOES and CONJ conditions. Along the way, our experiments produce new empirical evidence that elided content is not completely equivalent to full explicit versions of the same information, but rather less salient, and in that sense more backgrounded, than corresponding full versions (though still more salient than the similarly implicit material associated with a presupposition trigger). This is consistent with similar findings reported in Simons (2019). Finally, by broadening the types of presuppositions tested in this regard, our studies contribute methodologically to the literature supporting the use of cognitive salience in a picture-matching task as a proxy for presuppositional backgroundedness.

While the discourse status of presuppositional material introduced by triggers other than *also* and under operators other than *if* needs to be investigated in future work to assess the generality of our findings, the present findings about *also* already have implications for several questions of theoretical interest. The backgrounding of *also*'s presupposition when locally accommodated, for instance, seems to be an exception to the generalization, put forward in pragmatic accounts of presupposition (e.g., Simons et al. 2010; Tonhauser et al. 2018), that all and only not-at-issue or backgrounded material projects: locally accommodated *also* is backgrounded, but fails to project. More generally, our main conclusion, that local accommodation of *also* gives rise to backgrounding just as global accommodation does, suggests that local accommodation is more like the global kind than has commonly been assumed, and even explicitly argued (e.g., Krahmer and Beaver 2001; von Fintel 2008). This means that the backgrounded status of locally accommodated *also* presents a challenge even within more traditional accounts of local accommodation, which transform local – but not global – presuppositions into regular, non-backgrounded entailed content, either semantically, as in Heim (1983) or by means of a syntactic A operator (Krahmer and Beaver 2001). Such representations fail, as things stand, to capture the fact that locally interpreted presuppositions are backgrounded like their globally interpreted counterparts even though they are on a par with entailed content in terms of contributing their truth-conditional content within the local embedding environment. They thus differ crucially in their discourse status from equivalent non-presuppositional and/or explicit content. Traditional accounts of local accommodation could be amended to account for the backgrounded status of locally interpreted pesuppositions; indeed there have been quite a few recent proposals concerning the construction of local contexts in ways that assimilate them more to global ones, though none to date has considered explicitly the possibility that locally accommodated material shares the backgrounded status of globally accommodated material (e.g., Anvari and Blumberg 2021; Barker 2022; Kalomoiros to appear; Mandelkern and Romoli 2017; Schlenker 2009). Our results suggest that, however the content of local contexts is derived, all accommodation should be modelled as adding information to the relevant context, global or local, in a way that retains the backgrounded discourse status that we recognize as typical of presuppositions.

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It's not about *about* – comparatives, negation and intervals[1]

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Abstract. Solt (2014, 2018) discovered an intriguing pattern regarding the distribution of the approximator *about*. While *about n* is typically infelicitous under negation, this pattern is reversed with *more than about n*, which is fine under negation, but not in a simple, unembedded context. Solt proposed an ingenious account based on certain assumptions about the meaning of *about* and principles of language use, and, specifically, the fact that *about* is an approximator that manipulates a granularity parameter. I argue that the pattern uncovered by Solt is not specifically tied to approximators, as it can be reproduced with disjunctions of numerals and interval-denoting expressions (*between n and m*), and is therefore part of a broader generalization. I offer an account based on (a) the universal density of measurement scales (Fox and Hackl 2006), (b) a semantic analysis of degree constructions that involves in a crucial way the notion of *maximal informativity* (Buccola and Spector 2016, with roots in Rullmann 1995; Fox and Hackl 2006; Schlenker 2012; von Fintel et al. 2014) and (c) a pragmatic ban on redundant numerical expressions. I then discuss some limitations of the proposal, in comparison with Solt's.

Keywords: Numerals, Degrees, Intervals, Approximation, Comparatives, Negation, Maximal Informativity, Scope, Monotonicity.

1. Introduction

Solt (2014, 2018) noticed an intriguing pattern regarding the approximator *about*: while *about n* is typically degraded under negation (cf. (1)), *more than about n* is, on the contrary, degraded in a non-negative environment, and licensed in a negative environment (cf. (2)).

(1) a. Mary is about twenty years old
    b. *Mary is not about twenty years old

(2) a. *Mary is more than about twenty years old
    b. Mary is no more than about twenty years old
    c. (?) Mary's isn't more than about twenty years old.

Focusing mostly on the contrast in (2), I argue that Solt's account is not general enough: it crucially relies on the fact that *about* induces a kind of vagueness, but the very same pattern is observed for other degree expressions which denote sets of degrees, but are not semantically vague. I propose an alternative account based on the universal density of measurement scales and the notion of maximal informativity, in the spirit of Fox and Hackl (2006). I then discuss

[1]The title of this paper is inspired by that of another paper on approximators, by Paul Égré, entitled 'Around *around*' (Égré 2022), which briefly alludes to ideas I had at the time in connection with Solt's observations, but which I have since then become skeptical of. I am grateful to Paul Égré for the innumerable conversations we have had about *about*! I would like to also thank Danny Fox, Jeremy Kuhn and Stephanie Solt for extremely helpful exchanges, as well as the audience of *Sinn und Bedeutung 27* in Prague and four anonymous reviewers. I also acknowledge support from the Agence Nationale de la Recherche (FrontCog Project ANR-17-EURE-0017 and ProbaSem project ANR-19-CE28-0004-01).

the pattern in (1).

Section 2 provides a summary of Solt's (2018) proposal in connection with (2).[2] Section 3 argues that the underlying generalization is not specifically related to approximators, which creates a problem for this account. In section 4, I advance my alternative proposal. Section 5 then discusses how the proposal could apply to (1) (and related data). Finally, section 6 discusses additional data that bear on the comparison of Solt's proposal and mine, in relation with monotonicity.

2. Solt's (2018) account

Solt (2018) accounts for the deviance of (2a) in terms of competition with the sentence that is obtained by deleting *about*, and specific pragmatic principles that regulate message choice in cases involving imprecision and approximators. Following Lasersohn (1999), Solt assumes that numerals are interpreted with respect to a certain contextually given granularity parameter i, and that an approximator such as *about* has the effect of turning a degree-refering expression into an expression that denotes a 'coarse-grained' degree, i.e. an interval centered on the relevant degree, with a length that itself depends on a granularity level i'. So the deviant sentence in (2a) and its countepart without *about* are interpreted as follows.

(3) a. *Mary is more than about twenty years old
$\rightsquigarrow$ Mary's age is above the interval $[20-i', 20+i']$, i.e. Mary's age $> 20+i'$
b. Mary is more than twenty years old
$\rightsquigarrow$ Mary's age is above 20, interpreted at some level of granularity i,
i.e Mary's age $> 20+i$

Now, nothing in the semantics imposes that i' should be greater than i. As a result of this, (3a) is not *definitevely more informative* than (3b) according to Solt's definition of *definitive informativeness*: a sentence S is definitively more informative than a sentence T if a) relative to any fixed granularity level for both sentences, S entails T, and b) there is a world where for every possible pair of granularity levels (i,i'), T is true relative to i and S is false relative to i'. Now, while (3a) does entail (3b) relative to any fixed granularity parameter (and is in fact equivalent to it), there is no world where, for every possible (i,i'), (3b) is true but (3a) is false, because it is always possible to set i' to 0, so (3a) is not definitively more informative than (3b). Furthermore, because (3a) is more complex than (3b) but is not definitively more informative, it is never a better message than (3b) if both are 'weakly assertable', namely if the speaker considers both to be true. So using (3a) should trigger the inference that the speaker does not take (3b) to be true. However, Solt also assumes a pragmatic principle whereby the use of an approximator signals that the bare numeral variant should be interpreted in a more precise way than the version with an approximator (i.e. $i' > i$). Given this, a speaker who takes (3a) to be true must take (3b) to be true, and so the inference that the speaker does not deem (3b) true is contradictory with her use of (3a). This explains the infelicity of (3a). In a nutshell, the gist of the account is the following:

1. Given the imprecise readings of round numbers, (3a) is not really more informative than

[2] I do not discuss here the more recent proposal made in Solt and Waldon (2019), which offers a completely different account for the contrast in (1), but does not address the one in (2).

(3b); it is also more complex. Hence (3b) is preferable to (3a) if it is assertable.

2. If (3a) was used, (3b) was not assertable.
3. In a context where a speaker is in a position to say (3a), she is also in a position to say (3b), since the use of 'about' in (3a) indicates that the granularity level used when interpreting (3a) is greater than the one used when interpreting (3b). So if the speaker used (3a), the conclusion (from above) that (3b) is not assertable is necessarily false, which leads to a contradiction.

The fact that (2b) is felicitous results from the observation that the last step in the above reasoning is no longer valid when we turn to the negations of the two competitors:

(4) a. Mary is no more than about twenty years old.
b. Mary is no more than twenty years old.

Again, (4a) is neither definitively more informative nor simpler than (4b), so using (4a) triggers the inference that (4b) was not assertable. But this time, this conclusion is not contradictory, because entailment relations are reversed under negation. Assuming that the granularity level for (4a) is greater than the one for (4b), one can believe (4a) (i.e. that Mary's age no more than $20+i'$) without believing (4b) (i.e. without believing that Mary's age is no more than $20+i$, with $i<i'$), and so no contradiction ensues. Furthermore, this account predicts that (4a) triggers the implicature that its competitor (4b) was not assertable under its precise meaning, i.e. that Mary is possibly more than 20 years old – though very close to 20 years old.

3. Beyond Approximators

Disjunctions of numerals, especially if they are neighbors relative to a salient granularity scale (*twenty-two or twenty-three*, *thirty or forty*), appear to pattern just like *about n*:[3]

(5) Context: is Mary still in college?
a. ?? She's more than twenty-two or twenty-three years old, so probably she has graduated.
b. She's no more than twenty-two or twenty-three years old, so she might still be in college.

As Solt (2018) notes in her conclusion, her account does not extend to this kind of contrast involving disjunctions of numerals. Since (5b) is semantically equivalent (in her account) to the simpler *She's no more than 23 years old*, it should always be infelicitous.

Furthemore, a similar pattern is also observed with expressions that denote intervals but contain no approximator, such as *between n and m*, as evidenced by the following attested examples, all found by a Google Search, in which *more than between n and m* occurs in the scope of a negative element:

(6) a. You should load your dogs pack with **no more than between ten and twenty-five percent** of your dog's weight.

[3]The degraded sentence in (5a) becomes better in an echoic context, e.g., as a direct objection to something like (5b). We put such uses aside for the rest of this paper.

b. Experienced instructors felt students would **not** engage in any one media or text for **more than between ten and twenty** minutes.
c. During the five years of occupation, probably **not more than between ten and twenty** thousand people participated in any form of armed resistance.
d. The Flesher Trade **rarely** had **more than between ten and twenty Masters**
e. Most of your landmass is **no more than between ten and twenty** metres above sea level.

Introspectively, removing the negative element, in each of these cases, degrades the sentence. To further buttress this empirical claim, I report judgments on the following pair, collected from 18 self-reported native speakers of English, obtained through the Amazon Mechanical Turk platform.

(7) a. *Air Syldavia owns more than between 50 and 100 airplanes.
b. (?) Air Syldavia owns no more than between 50 and 100 airplanes.

Of the 18 native speakers tested, 3 gave the same rating to both sentences, 13 preferred (7b), and 2 preferred (7a), making the difference in favor of (7b) statistically significant by a sign-test.[4]

In the *no more more than* ... environment, disjunctions of numerals and *between*-phrases also pattern with *about n* regarding the kind of inferences they give rise to. That is, in the same way as (2b) (*Mary is no more than about twenty years old*) suggests that Mary is about 20 years old, (5b) (*Mary is no more than twenty-two or twenty-three years old*) and (7b) (*Air Syldavia owns no more than between fifty and one hundred airplanes*) suggest, respectively, that Mary is 22 or 23 years old, and that Air Syldavia owns between 50 and 100 airplanes. In all these cases, a sentence of the form ... *no more than* $\{$*about n*$\}$/$\{$*n or m*$\}$/$\{$*between n and m*$\}$ ... is felt to imply the truth of ... $\{$*about n*$\}$/$\{$*n or m*$\}$/$\{$*between n and m*$\}$ ....

In the next sections, I argue for an alternative proposal, based on Fox and Hackl (2006), and argue that it captures both the core distributional facts and the perceived readings of the relevant sentences.

4. The proposal: degrees, maximal informativity and universal density of measurement scales

My proposal relies on several ingredients: Fox and Hackl's (2006) *universal density of measurement scales* hypothesis, and a specific treatment of modified numerals that involve the notion of maximal informativity, based on Buccola and Spector (2016) (with roots in Rullmann 1995; Fox and Hackl 2006; Schlenker 2012; von Fintel et al. 2014). It also includes a pragmatic preference for simpler sentences, spelt out below.

[4]Each participant saw both sentences on the same screen, the order of the two sentences was randomized, and they had to rate each sentence from 1 to 7. I tested 24 participants, but excluded one who did not provide any answer and 5 who gave an incorrect answer to a forced choice question based on a clear acceptability constrast which was completely unrelated to the sentences of interest. Keeping all the 23 participants who gave answers, 3 gave the same rating to both sentences, 16 preferred (7b), 4 preferred (7a), making again the contrast in favor of (7b) significant by a sign test.

4.1. Semantic and Pragmatic Assumptions

I adopt the following semantic assumptions (certain choices are made for convenience and are not crucial to the account):

1. Numerals are ambiguous: they can either denote degrees (type d) or Generalized Quantifiers over predicates of degrees (type $\langle d,t\rangle$):

   (8) a. $[\![\text{three}_d]\!]^w = 3$
   b. $[\![\text{three}_{\langle dt,t\rangle}]\!]^w = \lambda P_{dt}.P(3)$

2. When a numeral acts as a determiner (i.e. combines with a count noun), it needs first to combine with a silent existential closure operator ε, which creates a standard determiner (type $\langle et,\langle et,t\rangle\rangle$):

   (9) $[\![\varepsilon]\!]^w = \lambda n_d.\lambda P_{et}.\lambda Q_{et}.\exists X(\#X = n \wedge P(X) \wedge Q(X))$

3. *More than* combines with a degree-denoting expression to form a GQ over predicates of degrees (type $\langle dt,t\rangle$):

   (10) $[\![\text{more than}]\!]^w = \lambda n_d.\lambda P_{dt}.\exists m_d(m > d \wedge P(m))$

4. Type-mismatches are resolved by movement. That is, the analysis is couched within Heim and Kratzer's (1998) framework where type mismatches are resolved by covert LF movement rather than in terms of type-shifting, flexible types or function composition, but nothing essential hinges on this, and the analysis should be easy to translate into another framework.

5. A covert operator $\mathtt{max_{inf}}$ that can freely be introduced takes the intension of a predicate of degree P and returns a predicate of degree P' defined as follows: P' is true a degree n if (a) P is true of n and (b) there is no true proposition of the same form that asymmetricallty entails the proposition that P is true of n. In other words, and very informally (and allowing for massive confusion between the metalanguage and our object language), '$\mathtt{max_{inf}}(P)(n)$' states that the proposition expressed by '$P(n)$' is true and that there is no other true proposition expressible as '$P(m)$' which is both true and strictly more informative than the proposition expressed by '$P(n)$'. To put it in yet another way, '$\mathtt{max_{inf}}(P)(n)$' states that n is the maximally informative numeral that can be truthfully used as an argument of P.[5]

   (11) $[\![\mathtt{max_{inf}}]\!]^w = \lambda P_{\langle s,dt\rangle}.\lambda n_d.P(w)(d) \wedge \neg\exists m(\lambda v_s.P(v)(m) \subsetneq \lambda v_s.P(v)(n))$

6. Universal Density of Measurement Scales: for any two degrees m and n such that $m < n$, there exists a degree k such that $m < k < n$.

Furthermore, in the spirit of Buccola and Spector (2016), I adopt the following usage principle, which instantiates a general pragmatic preference for simpler expressions (in line with Solt's own account):

[5] $\subsetneq g$ represents asymmetric entailment: $f \subsetneq g$ if for every x such that $f(x) = 1$, $g(x) = 1$, and there is a y such that $f(y) = 0$ and $g(x) = 1$

Ban on redundant numerical expressions
A sentence S containing an occurrence of an expression of the form *m or n*, *about n*, or *between n and m* is infelicitous if for some numeral k, replacing the relevant occurrence with k yields a sentence S' that is equivalent to S.

4.2. Simple Comparative Numerals

Fox and Hackl (2006) noticed the following constrast:

(12) a. Gloria read more than three books.
$\rightsquigarrow$ does not implicate that John read exactly four books
b. Gloria read no more than three books.
$\rightsquigarrow$ implicates that John read exactly three books.

Our assumptions in the previous section allow us to explain this contrast, in exactly the same way as Fox and Hackl (2006), apart from implementation details (which is not surprising, since the above assumptions are directly inspired by Fox and Hackl 2006)

Starting with (12a), this sentence can receive many different parses, depending on whether and where $\mathtt{max_{inf}}$ is introduced, as well as whether LF movement takes place. I will consider all and only structures that result from type-mandated LF movement and optional insertion of $\mathtt{max_{inf}}$. In particular, not only must *more than three* raise for type-reasons (on top of 'standard' LF object movement for type reasons), *three* itself, when parsed as a GQ as in (8b) (type $\langle dt,t\rangle$), must raise out of *more than* ..., since *more than* combines with a type d expression. Then $\mathtt{max_{inf}}$ can be freely inserted in any position where its type fits.[6] As a result, we have to consider six parses, as in (13) (even if we allowed additional parses, they would, as far as I can tell, always involve semantically vacuous movement, vacuous insertion of $\mathtt{max_{inf}}$ or contradiction-inducing insertion of $\mathtt{max_{inf}}$ and will essentially reduce to one of those parses):

(13) a. [more than three]$[\lambda n_d.[[\varepsilon\ n]$books$][\lambda x.$Gloria read $x]]$
b. three$_{\langle dt,t\rangle}[\lambda m_d[$[more than $m_d][\lambda n_d.[[\varepsilon\ n]$books$][\lambda x.$Gloria read $x]]]]$
c. [more than three]$[\mathtt{max_{inf}}[\lambda n_d.[[\varepsilon\ n]$books$][\lambda x.$Gloria read $x]]]$
d. three$_{\langle dt,t\rangle}[\lambda m_d[$more than $m_d][\mathtt{max_{inf}}[\lambda n_d.[[\varepsilon\ n]$books$][\lambda x.$Gloria read $x]]]]]$
e. three$_{\langle dt,t\rangle}[\mathtt{max_{inf}}[\lambda m_d[$[more than $m_d][\lambda n_d.[[\varepsilon\ n]$books$][\lambda x.$Gloria read $x]]]]]$
f. three$_{\langle dt,t\rangle}[\mathtt{max_{inf}}[\lambda m_d[$[more than $m_d][\mathtt{max_{inf}}[\lambda n_d.[[\varepsilon\ n]$books$][\lambda x.$Gloria read $x]]]]]]$

Even though these parses are hard to make sense of, it should be clear that (13a) and (13b) are equivalent (they only differ with respect to the type of the numeral, which in the second case was forced to move for type reason, but with no intervening material). Likewise, (13c) and (13d) are equivalent. So we can focus on (13a), (13c), (13e) and (13f). I translate them into semi-formal representations in (15), in which only the most relevant elements are retained.

(14) a. Gloria read more than three books
b. [more than three]$[\mathtt{max_{inf}}[\lambda n_d.$Gloria read n books$]]$

[6]Since $\mathtt{max_{inf}}$ must take as its argument something of type $\langle s,dt\rangle$, the denotation of its sister (of type dt) must be 'raised' to such an intensional type, i.e., within the Heim & Kratzer framework, we must resort to 'intensional functional application'.

c. $\text{three}_{\langle dt,t\rangle}[\mathtt{max}_{\mathtt{inf}}[\lambda n_d.\text{Gloria read more than } n \text{ books}]]$
d. $\text{three}_{\langle dt,t\rangle}[\mathtt{max}_{\mathtt{inf}}[\lambda m_d.[\text{more than } m_d][\mathtt{max}_{\mathtt{inf}}[\lambda n_d.\text{Gloria read } n \text{ books}]]]]$

It turns out that (14a) and (14b) are equivalent, and just mean, unsurprisingly that the number of books read by Mary is greater than 3, while (14c) and (14d) are contradictory.

(13a) and (13b) are just equivalent to the plain, literal intuitive meaning of the sentence, represented in (14a), since they are essentially the most simple structures compatible with the types of the various elements and do not include $\mathtt{max}_{\mathtt{inf}}$.

To interpret (14b) (which corresponds to (13c)), let us first focus on the subconstituent '$[\mathtt{max}_{\mathtt{inf}}[\lambda n_d.\text{Gloria read } n \text{ books}]]$'. This denotes a predicate of degree which is true of a number n if (a) Gloria read n books and (b) there is no number m such that the proposition that Gloria read m books is true and asymmetrically entails the proposition that Gloria read n books. One can see that there is exactly one number that satisfies this condition, namely the maximal number n such that Mary read n books, i.e. the number of books that Mary read. This predicate then combines with *more than three*, giving rise to the proposition that there is a number greater than 3 which is the number of books that Mary read – so the resulting meaning is equivalent to that of (14a), making $\mathtt{max}_{\mathtt{inf}}$ vacuous.

As to the third parse in (14c) (which corresponds to (13e)), let us see what the (semi-formal) predicate '$[\mathtt{max}_{\mathtt{inf}}[\lambda m_d.\text{Gloria read more than } n \text{ books}]]$' is predicted to mean. This predicate is true of a number n if (a) Gloria read more than n books, and (b) there is no m such that the proposition that Gloria read more than m books is true and asymmetrically entails that Gloria read more than n books. Fox and Hackl's (2006) key insight is that, due to density, there cannot exist any such n. For suppose that, for some n, Gloria read more than than n books (which is a necessary condition for the predicate to hold of n, cf. clause (a)). Then there is a number x such that $x > n$ and Gloria read x books. But then take a number y such that $x > y > n$, which is guaranteed to exist given density. Since Gloria read x books, Gloria read more than y books. And since $y > n$, the proposition that Gloria read more than y books asymmetrically entails the proposition that Gloria read more than n books, and therefore n cannot meet the condition stated in clause (b). Since this reasoning holds for any n, the denotation of the predicate '$[\mathtt{max}_{\mathtt{inf}}[\lambda m_d.\text{Gloria read more than } n \text{ books}]]$' is necessarily empty. Consequently, the whole parse in (14c) is necessarily false (i.e. contradictory), since it entails that the number 3 belongs to the denotation of a necessarily empty predicate.

Finally, we can see that (14d) is contradictory again. This is because the subconstituent '$[\lambda m_d.[\text{more than } m_d][\mathtt{max}_{\mathtt{inf}}[\lambda n_d.\text{Gloria read } n \text{ books}]]$' is true of m just in case there is a number greater than m which is the number of books that Mary read. In other words, this predicate means *be a number greater that the number of books Gloria read*. As discussed in the previous paragraph, appending $\mathtt{max}_{\mathtt{inf}}$ to this predicate results into a necessarily empty predicate; so the larger constituent '$[\mathtt{max}_{\mathtt{inf}}[\lambda m_d.[\text{more than } m_d][\mathtt{max}_{\mathtt{inf}}[\lambda n_d.\text{Gloria read } n \text{ books}]]]]$' is necessarily empty and the whole parse in (14d) is contradictory.

This explains why (12a) does not trigger the implicature that Gloria read exactly four books, on the assumption that $\mathtt{max}_{\mathtt{inf}}$ is responsible for such implicatures.

Turning to (12b) (*Gloria read no more than three books*), I assume that *no more than n* is simply the (generalized) negation of *more than three*, i.e. $[\![\text{no more than } n]\!]^w = \lambda P_{dt}.\neg\exists n(n >$

$3 \wedge P(n))$. Consider then the following semi-formal parses for (12b), obtained from those in (14) by replacing *more than* with *no more than*

(15) a. Gloria read no more than three books
b. [no more than three][$\mathtt{max_{inf}}$[λn_d.Gloria read n books]]
c. three$_{\langle dt,t\rangle}$[$\mathtt{max_{inf}}$[λn_d.Gloria read no more than n books]]
d. three$_{\langle dt,t\rangle}$[$\mathtt{max_{inf}}$[λm_d.[no more than m_d][$\mathtt{max_{inf}}$[λn_d.Gloria read n books]]]]

The parses in (15a) in (15b) are simply equivalent to the negation of those in (14a) and (14b), and so give rise to the expected non-strengthened reading (true just in case the number of books read by Gloria, if any, is at most three). But let us now consider the parse in (15c).

The predicate '$\mathtt{max_{inf}}[\lambda n$(Gloria read no more than n books)]' is true of a number n just in case Gloria read at most n books, and there is no number m such that Gloria read at most m books and saying that Gloria read at most m books asymmetrically entails that she read at most n books. It turns out that the denotation of this predicate is not necessarily empty, and will in fact consist, if Gloria read some books,[7] of the singleton whose only member is the unique number n such that Glorial read exactly n books. To see this, assume that Gloria read exactly n books. Then of course she read no more than n books (in the purely logical, mathematical normative sense of *no more than n*). Furthermore, for any $m > n$, it is also true that she read no more than m books, but stating this is strictly less informative than stating that she read no more than n books. And for any $m < n$, it is simply false that Gloria read no more than m books. Therefore, n is the unique number such that (a) Gloria read no more than n books and (b) no true proposition of the same form is logically stronger. The predicate '$\mathtt{max_{inf}}[\lambda n$(Gloria read no more than n books)]' is therefore equivalent to *being the number of books that Gloria read*. It then combines with *three*, and the resulting proposition is simply that Gloria read exactly three books. I leave it to the reader to check that the very same reading is derived for (15d). This is the desired result: even if this reading is not the only reading for (12b), it is nevertheless a possible inference that we can draw from it. On the view defended here, this is simply due to the fact that (12b) has several parses, some but not all of which mean that Gloria read exactly three books.

4.3. Disjunctions of Numerals

Everything is now in place to account for the observed pattern with disjunctions of numerals, repeated below:

(16) a. ??Mary is more than twenty-two or twenty-three years old.
b. Mary is no more than twenty-two or twenty-three years old.

I assume that *or* is a polymorphic disjunction that can conjoin two expressions of the same type that ends in t, in the familiar way. In *twenty-two or twenty-three*, the two numerals must therefore be interpreted as GQs over predicates of degrees (type $\langle dt,t\rangle$) and not as degree-denoting (type d). As a result, the denotation of *twenty-two or twenty-three* is the following:

(17) $[\![\text{[twenty-two or twenty-three]}_{\langle dt,t\rangle}]\!]^w = \lambda P_{dt}.P(22) \vee P(23)$

[7] I ignore here the complications that can arise from considerations of situations where Gloria read no books. See Buccola and Spector (2016) for a detailed discussion.

Since *more than* must combine with a degree-denoting expression, a disjunction of numerals in its scope needs to move out of it to be interpretable (type mismatch). We can therefore essentially consider two parses, depending on whether $\mathtt{max}_{\mathtt{inf}}$ is introduced (additional parses involing movement of *more than n* after the disjunctive phrases has raised are in principle possible, but they will not create new meanings):

(18) a. [twenty-two or twenty-three] $[\lambda n_d.$[Mary is more than n years old]]
b. [twenty-two or twenty-three] $[\mathtt{max}_{\mathtt{inf}}[\lambda n_d.$[Mary is more than n years old]]]

The first parse is true if either 22 or 23 is a number n such that Mary is more than n years old, which is equivalent to saying that Mary is more than 22 years old. Hence this parse is infelicitous due to the ban on redundant numerical expressions, since one could replace the disjunction of numerals with simply *twenty-two* and get an equivalent sentence. The second parse is contradictory, for the very same reason why (14c) was contradictory. Namely, given the universal density of measurement scales, the predicate '$[\mathtt{max}_{\mathtt{inf}}[\lambda n_d.$[Mary is more than n years old]]]' necessarily has an empty denotation (as discussed above in connection to (14c)): if Mary is more than n years old, then she is also more than $n+\varepsilon$ years old, for some ε, and so the proposition that Mary is n years old, if true, is always asymmetrically entailed by some true proposition of the same form. So (16a) is necessarily infelicitous, since, depending on the parse, it either violates the ban against redundant numerical expressions, or is contradictory.

Let me now turn to why (16b), repeated below as (19), is felicitous.

(19) Mary is no more than twenty-two or twenty-three years old.

Let us consider the following two parses:

(20) a. [twenty-two or twenty-three] $[\lambda n_d.$[Mary is no more than n years old]]
b. [twenty-two or twenty-three] $[\mathtt{max}_{\mathtt{inf}}[\lambda n_d.$[Mary is no more than n years old]]]

The discussion is essentially parallel to our discussion of the parses in (15) for *Gloria read no more than three books*. (20a) means that 22 or 23 is an n such that Mary is no more than n years old, which is just equivalent to saying that Mary is no more than 22 years old. Hence this parse is infelicitous given the ban on redundant numerical expressions. (20b), on the other hand, ends up meaning that Mary is 22 or 23 years old (an not older). Let us see why. The predicate '$\mathtt{max}_{\mathtt{inf}}[\lambda n_d.$[Mary is no more than n years old]]' is true of n is (a) Mary is no more than n years old, and (b) there is no m such that the proposition that Mary is no more than m years old is true and asymmetrically entails that Mary is no more than n years old. There is exactly one value that meets both condition, namely Mary's exact age. First, if a is Mary's age (measured in years), then Mary is no more than a years old. Second, the propositions of the form 'Mary is no more than m years old' that asymmetrically entail that Mary is no more than a years old are obtained by taking $m < a$; but these propositions are all false, hence condition (b) is satisfied for a. Therefore, the predicate '$\mathtt{max}_{\mathtt{inf}}[\lambda n_d.$[Mary is no more than n years old]]' is equivalent to 'being Mary's age', and (20b) means that Mary's age is either 22 or 23. Importantly, the ban on redundant numerical expressions is not violated, because if we replace *twenty-two or twenty-three* with *twenty-two* (resp. *twenty-three*), the resulting meaning is that Mary's age is 22 (resp. 23), which is not equivalent to saying that it is 22 or 23. Finally, this analysis explains why (19) is typically understood as conveying that Mary's age measured in years is 22 or 23.

A problem this proposal encounters is the following: if someone utters (19) and we later learn that Mary is in fact only 15 years old, we typically do not judge the sentence false (though certainly misleading). I would like to advance two possible answers. One is that there is a parse that makes the sentence true in this situation, namely the parse in (20a). Even if this parse is pragmatically infelicitous, a charitable listener could agree that the sentence is true because it has a true parse. A second possible answer, which is even more speculative, is that the specific contribution of $\mathtt{max}_{\mathtt{inf}}$ might not be 'at issue' and for this reason might be, under certain conditions, ignored when performing a truth-value judgment task. Given that $\mathtt{max}_{\mathtt{inf}}$ can be viewed as an exhaustivity operator, this would be in line with some recent works claiming that the contribution of the exhaustivity operator is typically not at issue. (Bassi et al. 2021). Typically, a sentence such as (19) is used when there is a prior expectation that Mary is more than 22 or 23 years old, and seems to be used to convey that Mary is younger than one could have expected (rather than, say, older than one could have expected). The information that she is in fact 22 or 23 years old is from this point of view secondary.

4.4. *Between n and m* and *about n*

The account I have just proposed straightforwardly extends to interval-denoting expressions like *between n and m*, assuming that they are essentially equivalent to a (potentially infinite, given density) disjunction of degrees. That is:

(21) $[\![\text{between fifty and one hundred}]\!]^w = \lambda P_{dt}.\exists x_d(x \in [50,100] \wedge P(n))$ (if we ignore non-integers, this is just the same as the grand disjunction expressed by *fifty or fifty-one or ... or one hundred*)

Based on such a lexical entry, we can account for the judgments reported in Section 3 in exactly in the same way as we did in the previous section for disjoined numerals. Consider again the contrast in (7), repeated below in (22).

(22) a. *Air Syldavia owns more than between fifty and one hundred airplanes.
b. (?) Air Syldavia owns no more than between fifty and one hundred airplanes.

Essentially, parses that involve $\mathtt{max}_{\mathtt{inf}}$ in the case of (22a) are contradictory or equivalent to a parse without $\mathtt{max}_{\mathtt{inf}}$. And parses without $\mathtt{max}_{\mathtt{inf}}$ express the proposition that there is a number n in $[50,100]$ such that Air Syldavia owns more than n air plances, which is equivalent to *Air Syldavia owns more than 50 airplanes*. Such parses are therefore ruled out by the ban on redundant numerical expressions. (22b), on the other hand, with a parse such as the one in (23), means that the maximally informative true proposition of the form *Air Syldavia owns n airplanes* is such that n is between 50 and 100. Since the maximally informative true proposition of this form is obtained with n being equated to the numbers of airplanes owned by Air Syldavia, the resulting meaning is that the numbers of airplanes owned by Air Syldavia is between 50 and 100 airplanes, which is the desired result.

(23) [between fifty and one hundred][$\mathtt{max}_{\mathtt{inf}}$[$\lambda n_d$.Air Syldavia owns no more than n airplanes]]

Regarding *about n*, I assume that it denotes an interval whose half-length i length is contextually given:

(24) $[\![\text{about } n]\!]^{w,i} = \lambda P_{dt}.\exists x_d(x \in [n-i, n+i] \wedge P(x))$

The account then applies in the same way. In particular, relative to a fixed i, a sentence such as *Mary is more than about 18 years old* is equivalent to *Mary is more than 18-i years old*, if $\texttt{max}_{\texttt{inf}}$ does not occur (and therefore violates the ban on redundant numerical expressions), or is contradictory if $\texttt{max}_{\texttt{inf}}$ occurs non-vacuously. But *Mary is no more than about 18 years old* is correctly predicted to be felicitous and to mean that Mary's age is in the interval $[18-i, 18+i]$, which is the desired result.

5. *About n*, *between n and m* and *n or m* without comparatives

Let me now discuss the contrast in (1), repeated in (25).

(25) a. Mary is about twenty years old.
b. ??Mary is not about twenty years old.

In the case of (25a), a parse that does not include $\texttt{max}_{\texttt{inf}}$ violates the ban on redundancy, since (24a) would then be equivalent to *Mary is 20-i years old* under an at-least readings, where i being the contextually given half-length of the interval denoted by *about twenty*, and thus would violate the ban on redundancy. But there is a parse that does not encounter this problem, provided in (26).

(26) [about twenty][$\texttt{max}_{\texttt{inf}}$[$\lambda n_d$.Mary is n years old]]

The predicate '$\texttt{max}_{\texttt{inf}}$[$\lambda n_d$.Mary is n years old]' means *being Mary's age*. As a result, (26) means that Mary's age is in the interval $[20-i, 20+i]$, which is the desired reading, and does not violate the ban on redundancy.

Given this observation, if nothing more is said, there is also a parse for (25b) that does not violate the ban of redundancy, and which is simply the negation of the parse in (26):

(27) not[[about twenty][$\texttt{max}_{\texttt{inf}}$[$\lambda n_d$.Mary is n years old]]]

To rule out this parse, we might posit that $\texttt{max}_{\texttt{inf}}$ does not like to occur under the scope of negation. As already noted, the operator $\texttt{max}_{\texttt{inf}}$ is in fact akin to the exhaustivity operator proposed in the scalar implicature and exhaustivity literature, which is typically viewed as not licensed under negation (see, e.g., Chierchia et al. 2012). One can check that all the parses that made felicitous the *no more than [m or n]/[about n]/[between m or n]* sentences in the previous sections are parses where $\texttt{max}_{\texttt{inf}}$ takes scope over the negative element *no more than*. Such a move is therefore consistent with my analysis so far.

Given this additional assumption, the only parse for (25b) that contains $\texttt{max}_{\texttt{inf}}$ is as follows:

(28) [about twenty][$\texttt{max}_{\texttt{inf}}$[$\lambda n_d$.not[Mary is n years old]]]]

We can show that (28) is contradictory (following again a core insight from Fox and Hackl 2006), because the predicate '$\texttt{max}_{\texttt{inf}}$[$\lambda n_d$.not[Mary is n years old]]' is necessarily empty, given an *at least*-meaning for the expression *n years old*.[8]. If a is Mary's age, then the set of degrees

[8]Following Heim (2000), I assume that lexical degree predicates are *monotonic*: if someone is d years old, then that person is also d' years old, for any $d' < d$, which makes *d years old* equivalent to *at least d years old*. This

that satisfy the predicate 'λn_d.not[Mary is n years old]]' is the open interval $(a, +\infty)$. Given density, this interval has no least element (since a does not belong to it). Now, for any two x and x' in this interval, the proposition that Mary is not at least $x - old$ asymmetrically entails that Mary is not at least $x' - old$ if and only if $x < x'$. But given density, there does not exist any x such that (a) Mary is not x-old and (b) there is no x' such that both $x' < x$ and Mary is x'-old. For any x such that Mary is not at least x-old, there is a smaller x' such that Mary is not at least x'-old (just pick x' between a and x). This means that the predicate '$\mathtt{max}_{\mathtt{inf}}[\lambda n_d$.not[Mary is n years old]]' is empty – there is no maximally informative true proposition of the form *Mary is not x-old*, because it is always possible, starting from such a true proposition, to find another true proposition that asymmetrically entails it. It follows that (28) is contradictory.

Now, this analysis makes completely parallel predictions when *about n* is replaced with *between m and n* and *m or n*. That is, the following patterns are *predicted*:

(29) a. Mary is twenty-two or twenty-three years old.
b. [Predicted: ??] Mary is not twenty-two or twenty-three years old.

(30) a. Mary is between twenty and twenty-five years old.
b. [Predicted: ??] Mary is not beween twenty and twenty-five years.

These judgments are quite unclear, possibly due to the possibility of interpreting the negative sentences as echoic (i.e. direct objections to their affirmative counterparts), in which case they are expected to be felicitous no matter what (it is as far as I know always felicitous to negate a sentence that has just been uttered – cf. also footnote 3). And (29b) and (30b) do in fact suggest, it seems to me, a situation where someone is directly replying to the corresponding affirmative sentence. This possibility however does not explain on its own why the judgments might be sharper, out of the blue, with (25b) than with these cases.

6. The role of monotonicity

Solt's (2018) proposal predicts that what matters to the felicity of *more than about n* is the global monotonicity of its environment: it needs to be in a monotone-decreasing environment. This is so because the key to her explanation for *Mary is no more than about 18 years old* is that this sentence can be true, relative to a certain granularity level *i*, while its counterpart without *about* is not true, under a more fine-grained granularity level. And indeed, we observe that *more than about n* is, for instance, felicitous in the scope of a universal quantifier:

(31) Everyone who is more than about twenty years old hated this movie.

However, a side effect of the fact that Solt's proposal is entirely pragmatic in nature is that it's only the *global* monotonicity of the environment that matters. That is, Solt predicts (32) to be infelicitous, contrary to fact:

(32) Everyone who is no more than about twenty years old hated this movie.

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does not entail that the English sentence *Mary is twenty-two years* old means that Mary is at least twenty-two years old, since it is possible that such a sentence always or preferably receives a parse that includes $\mathtt{max}_{\mathtt{inf}}$.

In (32), *more than about twenty* is in the scope of a negative element (*no*), which is itself in a decreasing environment, so the global environment for *more than about twenty* is itself increasing. For this reason, Solt's proposal, as far as I can tell, predicts (32) to be infelicitous.

In contrast with this, my proposal can predict both (31) and (32) to be felicitous, though in the case of (32), I need to make some quite counterintuitive assumptions, which are already present in Fox and Hackl (2006)).

Starting with (31), consider the following parse:

(33) [about twenty]$[\mathtt{max_{inf}}[\lambda x_d$.Everyone who is more than x years old hated this movie$]]$

Consider a model where there is someone who is x years old and who loved the movie, and where everybody who is more than x years old hated it. Then, quite obviously, the proposition that everyone who is more than x years old hated the movie is the strongest true proposition of this form. In such a situation, the predicate '$\mathtt{max_{inf}}[\lambda n_d$.Everyone who is more than n years old hated this movie$]$' is true of x and only x. The important thing is that this predicate is not necessarily empty. When combining with *about twenty*, the resulting meaning (restricting ourselves to situations with finitely many individuals)[9] is that there is someone whose age is in the vicinity of 20 and who didn't hate the movie, and such that everybody older than this person hated the movie. What can be definitely concluded is that everybody whose age is significantly above 20 years old hated the movie, and that someone who is about 20 years old didn't hate it. This seems to be a plausible prediction. The reading predicted by Solt is that everyone whose age is above some interval $20+i$ for some i hated the movie, together with an implicature that it is possible that someone who is more than 20 years old didn't hate the movie (from the fact that the very same sentence without *about* is not assertable). These readings are very hard to tease apart in practice.

Let me now consider (32), which Solt (2018) does not predict to be felicitous to begin with, under the following parse:

(34) [about twenty]$[\mathtt{max_{inf}}[\lambda x_d$.Everyone who is no more than x years old hated this movie$]]$

The predicate 'λx_d.Everyone who is no more than x years old hated movie' is true of a degree x just in case everyone who is at most x years old hated this movie. Now, imagine a situation where someone whose age is x hated the movie and so did everyone younger, but everyone older loved it. Consider then the youngest person who is older than x (and therefore didn't hate it), call her age y. Then, *Everybody who is no more than x years old hated this movie* is true, and *Everybody who is no more than y years old hated this movie* is false (since someone who is y years old didn't hate the movie.) But then, for every x' in $[x,y]$, it is also true that everyone who is no more than x' years old hated this movie (since no one's age is between in $(x,x'])$, and this last proposition asymmetrically entails the one based on x. Therefore, in a situation where there are finitely many individuals (so that we can talk about the youngest person who is older than the oldest person who hated the movie), given density, there can be no x such that *Everyone who is no more than x years old hated this movie* is the maximally true proposition of this form. So it looks like the predicate obtained by appending $\mathtt{max_{inf}}$ is necessarily empty, which would fail

[9]Taking into account density, the truth-conditions are in fact significantly more complicated if we allow for models with infinitely many individuals, in a way that is connected with our discussion of (34) below, but I do not discuss these complications here.

to explain the felicity of (34) (since a parse without $\mathtt{max_{inf}}$ would violate the ban against redundancy, and other parses with $\mathtt{max_{inf}}$ would violate the condition that $\mathtt{max_{inf}}$ is excluded in decreasing environments). However, consider a model with infinitely many individuals, in which someone whose age is *x* hated the movie and everybody who is at most *x* years old hated the movie, but for every *y* above *x*, there is someone whose age is *y* and who loved the movie. In this case the predicate '$\mathtt{max_{inf}}[\lambda x_d$.Everyone who is no more than *x* years old hated this movie]' is not empty, and is exactly true of *x*. And then the sentence is true if *x* is in the vicinity of 20 (a reading that does not violate the ban on redundancy). Following Fox and Hackl (2006), I need to assume that whether a sentence is ruled out as contradictory is evaluated not on the basis of underlying common knowledge (for instance we might know that there aren't infinitely many individuals), but on a purely logical basis, blindly to contextual information. When a sentence has passed this test, it can then be interpreted relative to a specific context, in which it is known that there are finitely many individuals, and scales are not necessarily treated as dense anymore. So the above parse would be felicitous and convey that there is an age *a* in the vicinity of 20 years old such that everybody who is at most *a*-years old hated the movie, but the youngest person whose age is more than *a* didn't hate the movie – which is, in fact, the intuitive reading of the sentence.

So it may seem that, on top of providing an account that extends to *between n and m* and *n or m*, the proposal advanced here has another advantage over Solt's (2018), namely it does not predict that global monotonicity is the only relevant factor that regulates the distribution of *more than about*.

That being said, my proposal seems to suffer from overgeneralization compared to Solt's. In particular, I predict the following to be felicitous:

(35) ??(In order to be allowed to drink alcohol in this country), one must be more than about eighteen years .

Because *more than eighteen* occurs in an increasing environment, Solt (2018) correctly predicts (35) to be infelicitous. I predict it to be fine, however, under the following parse:

(36) [about eighteen][$\mathtt{max_{inf}}[\lambda x_d$.one must be more than x years old]]

The predicted reading is the following: there is an age *x* such that one must be above *x* in order to be allowed to drink alcohol, and for any age *y* greater than *x*, it is not the case that one must be older than *y* to be allowed to drink alcohol, and *x* is in the vicinity of 18. This describes a situation where the only age-related rule has the form *You must be more than x years old to be allowed to drink alcohool* and *x* is in the vicinity of 18 (typically the speaker would not know the exact value of *x*).

Now, I should note that the corresponding structure with a disjunction of numerals seems quite felicitous, unlike the one with a *between*-phrase

(37) a. (In order to be allowed to drink alcohol in this country), one must be more than twenty or twenty-one years old (I don't remember)

b. ??(In order to be allowed to drink alcohol in this country), one must be more than between 18 and 20 years old (I don't remember).

The predicted meaning of (37a), under a parse analogous to the one in (36), is simply that the underlying rule states *One must be more than x years old*, with $x = 20$ or $x = 21$ (and the speaker does not remember whether $x = 20$ or $x = 21$). The predicted reading for the infelicitous sentence in (37b) is completely similar, except that the condition on x is now that x should belong to the interval $[18, 20]$ (and the speaker does not know more).

The fact that my proposal incorrectly predicts (35) and (37b) to be potentially felicitous is a clear weakness. One unsatisfying move I could make is to argue that there are certain syntactic constraints on the scope of *about n* and *between n and m* that would rule out a parse analogous to the one in (36) in the case of these two expressions, but not in the case of disjunctions of numerals. But given the kind of parses that I need to assume in connection with the sentences in (31) and (32), this does not seem to be a very promising avenue.

7. Conclusion

In this paper, I showed that the universal density of measurement hypothesis (Fox and Hackl 2006), together with independently motivated assumptions, can account for the pattern uncovered and discussed in Solt (2014, 2018) regarding the distribution of *about* used as a degree approximator. I argued that this account has the advantage of generalizing to *between*-degree phrases as well as to disjunctions of numerals. Furthermore, where Solt (2014, 2018) predicts that the distributional facts depend on the global monotonicity of the environment in which *more than about* and *about* find themselves, I argued that this was not in general a good prediction, and that the proposal I made fared better in this respect. However, it also appears that my proposal overgenerates: some sentences that Solt correctly predicts to be infelicitous are predicted to be felicitous (in some contexts) by my proposal, suggesting that additional work is needed if we want to fully understand the patterns discussed by Solt and the related ones discussed in this paper.

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English does too have a [REVERSE,+] polarity particle![1]

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Abstract. This paper argues that the refutational use of English *too* is a polarity particle requiring a positive prejacent and a negative antecedent—that is, what Farkas and Bruce (2010) call a [REVERSE, +] particle. This places refutational *too* in a class with well-known [REVERSE, +] particles in other languages, such as French *si* and German *doch*. However, refutational *too* exhibits a property that has not been observed in previous research on polarity particles cross-linguistically: It requires the addressee to have expressed an epistemic bias against the content of its prejacent. To account for this, this paper proposes that *too* realizes a new polarity feature called [REFUTE], which presupposes that the negation of its prejacent is a member of the set of *projected addressee commitments* introduced by Malamud and Stephenson (2015). The existence of the [REFUTE] feature opens new avenues for research on the typology of polarity particles.

Keywords: polarity particles, commitment-based discourse models, question bias, tag questions, rising declaratives, additive particles.

1. Introduction

Research on English *too* has focused on its additive use, shown in (1), which is more or less synonymous with *also* and conveys that its prejacent is true in addition to a salient antecedent sentence being true.

(1) I like pizza. I like spaghetti, **too**. (Rullmann 2003)

However, *too* has another, less well-studied use, which Schwenter and Waltereit (2010) call the *refutational* use. The refutational use expresses disagreement, as shown in (2) and (3). The two uses are diachronically related, but whereas the additive use of *too* is attested in Old English, the earliest attestation of the refutational use in the *Oxford English Dictionary* is from the early twentieth century.

(2) A: You didn't do your homework!
B: I did **too**!
(Schwenter and Waltereit 2010)

(3) A: You ate all my cookies.
B: I did not!
A: You did **too**!
(Rullmann 2003)

Schwenter & Waltereit investigate the diachronic development of refutational *too* by identifying bridging contexts in which additive *too* plausibly could have been reanalyzed as refutational *too*. However, the refutational use, in contrast to the additive use, has not yet received a formal semantic analysis. In this paper, I argue that refutational *too* should be analyzed as a polarity

[1]I would like to thank Ashwini Deo for helpful feedback on this paper. I am also grateful to the OSU Pragmatics and Synners discussion groups and to audience members at *SuB 27* for thought-provoking discussion. Four anonymous abstract reviewers also provided useful comments.

particle (like *yes* and *no*), but that it possesses a property that other polarity particles have not been reported to have: It is sensitive to the epistemic bias of the addressee. Building on earlier work on polarity particles by Farkas and Bruce (2010) and Roelofsen and Farkas (2015), this paper proposes a new polarity feature, [REFUTE], to account for the behavior of refutational *too*.

I begin by reviewing some previous research on polarity particles in Section 2. The behavior of refutational *too* will then be examined in Section 3 and analyzed in Section 4. Section 5 concludes.

2. Background: Polarity Features

Early work on responses to polar questions (e.g. Pope 1976; Sadock and Zwicky 1985) noted that *yes*, *no*, and their analogues in other languages require a salient antecedent sentence and are sensitive to its polarity. In particular, *yes* can occur both in positive sentences (as in (4a) and (5b)) and in negative sentences that confirm a negative antecedent (as in (5a)), while *no* can occur both in negative sentences (as in (4b) and (5a)) and in positive sentences that deny a negative antecedent (as in (5b)).

(4) Peter passed the test.
- a. Yes, he did. / #No, he did.
- b. #Yes, he didn't. / No, he didn't.

(5) Peter didn't pass the test.
- a. Yes, he didn't. / No, he didn't.
- b. Yes, he DID. / No, he DID.

Roelofsen and Farkas (2015), refining the analysis of Farkas and Bruce (2010), take this class of particles, known as *polarity particles*, to realize two types of *polarity features*: absolute and relative. The absolute polarity features [$+$] and [$-$] presuppose that the polarity of the sentence the particle occurs in (henceforth its *prejacent*) is positive or negative, respectively. The relative polarity features [AGREE] and [REVERSE][2] presuppose that the polarity of the prejacent is the same or different, respectively, as the polarity of the antecedent. The following simplified versions of Roelofsen and Farkas's definitions of the polarity features will suffice for present purposes; the reader may consult Roelofsen and Farkas (2015) for further details.

(6) **Absolute polarity features:**
- a. [$+$] presupposes that its prejacent is a declarative sentence with positive polarity.
- b. [$-$] presupposes that its prejacent is a declarative sentence with negative polarity.

(7) **Relative polarity features:**
- a. [AGREE] presupposes that the context provides a unique most salient antecedent proposition that is equivalent to the proposition expressed by the prejacent and has the same polarity.
- b. [REVERSE] presupposes that the context provides a unique most salient antecedent proposition that is the negation of the proposition expressed by the prejacent and has the opposite polarity.

[2]Note that by calling the relative polarity features [AGREE] and [REVERSE], I am adopting the terminology of Roelofsen and Farkas (2015). Farkas and Bruce (2010) call those features [*same*] and [*reverse*].

According to Farkas and Bruce (2010) and Roelofsen and Farkas (2015), *yes* can realize [AGREE] or [+], while *no* can realize [REVERSE] or [−]. This accounts for the data in (4) and (5).

Some languages are known to have polarity particles that realize the feature combination [REVERSE, +]—that is, they occur only in positive responses to negative antecedents. The best-known examples of [REVERSE, +] particles are French *si* and German *doch*, examples of which are shown in (8) and (9), respectively.

(8) a. A: Anne n'est pas partie. 'Anne didn't leave.'
B: Mais **si**. 'You are wrong, she did.'
b. A: Anne n'est pas partie? 'Didn't Anne leave?'
B: Mais **si**. 'Yes, she did.'
(Farkas and Bruce 2010)

(9) a. A: Anna kommt nicht mit ins Kino. 'Anna isn't coming along to the movies.'
B: **Doch!** Sie kommt schon. 'You are wrong. She's coming.'
b. A: Wollen Sie den Job nicht? 'Don't you want this job?'
B: **Doch!** Ich brauche das Geld. 'But I do. I need the money.'
(Farkas and Bruce 2010)

Farkas and Bruce (2010), Roelofsen and Farkas (2015), and other authors seem to assume that English does not have a [REVERSE, +], but it will be seen in the next section that the behavior of refutational *too* challenges that assumption.

3. Data

Some naturally-occurring examples of refutational *too* found in the Corpus of Contemporary American English (COCA; Davies 2008) are shown in (10). (The speaker labels 'A' and 'B' are added for clarity.) This paper focuses on data from American English, and judgments of all constructed examples that follow were checked with speakers of American English.[3] It should be noted that refutational *too* is strongly associated with children's speech. When used by adults, it tends to sound playful or lighthearted and is not generally appropriate in formal contexts or in discussions of serious topics.

(10) a. A: You tripped me.
B: Did not.
A: Did **too**!
b. A: She doesn't know what she wants.
B: I do **too**!
c. A: Peter Pan isn't real, and people don't fly!
B: They do **too**!
d. A: No, the music [in Porgy and Bess] actually came together. I had trouble with the plot, but I guess Gershwin had nothing to do with that.
B: He did **too**!
e. A: You have never looked better.
B: I have **too** looked better.

[3]The extent to which refutational *too* is attested in other varieties of English is a question for future research. Speakers of British English in attendance at *SuB 27* report the impression that it may be a dialectal feature of American English.

f. A: We'll never fit.
B: Will **too**!

g. A: No, you can't come in.
B: Can **too**!

(COCA)

Note that although refutational *too* prototypically occurs in the elliptical construction *Do too!/Did too!*, it also occurs with other auxiliary verbs (such as *have*, *will*, and *can* in (10e–g)), and it does not require verb phrase ellipsis (as demonstrated by (10e)). Its distribution is, however, quite restricted: The clause in which it appears must be a main clause, must be declarative, and must have positive polarity. Its unacceptability in embedded clauses, interrogatives, and negative sentences is demonstrated by (11), (12), and (13), respectively.

(11) a. A: You ate all my cookies!
B: I did not!
A: I think you did (**#too**)!

b. A: People don't fly!
B: I think they do (**#too**)!

(12) A: I guess Gershwin had nothing to do with that.
B: #Did he **too**? / #Did **too** he?

(13) A: You ate all my cookies!
B: I didn't **(#too)**! / I did **(#too)** not!

In addition, refutational *too* always immediately follows an auxiliary verb. Placing it in any other position in the examples above results in unacceptability. The syntactic distribution of refutational *too* is thus quite different from that of additive *too*, which typically (though not exclusively) appears in sentence-final position, as in (1). It also differs from the distribution of the canonical English polarity particles *yes* and *no*, which typically appear in sentence-initial position. *Too*'s inability to form responses by itself without an overt prejacent, as shown in (14), also sets it apart from *yes* and *no*.[4]

(14) A: You didn't feed Fido.
B: #Too!

3.1. *Too* as a polarity particle

Notwithstanding the syntactic differences between refutational *too* and the canonical English polarity particles,[5] I claim that refutational *too* is a polarity particle because it exhibits what I take to be the two key properties of polarity particles: anaphoric reference to a salient antecedent sentence (which is either equivalent to the particle's prejacent or the negation of it) and sensitivity to the polarity of that antecedent and/or its prejacent. To see that refutational *too* does indeed require an overt antecedent, consider the dialogue in (15). Even though it is clear that A believes B did not feed Fido, B cannot use *too* to disagree with that accusation since it

[4] I will not attempt to explain *too*'s syntactic behavior here, but see Sailor (2014) for an analysis of it.

[5] Farkas and Bruce (2010) report that the Romanian polarity particle *ba* also cannot occur by itself, so that does not seem to be a property shared by polarity particles in general. It is not clear how common this property is for polarity particles cross-linguistically.

was merely implicated by A, leaving it unavailable for anaphoric reference.

(15) A: Fido looks hungry.
B: #I did too feed him!

Too's sensitivity to the polarity of its antecedent and prejacent is demonstrated in (16). As already pointed out, it requires a positive prejacent, which can be accounted for by taking it to realize the [+] polarity feature. In addition, it requires a negative antecedent, which can be accounted for by taking it to simultaneously realize the [REVERSE] feature. Accordingly, *too* is licensed in a wide range of [REVERSE, +] responses involving both declarative and interrogative antecedents, such as those shown in (16a), but it is never licensed in [AGREE] or [−] responses, such as those in (16b–c). Refutational *too* therefore seems to be a [REVERSE, +] polarity particle, just like French *si* and German *doch*.

(16) <u>**Context:**</u> A and B have a dog, Fido, which B is supposed to feed every day. One day, A comes home and sees Fido lying next to his empty bowl, looking hungry.

a.	(i)	**A:** You didn't feed Fido.	**B:** I did **too**!	[REVERSE,+]
	(ii)	**A:** You didn't feed Fido?	**B:** I did **too**!	[REVERSE,+]
	(iii)	**A:** Did you not feed Fido?	**B:** I did **too**!	[REVERSE,+]
b.	(i)	**A:** You fed Fido!	**B:** #I did **too**!	[AGREE, +]
	(ii)	**A:** Did you feed Fido?	**B:** #I did **too**!	[AGREE, +]
c.	(i)	**A:** You didn't feed Fido.	**B:** #I didn't **too**!	[AGREE, -]
	(ii)	**A:** You fed Fido.	**B:** #I didn't **too**!	[REVERSE,-]

3.2. *Too*'s sensitivity to addressee bias

Refutational *too* being a [REVERSE, +] particle cannot be the whole story, however, as there are [REVERSE, +] responses that fail to license *too*. Some examples are shown in (17a–d), where *too* is not acceptable but *yes* and *no* both are, as Farkas and Bruce's (2010) analysis predicts (though *yes* may be slightly more natural). Note that the superscripted ↑ in (17b) and (17c) indicates rising intonation on the tag question.

(17) **[REVERSE,+] responses in which *too* is not licensed**

a. <u>**Context:**</u> B is organizing a party and is in charge of supplying all the non-alcoholic beverages for teetotalers. A and B are going through a list of people that are invited. B has no previous belief or expectation about their drinking habits.
A: Jane and Mary do not drink.
B: OK. What about John? Does he not drink (either)? (Romero and Han 2004)
A: He does **(#too)**! / (Yes/no), he does drink. [REVERSE, +]

b. <u>**Context:**</u> A and B are exploring a spooky abandoned house when they see a door slam for no apparent reason.
A: This house isn't haunted... is it?$^{\uparrow}$
B: It is **(#too)**! / (Yes/no), it is haunted. [REVERSE, +]

c. <u>**Context:**</u> A and B are planning to go to the beach later today, but only if it's sunny. A has been working in a windowless room all day and has no idea what the weather is like. B comes in from outside.
A: I hope we can still go to the beach. It's not raining, is it?$^{\uparrow}$

B: It is **(#too)**! / (Yes/no), it is raining. [REVERSE, +]

d. **Context:** A student is giving a presentation about France.
Student: Marseille is the capital of France.
Teacher: Paris isn't the capital of France?
Student: It is **(#too)**! / (Yes/no), Paris is the capital of France. [REVERSE, +]

The *too* responses in (17) are all pragmatically odd because they seem to convey that the speaker (A in (17a), B in (17b–c), and the student in (17d)) is disagreeing with the addressee, but in fact there is no conflict between the interlocutors' discourse commitments. In (17a), A's use of *too* suggests that B believes that John does not drink, but in the given context B's utterance, a low-negation polar question, does not convey anything about B's beliefs with regard to the question of whether John drinks (see Romero and Han 2004 for discussion of such questions). In (17b), B's use of *too* suggests that B thinks that A believes the house is haunted, but the context does not provide any reason to think that A holds that belief. Rather, A's use of a tag question with rising intonation after a pause conveys that A wishes to confirm that the house is not haunted because A does not *want* the house to be haunted but suspects that it actually might be. Similarly, A's tag question in (17b) does not convey that A *believes* that it is not raining. Instead, it seems to convey that A *desires* that it not be raining so that A and B can go to the beach. In (17d), the rising declarative uttered by the teacher cannot be taken to convey that the teacher believes that Paris is not the capital of France, as the teacher can be assumed to know what city is the capital of France and therefore must have intended their utterance as a correction of the student's claim (see Farkas and Roelofsen 2017 for discussion of rising declaratives that fail to signal any bias toward their contents). By contrast, *too* is acceptable in the examples in (10) because each utterance containing *too* is a response to an assertion of the negation of *too*'s prejacent.

However, *too* does not seem to require the addressee to be fully committed to the negation of its prejacent. This is demonstrated by (16a-iii), repeated in (18), which seems to license *too* because A's question, especially when uttered in an accusatory tone, clearly conveys that A believes that B did not feed Fido.[6] However, by choosing to express the accusation as a

[6] A reviewer points out that *too* seems to be unacceptable in (i) even though it occurs in a [REVERSE, +] response and A has expressed the bias that I argue *too* requires. The oddity of (iB) seems to have something to do with the presence of an indefinite in the subject, as *too* is similarly odd in other sentences with indefinite subjects, such as (iiB), and a search in COCA does not turn up any examples of refutational *too* with indefinite subjects.

(i) A: No one fed Fido.
B: #Someone did too!

(ii) A: A dog has never been to space.
B: #A dog has too!

Interestingly, however, refutational *too* is perfectly acceptable with indefinites in the predicate of the prejacent, as demonstrated by (iii)–(vi). I must leave the question of why refutational *too* is incompatible with indefinite subjects to future work.

(iii) A: There is no dog that has been to space.
B: There is too a dog that has been to space!

(iv) A: There is no credit crunch.
B: There is too a credit crunch! (`https://economistsview.typepad.com/economistsview/2008/11/there-is-too-a.html`)

(v) A: Mary has no car.
B: She does too have a car!

(vi) A: That dog belongs to no one.

question instead of an assertion, A also conveys that they are not entirely certain that B did not feed Fido. (This choice may have a politeness motivation, as it softens the accusation somewhat.) *Too* is felicitous in B's response in spite of A's apparent uncertainty. This contrasts with (17a), which also involves a low-negation polar question but fails to license *too*. Thus the acceptability of *too* in response to low-negation polar questions seems to depend on whether the question conveys an epistemic bias toward the negative answer on the part of the speaker (see Han 1998 Romero and Han 2004, Romero 2020, Goodhue 2021 for further arguments that low negation polar questions do not require such a bias).

(18) **Context:** A and B have a dog, Fido, which B is supposed to feed every day. One day, A comes home and sees Fido lying next to his empty bowl, looking hungry.
A: Did you not feed Fido?
B: I did **too**! [REVERSE, +]

The examples in (19) provide further evidence that even a weak bias toward the negation of the prejacent is sufficient to license *too*. In (19a), A's rising-intonation tag question conveys that A believes, but is not certain, that Mary is not home. (Contrast this with the lack of bias conveyed by the tag questions in (17b) and (17c), and see Reese and Asher 2007 for discussion of the interpretation of tag questions.) In (19b), A's use of *maybe* conveys the same belief and a similar lack of certainty.[7] In both cases, *too* is perfectly acceptable in B's response even though the antecedent expresses a weaker commitment than an outright assertion would.

(19) a. **Context:** Two children, A and B, are baking a surprise for their parents one evening when they run out of sugar. Their neighbor, Mary, sometimes loans things to them. She usually works late, but B saw her get home an hour ago. A does not know this.
B: Let's see if Mary can give us some sugar.
A: (But) she isn't home, is she?$^{\uparrow}$
B: She is **too**! [REVERSE, +]

b. **Context:** A and B knock on Mary's door and there is no answer for a couple of minutes. B saw her arrive and go inside an hour ago, but A does not know that.
A: Maybe Mary isn't home.
B: She is **too**! [REVERSE, +]

What seems to distinguish *too* from other polarity particles, then, is its sensitivity to the perceived epistemic bias of the addressee: Unlike *yes* and *no*, it appears that refutational *too* can only be used by a speaker who believes the addressee to be epistemically biased toward the negation of its host sentence. I take an interlocutor to be epistemically biased toward a propo-

B: He does too belong to someone!

The same reviewer also suggests that refutational *too* is unacceptable in responses to rhetorical questions such as *Are you never going to learn?* However, I do find *too* to be acceptable in such responses if appropriate context is provided, as in (vii).

(vii) **Context:** A sees B eating a peanut butter and jelly sandwich for dinner for the third day in a row.
A: Are you never going to learn to cook?
B: I am **too**! I just haven't had time.

[7] Thanks to a reviewer for the dialogue in (19b). The reviewer actually felt *too* to be unacceptable in response to *Maybe Mary isn't home* but did not suggest any particular context for the dialogue. Several American English speakers consulted found B's response in (19b) to in fact be acceptable with the given context.

sition at a particular moment in discourse if at that moment they believe it to be more likely to be true than its negation.

As should be clear from the preceding discussion, listeners' inferences about interlocutors' biases result from a complex interplay of semantic and pragmatic factors including the literal meaning of utterances, prosody, and information available in the context. In (19a), for example, A's bias toward Mary not being home is the result of A's pre-existing knowledge that Mary is not usually home on weekday evenings and is conveyed by A's rising-intonation tag question. But rising-intonation tag questions do not give rise to this kind of bias in all contexts, as demonstrated by (17c). In (19b), A's bias has a different source, namely the fact that Mary is not answering the door. The listener infers A's bias by assuming that a person's failure to answer the door is generally credible evidence that they are not home and that A will therefore be inclined to believe that Mary is not home. But of course sentences containing *maybe* do not always indicate this kind of bias. For instance, if it has been raining for a week, a speaker who has no information about the weather forecast and utters *Maybe it will be sunny tomorrow* does not express any belief about what tomorrow's weather will be like, but rather seems to express a wish for it to be sunny tomorrow. A great deal of the research on speaker bias and commitment has been dedicated to understanding the ways in which the conventional effects of various sentence forms interact with contextual factors to license inferences about speakers' epistemic states (see e.g. Malamud and Stephenson 2015; Gunlogson 2008; Jeong 2018; Reese and Asher 2007; Rudin 2018; Goodhue 2022). For the purposes of this paper, I do not take any positions on what the conventional meaning of any particular sentence form might be. What I claim is that refutational *too* is felicitous only in contexts where the addressee can be inferred (based on their previous utterances and other contextual information) to hold an epistemic bias against *too*'s prejacent.

At this point, one might wonder whether the $[-]$ feature and the addressee bias requirement are sufficient to account for the distribution of refutational *too*, allowing the [REVERSE] feature to be left out of the analysis. After all, antecedents that have the required addressee bias tend to have negative polarity, so does the [REVERSE] feature actually rule out any antecedents that the bias requirement does not? I argue that refutational *too* does, in fact, realize [REVERSE] because it sounds unnatural in the $[\text{AGREE}, +]$ responses in (20a–b) even though the addressees in these examples have expressed the negative bias that *too* requires: In (20a), A's use of *really* conveys that A believes the house is not haunted after all, and in (20b), B's rising declarative conveys that B does not believe that Dana can bake. The fact that *too* is not acceptable with these antecedents therefore cannot be accounted for by the requirement that the addressee be epistemically biased against *too*'s prejacent; thus refutational *too* must realize [REVERSE].

(20) a. **Context:** A and B are exploring an abandoned house that a friend told them was haunted. They look for evidence of paranormal activity but don't find any.
A: Is this house really haunted?
B: It is **(#too)**! $[\text{AGREE}, +]$

b. **Context:** A and B are discussing a birthday party that they are planning to host for their friend Cameron.
A: Dana volunteered to bake the cake.
B: (Really?) Dana can bake?
A: He can **(#too)**! $[\text{AGREE}, +]$

4. Proposal: A new polarity feature

I propose to account for refutational *too*'s sensitivity to addressee bias by introducing a new polarity feature, [REFUTE], which presupposes that the addressee is at least tentatively committed to the negation of the prejacent, in a sense to be made precise below.

Farkas and Bruce (2010) develop a pragmatic framework that treats discourse as a sequence of question and answer moves aimed at expanding the common ground, or body of information that interlocutors are jointly committed to. In doing so, they build on much previous work that represents context as a set of parameters that interlocutors have joint access to, à la Lewis's (1979) "conversational scoreboard". In their model of context, the discourse commitments of each interlocutor X are tracked by a set DC_X, similarly to earlier proposals such as Hamblin (1971) and Gunlogson (2008) that model each discourse participant's commitments separately. Following Roelofsen and Farkas (2015), I take DC_X to include all of the propositions that X has publicly committed to; then the intersection $\bigcap_X DC_X$ of the interlocutors' individual commitments is the common ground, i.e., the set of propositions to which the interlocutors are jointly committed (Stalnaker 1978).[8]

The other crucial component of context in Farkas and Bruce's model is the Table, which is a stack that defines the interlocutor's conversational goals. Discourse moves place sentences, along with their denotations, on the Table. A speaker can place a declarative on the Table in order to propose that it be added to the common ground; if the other interlocutors accept that proposal, it is added to their commitment sets. If a speaker instead places an interrogative on the Table, it serves as a Question Under Discussion that the interlocutors are expected to answer (cf. Ginzburg 1996; Roberts 2012).

I adopt this model of discourse as a starting point for the analysis, but as it stands it is not able to capture the kinds of weak bias that refutational *too* seems to be sensitive to. It would clearly be inadequate to analyze *too* as requiring the negation of its prejacent to be one of the addressee's public discourse commitments since, as shown in the preceding section, refutational *too* does not require the addressee to be *fully* committed to the negation of its prejacent. Alternatively, in view of Rudin's (2018) proposal that rising declaratives place their content on the Table without committing the speaker to anything, one might attempt to analyze refutational *too* as requiring the negation of its prejacent to be on the Table. If falling declaratives, rising declaratives, biased questions, and sentences with tag questions could all be taken to place the semantic content of their sentence radicals on the Table, then this would account for much of the behavior of refutational *too*. This cannot be right, however, because it would predict *too* to be licensed by the rising declaratives in (17d) and (20b). In order to precisely specify the presupposition of [REFUTE], then, Farkas and Bruce's 2010 framework needs to be enriched so that it can track propositions toward which interlocutors have publicly expressed a bias but not a full commitment.

This can be done by adopting Malamud and Stephenson's (2015) notion of "projected commitments". Projected commitments "represent the expected next stage of the conversation" (Malamud and Stephenson 2015: 288). As such, an interlocutor's projected commitment set includes propositions which that interlocutor believes (and therefore expects to commit to in

[8]Note that Farkas and Bruce (2010) define DC_X slightly differently, taking it to include only those commitments of X that are not shared by the other interlocutors.

the future) but wishes to delay committing to for some reason, such as uncertainty or politeness considerations. Malamud and Stephenson (2015) introduce projected commitments in order to characterize the effects of certain kinds of tag questions and rising declaratives. According to them, a speaker who utters the declarative with a rising-intonation reverse-polarity tag question in (21a) or the rising declarative in (21b) projects a commitment to the proposition that Sue likes licorice.[9]

(21) a. Sue likes licorice, doesn't she?
b. Sue likes licorice?

Malamud and Stephenson (2015) notate the set of projected commitments of an interlocutor A as DC_A^*, and they assume that the full commitments of A are also added to DC_A^* in addition to being added to the set DC_A of A's discourse commitments (so $DC_A \subseteq DC_A^*$).

In terms of projected commitments, then, the present proposal is that a particle with the [REFUTE] feature presupposes that the negation of the content of its prejacent is a member of the addressee's projected discourse commitments. The behavior of refutational *too* is then accounted for by taking it to be a [REVERSE, +, REFUTE] polarity particle, as shown in (22).

(22) **Proposal:** Refutational *too* is a polarity particle realizing the feature combination
$$[\textsc{reverse}, +, \textsc{refute}],$$
where [REFUTE] is a polarity feature carrying the following presupposition:
$$\neg[\![\text{prejacent}]\!] \in DC_{Ad}^*.$$

Though I borrow Malamud and Stephenson's (2015) notion of projected commitments, I remain agnostic toward their analysis of rising declaratives and tag questions. They propose that rising declaratives and tag questions both add a proposition to the speaker's projected commitments. However, as Farkas and Roelofsen (2017) point out, rising declaratives (such as (17d), for instance) can in fact convey a complete rejection of their contents, which suggests that the addition of a projected commitment is not a conventional effect of rising declaratives. The data in (17b) and (17c) seem to demonstrate that rising-intonation tag questions do not always give rise to projected commitments, either. I therefore do not assume any particular analysis of rising declaratives, tag questions, or any other sentence form, and the analysis proposed here does not depend on one. What I do assume is that any proposition p that a speaker publicly expresses any degree of belief in is immediately added to that speaker's projected commitment set. (And of course if the truth of p is entailed or presupposed by the speaker's utterance, then it is also added to the speaker's commitment set.)

It is worth pointing out that DC_A^* need not be limited to propositions that A sincerely believes. Conceptualizing the kind of bias that refutational *too* is sensitive to as a projected commitment allows us to abstract away from the addressee's actual doxastic state. Just as interlocutors can choose to take information for granted in conversation without actually believing it (see e.g. Stalnaker 1998), they can also make projected commitments in order to adopt biases for the purposes of the conversation that do not represent their actual beliefs.[10] For example, in (23),

[9]Note that Malamud & Stephenson also claim that, in addition to adding a proposition to the speaker's projected commitment set, rising declaratives signal the presence of a "metalinguistic issue" (see Ginzburg 2012). Fully characterizing the semantic contribution of rising declaratives lies beyond the scope of this paper, however, so I will not discuss metalinguistic issues here.
[10]Thanks to Ashwini Deo for pointing this out.

A suggests that B would not mind washing the dishes as a strategy for requesting that B wash the dishes. A thereby projects a commitment to the proposition that B does not mind washing the dishes even though A is well aware that B actually does mind. This licenses *too* in B's response even though B knows that A knows that B does not like to wash the dishes. Similarly, in (24), A projects a commitment to the proposition that B does not like cookies, which can only be interpreted as a joke since B knows that A knows that B likes cookies. Even though A cannot be taken to believe that B does not like cookies, *too* is licensed in B's response.

(23) **Context:** A is B's parent and often requires B to wash the dishes. B, a young child, hates doing the dishes and frequently complains to A about it.
A: You wouldn't mind washing these dishes, would you?
B: I would **too**!

(24) **Context:** A made cookies for B because A knows that B likes cookies. B knows that A knows that B likes cookies.
A: (teasing) I made some cookies today, but you don't like cookies, do you?
B: I do **too**!

In the literature on rising declaratives and tag questions, there are a number of other notions besides projected commitments that have been proposed to analyze the discourse effects of those sentence forms and which might offer alternative ways to model the kind of bias to which refutational *too* is sensitive. I now briefly explore two of these possibilities—Gunlogson's (2008) "contingent commitments" and Farkas and Roelofsen's (2017) set of "evidenced possibilities"—before dispensing with them in favor of projected commitments for the present analysis.

Gunlogson's (2008) contingent commitments are commitments that a speaker incurs only if the addressee makes the same commitment. In other words, they are commitments that are contingent on the addressee's ratification and will be withdrawn if the addressee does not ratify them. For example, according to her, Max's commitment to the proposition that Laura got a haircut in (25) is contingent on Laura's confirmation of that fact.

(25) **Context:** Laura has just entered the room, where Max sees her for the first time that day.
Max: You got a haircut?

Contingent commitments are similar to projected commitments in that they are more tentative that actual commitments. However, not all of the antecedents that license refutational *too* seem to give rise to contingent commitments: In (19b), A's utterance of *Maybe Mary isn't home* does not seem to be soliciting B's confirmation that Mary is not home, so it is not clear that A's suggestion that Mary is not home will be withdrawn if B does not confirm it. For example, B could respond by saying *Yeah, maybe not*, which would neither confirm nor deny that Mary is not home. This would neither result in *Mary isn't home* being added to the interlocutors' commitments nor result in A's tentative commitment being withdrawn. Instead, both interlocutors would be tentatively committed to Mary not being home, which can be modeled by taking *Mary is not home* to be a member of both interlocutors' projected commitment sets. There is no obvious way to characterize this kind of situation in terms of contingent commitments.

Farkas and Roelofsen (2017) propose yet another analysis of rising declaratives and tag questions, arguing that one of their effects is to add their contents to a set of propositions that the speaker has evidence for. Could *too* be analyzed as requiring the negation of its prejacent to be in the addressee's set of evidenced possibilities? This would make correct predictions about the dialogues in (19). According to Farkas & Roelofsen's conception of evidence, however, the context in (17d) provides evidence (namely the student's assertion) that Marseille is the capital of France (cf. Farkas and Roelofsen 2017: example 56). They thus correctly predict that rising declaratives are licensed in such contexts, which is an advantage over Malamud and Stephenson's (2015) account since rising declaratives do not give rise to projected commitments in these contexts (as discussed above). The fact that refutational *too* is not licensed in (17d) is evidence that *too* is sensitive to projected commitments, not evidenced possibilities.

5. Conclusion

This paper has argued that refutational *too* is a $[\textsc{reverse}, +]$ polarity particle, but that it bears an additional polarity feature that has not been identified in previous work on response particles: $[\textsc{refute}]$, which requires the addressee to have a projected commitment to the negation of its prejacent. This raises the question of whether other languages also have $[\textsc{refute}]$ particles, and if so, whether $[\textsc{refute}]$ can be realized in other feature combinations besides $[\textsc{reverse}, +, \textsc{refute}]$. Future cross-linguistic investigation can search for particles that realize the feature combinations $[\textsc{reverse}, -, \textsc{refute}]$, $[\textsc{agree}, +, \textsc{refute}]$, and $[\textsc{agree}, -, \textsc{refute}]$. Some English speakers may in fact have a $[\textsc{reverse}, -, \textsc{refute}]$ particle: refutational *either*. Refutational *either* seems to be much less widespread among English speakers than refutational *too*, and I have no intuitions about its meaning. It has, however, been previously documented by Rullmann (2003), and naturally-occurring examples such as (26) can be found in COCA.

(26) A: It's the Callaway house. Nobody's lived there for years. It's haunted.
B: It isn't **either**! (COCA)

The existence of $[\textsc{refute}]$ also opens the possibility of an opposing feature, $[\textsc{confirm}]$, which would presuppose that its prejacent is a member of DC^*_{Ad}. Future work can also determine whether there are polarity particles that realize $[\textsc{confirm}]$ and if so, what feature combinations $[\textsc{confirm}]$ can occur with.

Another topic for future research is the relationship between the additive and refutational uses of *too*. One clear similarity between the two uses is the fact that they both signal that the speaker takes a previously addressed Question Under Discussion to still be open, in the additive case because they wish to add additional information relevant to the issue, and in the refutational case because they wish to reject information provided by an interlocutor (see Beaver and Clark 2008 and Theiler 2019 for QUD-based analyses of additive particles). The bridging contexts identified by Schwenter and Waltereit (2010) suggest a pathway for the reanalysis of additive *too* as a response particle. An illustrative example is shown in (27), which Schwenter and Waltereit (2010) draw from the 1871 novel *The American Baron* by James de Mille. Here *but he did too* could be interpreted either as denying *It was [...] not this one* (a refutational interpretation) or as claiming that both the Italian and the American saved A's life (an additive interpretation). Schwenter and Waltereit (2010) suggest that refutational *too* could have resulted from the reanalysis of additive *too* in this kind of context.

(27) A: The American$_j$ saved my life.
B: It was the Italian$_i$ that saved your life, you know, not this one$_j$.
A: But he$_j$ did **too**. (Schwenter and Waltereit 2010)

However, it is not clear how refutational *too* would have acquired its particular sensitivity to addressee bias (i.e., the [REFUTE] feature) through this reanalysis rather than simply becoming a [REVERSE, +] particle. Further explication of the semantic relationship between the two uses is therefore needed. Typological work can also investigate whether additive particles have a cross-linguistic tendency to develop refutational uses over time.

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Proleptic constructions in Modern Greek[1]

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Abstract. We investigate the semantics of an attitudinal construction in Modern Greek, where an attitude verb may take an accusative object followed by a CP (e.g. 'Maria wants Yanis.ACC$_i$ [$_{CP}$ *pro$_i$* only love her]'). Drawing on literature (Kotzoglou 2002; Kotzoglou and Papangeli 2007; Kotzoglou 2017) arguing that the accusative object is base-generated in the matrix clause, we propose that this is an instance of prolepsis. Importantly, unlike proleptic constructions described in other languages, the proleptic object can have *de dicto* readings, despite being base-generated in the matrix clause. We propose an analysis in terms of semantic lowering, along the lines of Dawson and Deal (2019), arguing that semantic lowering is not restricted to extensional, but can also apply to intensional types of pronouns. Finally, we describe an additional semantic restriction on the proleptic object, as well as the implications of the Modern Greek case for the broader function of prolepsis and the syntax-semantics interface.

Keywords: prolepsis, quasi-ECM, *de dicto*, *de re*, semantic lowering, causal constructions

1. Introduction

It has been observed that some languages have specific ways of marking that an attitude report has only a *de re* (e.g. Madurese (Davies 2005), German (Salzmann 2017a), Nez Perce (Deal 2018)) or a *de re* and a third reading (e.g. Tiwa (Dawson and Deal 2019)). This is done via *prolepsis*, which Salzmann (2017a) defines as "a construction where a structural complement of the matrix verb is semantically related to the predicate of the embedded clause without there being an obvious movement relationship". Here is an example from German (Salzmann 2017a), where *einem Mädchen* 'a girl' is base-generated in the matrix clause, and is repeated by the pronoun *es* 'her' in the complement clause (henceforth CP):[2]

(1) **Von einem Mädchen** weiss ich, dass Peter es geküsst hat.
Of a-DAT girl know-1SG-PRES I COMP Peter her kiss-PTCP have-3SG
'Of a girl, I know that Peter kissed her.'

This sentence only has a *de re* reading, according to which there exists a specific girl that I know Peter kissed. For example, I may know that Peter kissed Anne. It cannot have a reading according to which Peter kissed a girl but I don't know which. Similar constructions have been described for Nez Perce (Deal 2018) and Tiwa (Dawson and Deal 2019) – but in Tiwa they have an additional reading apart from the classic *de re* proleptic reading of German; they also have a third reading. Here is the crucial example:[3]

[1]I sincerely thank Amir Anvari, Amy Rose Deal, Kai von Fintel, Martin Hackl, and David Pesetsky for the very insightful comments and support with this project. Thanks also to Virginia Dawson for sharing with me her Tiwa data. Finally, I would like to thank the audience at *Sinn und Bedeutung* and MIT's *LFRG* reading group.

[2]For clarity, all proleptic arguments will be boldfaced. In this example, we could also have the verb "expect" *erwarte* (Martin Hackl, p.c.), which is also proleptic in Modern Greek (to have a more minimal cross-linguistic comparison). However, we should note that *erwarte* may trigger generic readings (Kai von Fintel, p.c.).

[3]Notice that the verb used in the Tiwa examples in this paper is *think*, but Dawson and Deal (2019) note that the process is very productive, and the generalizations extend to most attitude verbs. Although Ingria (1981) argues that *think* in MG is felicitous in this construction, we do not share this judgment. However, a minimal comparison can also be made with Tiwa (like with German) since the verbs *know, believe,* and *remember* can do prolepsis in both languages. Below is the relevant Tiwa example (Virginia Dawson, p.c.):

(3) *Mukton does not want to go outside.*
pro$_j$ **kishá khódo-gô**$_i$ atkhâl lá-ga, [*pro*$_i$ pe-go$_j$ chi-w honmandé]
3SG one mosquito-ACC think PFV 3SG 3SG-ACC bite-NEUT COMP
'He thinks a mosquito will bite him.'

This is a third reading, because there is no specific mosquito Mukton thinks will bite him. So, the quantificational force of the quantifier "a mosquito" scopes beneath the attitude verb. Yet, this is not a *de dicto* reading, since Mukton is committed to the existence of mosquitoes in the actual world. In fact, Dawson and Deal (2019) show that proleptic constructions in Tiwa cannot have *de dicto* readings:[4]

(4) *Tonbor is not very smart. He doesn't know that dogs can't be green.*
#Tonbor **kishá khódang-shór khúgri-gô**$_i$ atkhâl lá-ga, [Lastoi *pro*$_i$ pre-ga honmandé]
Tonbor one green dog-ACC think-PFV Lastoi 3SG buy-PFV COMP
Intended: 'Tonbor thinks that Lastoi bought a green dog.'

Therefore, proleptic constructions in Tiwa have either a *de re* or a third reading. What is common among the proleptic constructions described so far is that the *de dicto* reading is impossible. This justifies, in a sense, the existence of a specific construction that marks *de re* (in the case of Madurese, German and Nez Perce) or non-*de dicto* (in the case of Tiwa).

Modern Greek (henceforth MG) displays certain attitudinal constructions where an attitude verb may take an accusative object (henceforth ACC DP) followed by a CP. Hadjivassiliou et al. (2000); Kotzoglou (2002) dub this the "quasi-ECM" construction. Here is the basic pattern:[5]

(6) I Maria theli **ton Yani** [na aghapai mono aftin].
The.NOM Maria.NOM want.PRS the.ACC Yani.ACC [SBJV love only her.ACC]
'Maria wants Yanis to only love her.'

Crucially, there is a counterpart of "quasi-ECM" where the DP is in the CP and bears NOM case:[6]

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(2) Sonali **Mansing-go**$_i$ si-ga/ nol-ga/ khósoi mán-ga, [*pro*$_i$ lí-ga honmandé]
Sonali Mansing-ACC know-PFV/ believe-PFV/ remember-PFV 3SG go-PFV COMP
'Sonali knows/believes/remembered that Mansing went.'

[4]Throughout the paper we mark the hypothesized CP boundaries with brackets.

[5]We follow Philippaki-Warburton (1994) in treating *na* as a subjunctive mood marker rather than a complementizer, and therefore gloss it accordingly. However, note that the syntactic status of the *na* particle is not crucial for our analysis and that some of the verbs compatible with this construction in MG can also take indicative *oti*-clauses (Joseph 1976; Philippaki-Warburton 1987; Theophanopoulou-Kontou et al. 1998; Kotzoglou 2017), where the status of *oti* as a complementizer is more clear:

(5) a. Ksero tin Maria [oti ine kali mathitria].
Know.PRS the.ACC Maria.ACC [COMP be.PRS good.FEM student.FEM]
'Of Maria, I know that she is a good student.'

b. Perimename tin Eleni [oti tha eksorjisti].
Expect.PRS the.ACC Eleni.ACC [COMP will be-furious]
'We expected that Eleni will be furious.'

[6]Here, the NOM DP can be in post-verbal position too, but as Roussou (2010) notes it can also appear in SpecCP

(7)

I	Maria	theli	[o	Yanis	na	aghapai	mono	aftin].
The.NOM	Maria.NOM	want.PRS	[the.NOM	Yani.NOM	SBJV	love	only	her.ACC]

'Maria wants Yanis to only love her.'

This paper argues that "quasi-ECM" as in (6) is a proleptic construction, and investigates its semantics. Firstly, we motivate a proleptic analysis, showing that the ACC DP is base-generated in the matrix clause, while the NOM DP is part of the embedded clause. Secondly, we observe that, despite the fact that prolepsis cross-linguistically marks a *de re* or a non-*de dicto* reading, in MG it gives rise to *de dicto* readings as well. In other words, despite base-generation in the matrix clause, both low-scope and opaque readings of the proleptic object, i.e., the ACC DP, are allowed. So, MG is like Tiwa except that it can also have *de dicto* readings. We further argue that MG proleptic constructions impose an additional semantic requirement on the ACC DP, which we formalize in terms of causality. Finally, we extend the analysis of Dawson and Deal (2019) to account for *de dicto* readings as well as the causal requirement present in MG.

We should note that the process is more productive than in Nez Perce for example, where it is only possible with verbs meaning 'think' and 'know' (Deal 2018), but less productive than in Tiwa, where it can reproduce with any attitude verb. The verbs that are felicitous with this construction are *thelo* (want), *perimeno* (expect), *pistevo* (believe), *theoro* (consider), *ipologhizo* (estimate), *ksero* (know), *thimame* (remember) and -at least for Ingria (1981), although the judgment may vary across speakers- *nomizo* (think).[7] The class of proleptic verbs and the productivity of prolepsis varies cross-linguistically. Even though it most likely involves verbs of cognition, specifying one's mental state about an entity that is the proleptic object, we will not attempt to characterize this verb class here – we highlight this as an open theoretical question.

2. Syntactic Position of the ACC DP

We treat "quasi-ECM" like prolepsis, as opposed to object control (Kotzoglou 2002; Kotzoglou and Papangeli 2007; Kotzoglou 2017). In prolepsis, we have an object of the matrix verb that is base-generated in the matrix clause, but is semantically related to an argument of the embedded clause by co-reference. We advocate for a proleptic instead of an object control analysis, because, contrary to what is usually assumed in the literature, given the right context, the *pro* in the embedded clause that is co-referential with the ACC DP can be in object position:

(8) *Yanis is a political activist and part of an organization run by me. I want to raise awareness about it and I think that getting someone arrested will give us some publicity to this end.*

Thelo	**ton**	**Yani**$_i$	[na	*ton*$_i$	silavi	i	astinomia].
Want.PRS	the.ACC	Yani.ACC	[SBJV	*him.*ACC	arrest	the.NOM	police.NOM]

'I want the polirce to arrest Yanis.'

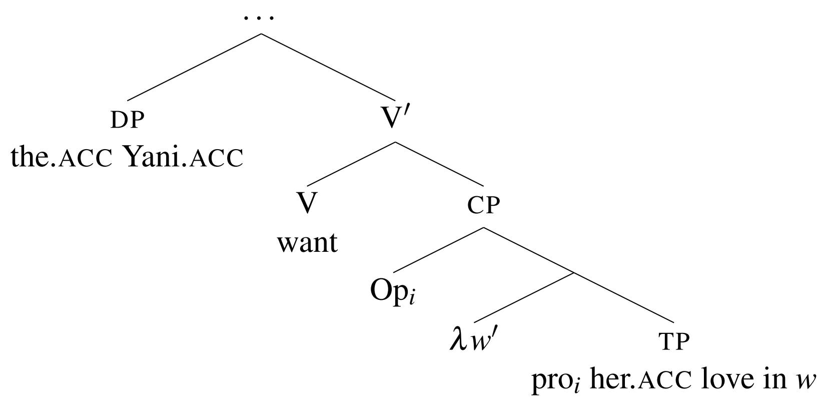
In fact, in this case, we see the *pro* overtly realized in the embedded clause as an ACC-marked pronoun *ton* 'him.ACC', since MG has subject- but not object-*pro*-drop (Papangeli 2000). Given that the embedded *pro* co-referential with the ACC DP can be both in subject and object positions

in a topicalized or focused position. We chose the SpecCP position in our examples to create a minimal pair with the ACC DP, which can only be in the object position of the matrix clause.

[7]We note that this is a non-exclusive list of verbs. Additionally, some of them take *na*-clauses, some *oti*-clauses, and some can take both.

in the CP, we conclude that this is an instance of prolepsis. We thus assume the following syntax for (6):[8]

(10)



Kotzoglou (2002); Kotzoglou and Papangeli (2007); Kotzoglou (2017) provide considerable evidence that the ACC DP is base-generated in the matrix clause. In this section, we survey some of their arguments, as well as provide some new ones, arguing that the ACC DP (a) is in the matrix clause, and (b) that it cannot have moved there.[9] From this, we will conclude that the ACC DP is base-generated in the matrix clause and given that it can be co-referential with a *pro* either in subject or in object position in the CP, it is a proleptic construction.

2.1. Prepositional Phrases

Kotzoglou (2002) notes that Prepositional Phrases (henceforth PPs) can intervene between the ACC DP and the CP. In this case, there are two available parses for the PP: it can either modify the matrix verb as in (11a) or the embedded one as in (11b), where the PP occupies a topicalized or focused position in the left periphery. Crucially, the meaning changes; the habit ends up being the son's (11a) or the father's (11b) accordingly.

[8]Two comments about the proposed syntax. Firstly, note that we derive the attested word order by V-to-I movement. Secondly, we posit a base-generated clause-edge abstractor, following Dawson and Deal (2019) (and unlike Salzmann (2017b) who argues that *pro* itself creates the abstraction by moving to the edge of the CP), because in MG as in Tiwa (Dawson and Deal 2019) and Nez Perce (Deal 2018) the embedded CP is not an island environment. Here is some evidence from long-distance scrambling:

(9) 'Yanis wants Zoi to give flowers to Christos.'

a.	O	Yanis	theli	**ti**	**Zoi**	[na	dhosi	luludhia	ston	Christo].
	The.NOM	Yani.NOM	want.PRS	the.ACC	Zoi.ACC	[SBJV	give	flowers	to-the.ACC	Christos.ACC].
b.	Ston	Chtisto	o	Yanis	theli	**ti**	**Zoi**	[na	dhosi	luludhia *t*].
	To-the.ACC	Christos	the.NOM	Yani.NOM	want.PRS	the.ACC	Zoi.ACC	[SBJV	give	flowers *t*]

[9]The ACC DP gets its case from the matrix verb. Kakouriotis (1980) argues for a systematic ambiguity of these verbs, which can have either a raised object or a non-raised direct object and a sbjvunctive CP. Philippaki-Warburton and Spyropoulos (1996); Hadjivassiliou et al. (2000) argue that the ACC DP is base-generated at SpecCP and is co-referential with a *pro* inside the VP. Pratt (2011) additionally argues that the ACC DP has to be focused at SpecCP (see Kotzoglou (2017) for problems with this account). The crucial part of our syntactic argument will thus be that the ACC DP could not have raised to and thus is instead base-generated in the matrix clause.

(11) a. Ithele **ton** **patera** **tu** apo sinithia [na tu lei kathe
Want.PST the.ACC father.ACC he.GEN by habit SBJV he.GEN say every
mera ke ena dhiaforetiko paramithi].
day and a.ACC different.ACC fairy-tale.ACC
'By habit, he wanted his father to read to him a different fairy tale every day.' (son's)

b. Ithele **ton** **patera** **tu** [apo sinithia na tu lei kathe
Want.PST the.ACC father.ACC he.GEN by habit SBJV he.GEN say every
mera ke ena dhiaforetiko paramithi].
day and a.ACC different.ACC fairy-tale.ACC
'By habit, he wanted his father to read to him a different fairy tale every day.' (father's)

Thus, given that the ACC DP can precede a PP modifying the matrix verb as in (11a), it has to be part of the matrix clause – since the PP on its right is. By contrast, when the DP surfaces in NOM, everything on its right has to be part of the embedded clause. Thus, if it precedes the PP, only one interpretation is possible, namely the PP has to modify the embedded verb as in (12):

(12) Ithele [o pateras tu apo sinithia na tu lei kathe mera
Want.PST the.NOM father.NOM he.GEN by habit SBJV he.GEN say every day
ke ena dhiaforetiko paramithi].
and a.ACC different.ACC fairy-tale.ACC
'By habit, he wanted his father to read to him a different fairy tale every day.' (father's)

This shows that contrary to the ACC DP, the NOM one is part of the embedded clause and everything on its right has to be part of it too. As a control, notice that if the PP precedes the NOM DP, the sentence is ambiguous between a matrix and an embedded attachment of the PP:

(13) a. Ithele [apo sinithia o pateras tu na tu lei kathe
Want.PST by habit the.NOM father.NOM he.GEN SBJV he.GEN say every
mera ke ena dhiaforetiko paramithi].
day and a.ACC different.ACC fairy-tale.ACC
'By habit, he wanted his father to read to him a different fairy tale every day.' (father's)

b. Ithele apo sinithia [o pateras tu na tu lei kathe
Want.PST by habit the.NOM father.NOM he.GEN SBJV he.GEN say every
mera ke ena dhiaforetiko paramithi].
day and a.ACC different.ACC fairy-tale.ACC
'By habit, he wanted his father to read to him a different fairy tale every day.' (son's)

This test shows that the ACC DP is part of the matrix clause, since it can have matrix clause material on its right. The contrary holds for the NOM DP, which necessarily marks a clause boundary; it is part of the embedded clause and anything on its right has to be part of it too.[10]

[10]There are other arguments that the ACC DP is part of the matrix clause, which do not have the space to elaborate on here. For example, even though a CP can be doubled in MG by the clitic pronoun *to* "it", this is not possible when there is an ACC DP in the higher clause (Hadjivassiliou et al. 2000; Kotzoglou and Papangeli 2007); instead the clitic has to double the ACC DP, agreeing with it in case. Thus, the ACC DP is an argument of the matrix verb.

2.2. Negative Polarity Items

Another argument showing that the ACC DP is in the matrix clause comes from Negative Polarity Item (henceforth NPI) licensing. It appears that when the ACC DP is an NPI, it cannot be licensed by the negation in the CP; but when the NOM DP is an NPI, it is licensed by the CP negation. Here is the minimal pair (Kotzoglou 2002):

(14) a. *Me tetia siberifora perimena **KANENA** [na mi me
With such.ACC behavior.ACC expect.PST nobody.ACC SBJV NEG me.ACC
proslavi sti dhulia tu].
hire in-the job he.GEN
Intended: 'With such a behavior, I expected nobody to hire me at their job.'

b. Me tetia siberifora perimena [KANIS na mi me
With such.ACC behavior.ACC expect.PST nobody.NOM SBJV NEG me.ACC
proslavi sti dhulia tu].
hire in-the job he.GEN
'With such a behavior, I expected nobody to hire me at their job.'

The NPI in (14b) is part of the embedded CP, having moved to its left periphery; it can reconstruct for licensing within its clause. However, the NPI in (14a) cannot be licensed in the same way, suggesting that it is not part of the embedded clause. Instead, a matrix clause negation is needed to license it. As a control, we should add that an NPI that has moved to the left periphery in the embedded CP can reconstruct for licensing:

(15) Me tetia chrimatodhotisi perimena [KANENA na mi proslavun *t*].
With such.ACC funding.ACC expect.PST nobody.ACC SBJV NEG hire.3PL *t*
'With such funding, I expected them to hire nobody.'

So, the fact that (14a) does not reconstruct, shows us that it is part of the embedded clause. However, we should note that this does not yet exclude the possibility that the ACC DP moved into the matrix clause. Indeed, Tsimpli and Roussou (1996) provide the following example, where an NPI moves into the matrix clause and fails to be licensed:

(16) *TIPOTA apofasisa [na mi fao *t*].
nothing decide.PST.1SG SBJV NEG eat *t*
Intended: 'I decided not to eat anything.'

The NPI data show us that the ACC DP is part of the matrix clause. Indeed, had it been part of the embedded clause as in (15) or (14b), it would have reconstructed for licensing. Thus, so far, we have proven that the ACC DP is part of the matrix clause; but we have not yet excluded the possibility that it may have moved there.

2.3. Absence of reconstruction

We have shown that the ACC DP is part of the matrix clause. This could be because (a) it was base-generated as an argument of the matrix verb, or (b) it moved to that position from the lower clause. We provide evidence in favor of a base-generation in the matrix clause approach and against a raising analysis. Had the ACC DP moved from the embedded CP, it would have left a trace. Thus, it should be able to reconstruct at the position of the trace for interpretation purposes whenever other moved elements are able to do so. We will precisely show that no such reconstruction effects are attested, attributing this fact to the absence of a trace. We provide data from anaphor licensing and scope reconstruction.

First, Kotzoglou (2002) shows that the anaphor *o idhios* 'himself' can only be bound in the NOM case in the following example:

(17) I Yana$_i$ theli *tin idhia$_i$ /[i idhia$_i$ na aponimi
The.FEM Yana want.PRS the.ACC same.ACC / the.NOM same.NOM SBJV award
ta metalia].
the.NEUTER.PL medal.NEUTER.PL
'Yana wants to award the medals herself.'

Crucially, this is a long-distance anaphor and by putting it in the ACC, we force it to be in the same clause as its licensor. Thus, the result is ungrammatical. However, when it is in NOM it is part of the CP, thus being licensed by virtue of being in a different clause than its antecedent. Note that anaphors in general reconstruct for licensing.[11] Therefore, the ACC DP not reconstructing shows that there is no place in the CP where it could reconstruct, i.e., no trace. We conclude that there cannot be a raising derivation, since reconstruction is not possible.

A similar argument can be made for scope. Kotzoglou (2017) notes that for many speakers inverse scope interpretations are possible with quantificational subjects or objects:

(20) enas ipurghos episkeftotan kathe poli tis eladhas
a.NOM minister.NOM visit.PST.3SG every city the.GEN Greece.GEN
'A minister was visiting every city of Greece.'

This sentence has both surface scope (i.e., there is a minister that was visiting every city) and inverse scope (i.e., for every city, there is a minister that is visiting it). However, Kotzoglou (2017) observes that we do not get inverse scope readings with "quasi-ECM", even if the context forces this interpretation:

(21) sto parti perimena **enan filo mu** [na fai kathe
at-the party expect.PST.1SG a.ACC friend.ACC mine.GEN SBJV eat every
tiropitaki].
cheese-pie.DIM.ACC
'In the party, I expected a friend of mine to eat every cheese pie.'

This sentence only has a surface scope interpretation (i.e., there is a friend whom I expected to eat everything). If inverse scope is the result of reconstruction to a lower copy position, then the lack thereof constitutes an argument for the lack of such a copy/trace position inside the CP. Therefore, we see that in the construction in question (a) anaphors do not reconstruct for

[11] For example, the anaphor *o eaftos tis* 'her self' is licensed in the CP where its trace is located:

(18) O eaftos$_i$ tis archizi [na tin$_i$ apoghoitevi t_i].
The.NOM self.NOM hers begin.PRS SBJV she.ACC disappoint t
'She is starting to disappoint herself.'

By contrast, when the pronoun does not c-command the trace, the anaphor is not licensed:

(19) *O eaftos$_i$ tis archizi [na apoghoitevi [ton adherfo tis$_i$] t_i].
The.NOM self.NOM hers begin.PRS SBJV disappoint the.ACC brother.ACC hers t
Intended: 'She is starting to disappoint her brother.'

licensing, and (b) we do not get inverse scope readings when the ACC DP is quantificational. We thus conclude that the absence of reconstruction effects is due to the absence of a trace in the CP, where the DP could have been interpreted. We argue instead that the ACC DP has not moved, but is base-generated in the matrix clause, being co-referential with a *pro* in the CP.

2.4. Coordinated DP island

Another argument against a movement approach comes from coordinated DP islands. We argue that the pronoun linked to the ACC DP can be inside a coordinated DP island:

(22) *Maria's dad usually does not like to meet her boyfriends, but yesterday he was drank and he wanted Maria and her boyfriend to come for dinner some day. Today, he sobered up and changed his mind again.*

O	babas	tis	ithele	chtes	**ti**	**Maria**$_i$	/[*i		Maria$_i$
The.NOM	dad.NOM	hers	want.PST	yesterday	the.ACC	Maria	/	the.NOM	Maria.NOM

na	erthi	**afti**$_i$	kai	to	aghori	tis	jia	fajito	mia	mera].
SBJV	come	she.NOM	and	the.NOM	boy.NOM	hers	for	food	one	day

'Her dad wanted yesterday Maria and her boyfriend to come for dinner one day.'

The DP is good in the ACC, but not in the NOM. The fact that the ACC DP can be co-referential with a pronoun inside an island environment, out of which it cannot move/raise, suggests that the ACC DP is base-generated in the matrix clause instead of moving there from a lower position in the CP. On the contrary, the NOM DP, which moves out of the coordinated DP island to SpecCP, is ungrammatical. This shows that, when the pronoun in the CP is in an island environment, the ACC DP is still felicitous, suggesting that the relationship between the ACC DP and *pro* in the CP is only one of co-reference. In other words, the ACC DP does not have a trace of movement in the CP, since it is licensed even when movement is impossible.

2.5. Unavailability of idiomatic readings

Another argument in favor of base-generation in the matrix clause and against a raising analysis comes from idiomatic readings. If the ACC DP was raised, we would expect idioms to be fine, since there would be no extra theta role assignment, as in the following English examples:

(23) a. The shit has hit the fan.

b. I expected the shit to have hit the fan.

But, if there is no movement of the ACC DP and there are rather two syntactically independent clauses, we would expect idioms to be ungrammatical, as in control cases in English:

(24) *I persuaded the shit to hit the fan.

Indeed, the construction in question in MG patterns with control in this case, as shown by the following data from Kotzoglou and Papangeli (2007):

(25) a. perimena **#psilus** /[psili na tu bun st' aftia].
expect.PST.1SG fleas.ACC / fleas.NOM SBJV he.GEN get.3PL in-the ears
'I expected fleas to get into his ears (I expected him to become suspicious).'

b. me afta pu eleghe perimena **#ton dhjaolo** /[o
with these COMP say.PST.3SG expect.PST.1SG the.ACC devil.ACC the.NOM
dhjaolos na ton pari].
devil.NOM SBJV him take.3SG
'With the things he said I expected the devil to take him (i.e., him to be destroyed).'

The unavailability of the idiomatic reading suggests that the matrix clause and the CP are syntactically independent and that the ACC DP is not a raised object, but rather a base-generated one, which receives a theta role from the matrix verb.

2.6. Interim Summary

We have have argued (a) that the ACC DP is syntactically part of the higher clause (see PP and NPI behavior), and (b) that it was base-generated there (see absence of reconstruction effects, no sensitivity to islands, no idiomatic readings). What is more, we have mentioned that the ACC DP is co-referential with a pronoun in the subject or object position in the embedded clause.

When in subject position, because of *pro*-drop, it is often a *pro*; but when it is in object position, it is necessarily overt (see (8)). In fact, further evidence for a *pro* in subject position comes from the fact that it can be modified by an emphatic modifiers/intensifiers, obligatorily in NOM (Philippaki-Warburton and Spyropoulos 1996; Kotzoglou and Papangeli 2007):

(26) I epitheorites ithelan **ton Yani** [na lisi monos
The.NOM inspectors.NOM want.PST.PL the.ACC Yani.ACC SBJV solve alone.NOM
/*mono tu to provlima].
/ alone.ACC he.GEN the.ACC problem.ACC
'The inspectors wanted Yanis to solve the problem on his own.'

Kotzoglou and Papangeli (2007) argue that since modifiers cannot appear in isolation with their own case, they must agree with a covert *pro* which assigns NOM to the emphatic modifier; the *pro* is co-indexed with the ACC DP, which gets its case from the matrix verb. In fact, the *pro* can sometimes be overt, such as when it appears in a coordinated DP (see (22)) or when it is focused:[12]

(27) Perimena/Ithela **ton Yiani** [na erthi *AFTOS* spiti]. Ochi na stili
Wait.PST/want.PST the.ACC Yianis.ACC SBJV come he.NOM home. NEG SBJV send
tin gramatea tu.
the.ACC secretary.ACC he.GEN
'I was expecting/wanted Yianis to come home himself. Not to send his secretary.'

Therefore, we can conclude that the ACC DP behaves like a proleptic object: it is base-generated in the matrix clause, and is co-referential with a (sometimes covert) pronoun in the embedded clause in subject or object position. Thus, we treat this pattern as an instance of prolepsis, as studied in Madurese (Davies 2005), German (Salzmann 2017a), Tiwa (Dawson and Deal 2019),

[12] Ingria (1981) argues that the pronoun can be in general overt, but it is more felicitous with contrastive focus.

and Nez Perce (Deal 2018). In what follows we investigate the semantics of this construction, arguing that the ACC DP can have both low-scope and opaque readings, despite base-generation in the matrix clause.[13]

3. Semantic Interpretations

3.1. Availability of *de dicto* readings

In the previous section, we showed that the MG construction in question is an instance of prolepsis, arguing that the ACC DP is base-generated in the matrix clause and is co-referring with a *pro* in the CP. The ACC DP is therefore structurally outside of the scope of the attitude verb, which correlates with a *de re* reading of proleptic objects in many languages (e.g. Madurese (Davies 2005), German (Salzmann 2017a), Nez Perce (Deal 2018)). In other words, the speaker is committed to the existence of a specific referent for the ACC DP, which has obligatory wide scope. However, third readings of proleptic objects have been described for Tiwa (Dawson and Deal 2019), where the quantifier of the ACC DP can scope under the attitude verb in (3), repeated here for reference:

(28)

Mukton$_j$	payâr-jíng	lína	mon	cha.	*pro*$_j$	kishá	khódo-gô$_i$	atkhâl-lá-ga,
Mukton	outside-ALL	go-INF	desire	NEG	3SG	one	mosquito-ACC	think-PFV

[*pro*$_j$	pe-go$_j$	chi-w	honmandé]
3SG	3SG-ACC	bite-NEUT	COMP

‘Mukton does not want to go outside. He thinks a mosquito will bite him.’

Dawson and Deal (2019) show that this is a low-scope transparent, i.e. a third, reading, since there need not be any specific mosquito Mukton has a belief about (low-scope); yet the mosquitoes cannot simply exist in the belief worlds, but have to exist in the a actual world (transparent). Crucially, as shown in (4), repeated here for reference, proleptic objects in Tiwa cannot be read opaquely – they commit the speaker to their existence in the actual world:

(29) *Tonbor is not very smart. He doesn’t know that dogs can’t be green.*

#Tonbor	**kishá**	**khódang-shór**	**khúgri-gô**$_i$	atkhâl	lá-ga,	[Lastoi	*pro*$_i$	pre-ga
Tonbor	one	green	dog-ACC	think	PFV	Lastoi	3SG	buy-PFV

honmandé]
COMP

Intended: ‘Tonbor thinks that Lastoi bought a green dog.’

This cross-linguistic picture suggests that proleptic objects have to be interpreted transparently, in all languages described so far. We take issue with this claim, arguing that proleptic objects in MG can have both a low-scope and opaque, i.e. a *de dicto*, reading. In addition to this, it may also have a *de re* or a *third* reading, like in Tiwa.

More concretely, even though the ACC DP is base-generated in the matrix clause, both low-scope and opaque readings are allowed. This is puzzling since the DP can be interpreted semantically at a different clause than the one where it was base-generated syntactically. We see a *de dicto* reading in (30):

[13] One could argue for a prolpetic analysis whenever the ACC DP is interpreted *de re* and a raising one whenever it is interpreted *de dicto*. However, all the syntactic arguments we gave for prolpesis can be reproduced with sentences targeting a *de dicto* interpretation. Therefore, the ACC DP is a proleptic object under every interpretation.

(30) *Little Petros is in kindergarten and he and his friends believe that green dogs exist. One day they are talking about green dogs and Petros bets that exactly three of them will show up at his party.*

O	Petrakis	theli	akrivos	**tris**	**prasinus**	**skilus**
The.NOM	Petros.DIM.NOM	want.PRS	exactly	three.PL	green.ACC.PL	dog.ACC.PL

[na	erthun	sto	parti].
SBJV	come	in-the	party

'Little Petros wants exactly three green dogs to come to the party.'

This attitude report does not commit the speaker to the existence of green dogs; in Fodor's (1970) terms, the embedded subject is read *opaquely*. Alongside *de dicto* readings, classic *de re* readings (found in prolepsis in all languages that semanticists have studied to date) are also permitted, as shown in the following example:

(31) *Maria is on an apostolic mission in Egypt during the pandemic, while working remotely. She started this job during COVID and thus never got to meet her colleagues, Yanis and Christos. It just so happens that Yanis and Christos are also in Egypt and Maria has met them without knowing they are her colleagues. She tried to convince them to become Catholic.*

I	Maria	theli	**kathe**	**tis**	**sinadhelfo**	[na	ine	katholikos].
The.NOM	Maria	want.PRS	every.ACC	she.GEN	colleague.ACC	SBJV	be	catholic.NOM

'Maria wants every colleague of hers to be Catholic. '

Finally, just like Dawson and Deal (2019) describe for Tiwa, proleptic objects in MG may have low-scope, third readings. However, this is not surprising, given that MG has both *de dicto* and *de re* readings and that the third reading is a combination of the two. Consider the following:

(32) *Zoi is attending a 100m race at the Olympics. Three contestants are talking to each other before the start. Unbeknownst to Zoi, these three contestants are my friends. She thinks to herself that she wants one of those three people to win the race, because they seem motivated.*

I	Zoi	theli	**enan**	**filo**	**mu**	[na	kerdhisi	ton	aghona].
The.NOM	Zoi	want.PRS	a.ACC	friend.ACC	mine	SBJV	win	the.ACC	race.ACC

'Zoi wants a friend of mine to win the race.'

This is an instance of a third reading, because the quantifier has low-scope but its restrictor is interpreted transparently. Zoi does not have any beliefs about friends of mine, but these people she has a belief about have to exist in the evaluation world.

Thus, we have shown that proleptic constructions in MG are especially interesting, since they show that proleptic constructions may also have *de dicto* readings. Based on Madurese, German and Nez Perce alone (Davies 2005; Salzmann 2017a; Deal 2018), we could have concluded that prolepsis is a designated road to *de re*; based on Tiwa (Dawson and Deal 2019), we would weaken our hypothesis saying that prolepsis is a designated road to non-*de dicto*. MG completes the empirical picture, showing that prolepsis need not necessarily exclude any readings.

Then the question that naturally arises is: why would we use prolepsis in MG if it is not more informative than a standard attitude report? In what follows we show that prolepsis in MG imposes an additional requirement on the proleptic object, which justifies its use and makes proleptic constructions indeed more informative without lacking any reading. We then provide an analysis in terms of semantic lowering, extending the analysis of Dawson and Deal (2019) to account for MG proleptic constructions.

3.2. Additional semantic requirement

We have shown that MG proleptic constructions can have *de dicto* readings, being interpreted both with low-scope and opaquely. If prolepsis in other languages described so far was a mechanism of targeting non-*de dicto* readings, then what is this mechanism for in MG? In other words, why do we use prolepsis if it is as informative as its non-proleptic counterpart? In fact, we argue that prolepsis does restrict the meaning of the sentence, just not by excluding opaque interpretations. Prolepsis in MG gives us a more specified meaning by imposing an additional semantic requirement on the proleptic object. Thus, the truth conditions of the proleptic construction are a strict subset of those of the usual sentence with a NOM DP.

More specifically, having access to the ACC DP in the syntax could be used to enrich its meaning. Indeed, intuitively, it feels like these constructions are infelicitous when the ACC DP does not take some kind of action to ensure that the CP holds. This intuition is also present in Hadjivassiliou et al. (2000); Kotzoglou (2002). The former note that when there is a NOM DP we are expecting an event, but when there is an ACC DP we expect the ACC DP to perform the event expressed by the CP. They argue that this indicates that the verb assigns some theta role to the DP, a theme or an affected object one. Kotzoglou (2002) observes that the ACC DP is the person or the thing that needs to undertake the action described by the embedded verb. Kotzoglou and Papangeli (2007) argue that the ACC DP receives a weak theta role, such as "as for... DP" or "on behalf of... DP" from the matrix verb. What exactly the additional semantic requirement is is an empirical question that requires further research. In the rest of this subsection, we empirically investigate and formalize this additional meaning that is conveyed by prolepsis in MG.

We have already shown that the ACC DP can be the object of the CP (see (8)), so the requirement cannot be about subjecthood.[14] Additionally, notice that subjects could be either agents or patients, namely in passive constructions. Is subjecthood enough of a licensing condition when the subject is not an agent? The following examples suggest the answer is 'no':

(33) a. Thelo ***ton** **Yani** /[o Yanis na silifthi].
Want.PRS the.ACC Yanis.ACC / the.NOM Yanis.NOM SBJV arrest.PASS
'I want Yanis to be arrested.'

b. Thelo **tin** **astinomia** /[i astinomia na silavi ton
Want.PRS the.ACC police.ACC / the.NOM police SBJV arrest the.ACC
Yani].
Yani.ACC
'I want the police to arrest Yanis.'

The ACC DP in (33a) is ungrammatical in an out-of-the-blue context because it is not up to Yanis to get arrested; it is rather the police that is doing the arresting. Yet, in (33b) the ACC DP, which is the police, is acting to make the CP hold. This confirms the intuition that the ACC DP in a proleptic construction needs to undertake the action expressed by the CP. In fact, (33a) becomes better in a context where the ACC DP causes its arrest:

[14] Notice that in (8) the ACC DP is the object of the embedded clause, but still needs to act to make the event expressed by the CP true.

(34) *Yanis is a political activist and part of an organization run by me. I want to raise awareness about the organization and I think that getting someone arrested will give us some publicity to this end.*
Thelo **ton** **Yani** [na silifthi]. Tha ine kalo jia tin kampania.
Want.PRS the.ACC Yani.ACC SBJV arrest.PASS. Will be good for the.ACC campain
'I want Yanis to be arrested. It will be good for the campaign.'

This shows that the same structure can be felicitous or not based on the context; if the ACC DP is able to take action in the context, the proleptic construction is licensed (but not otherwise). More specifically, if the context entails that the ACC DP plays a causal role in realizing the event expressed by the CP, the structure is felicitous. Ingria (1981) presents the ungrammaticality of the following datapoint as a puzzle:

(35) ??Thelo **ton** **Yani** [na tu dhosi to vivlio i Maria].
Want.PRS the.ACC Yani SBJV he.DAT give the.ACC book.ACC the.NOM Maria
Intended: 'I want Maria to give the book to Yanis .'

However, notice that the ungrammaticality of (35) could be due to the fact that in an out-of-the-blue scenario Yanis cannot cause the event described by the CP to be realized. Indeed, this becomes better in the following scenario:

(36) *Yanis is working for a publishing house. Maria is a famous writer and she just sold the rights of her new book to a rival publishing house. I am the boss of Yanis and I send him at a book fair to meet Maria and convince her to transfer to him the rights of her book.*
Thelo **ton** **Yani** [na tu dhosi to vivlio i Maria].
Want.PRS the.ACC Yani SBJV he.DAT give the.ACC book.ACC the.NOM Maria
'I want Maria to give the book to Yanis .'

This might lead us to suggest that the ACC DP is the agent of the event expressed by the CP. Could it therefore be that the ACC DP is assigned an agent theta role?[15]

There are two important things to consider. Firstly, (34) shows that the ACC DP has to cause the event expressed by the CP, but it need not be its only cause. Indeed, even if Yanis provokes the police to arrest him, at the end of the day the police needs to act for there to be an arrest. Secondly, as Kotzoglou and Papangeli (2007) note there is no animacy restriction on the ACC DP. Kotzoglou and Papangeli (2007) base this on their observation that the construction in question has a similar reading with other constructions involving a PP argument:

[15] This would be supported by the following datapoint from Kotzoglou (2002):

(37) Thelo **tin** **adherfi** /[i adherfi su na min anakatevete sta prosopika mas].
Want.PRS the.ACC sister.ACC / the.NOM sister.NOM yours SBJV NEG meddle in private.PL ours
'I want your sister to not meddle in our affairs.'

With the ACC DP, this has a meaning of "I want your sister to actively stop interfering", while with the NOM DP this means something weaker, namely "I want it to be the case that your sister stops interfering" no matter how this happens. It could be, for example, that we move to another country and we stop talking to her.

(38) I epivates perimenan *apo ton kapetanio* [na ferthi me aksioprepia].
The.NOM.PL passenger.NOM.PL expect.PST from the.ACC captain.ACC SBJV act with dignity.ACC
'The passengers expected on behalf of the captain that he would behave with dignity.'

We argue that the ACC DP can in fact be inanimate in proleptic constructions:

(39) *I am angry at and have negative thoughts about Yanis. I see him drinking coffee in a cup.*
Thelo **tin kupa** [na spasi sta cheria tu]!
Want.PRS the.ACC mug.ACC SBJV break in-the hands he.GEN
'I want the mug to break in his hands!'

Here is another example from a Google search, making the same point:[16]

(40) Thelo **ton ipolojisti** [na liturji san ena telia ekpedhevmeno vretano batler].
Want.PRS the.ACC computer.ACC SBJV function like a.ACC perfectly trained.ACC British.ACC butler.ACC
'I want the computer to function as a perfectly trained British butler.'

One could still argue that these are *agentive-like* readings, but we can still conclude that the ACC DP does not have to be strictly speaking animate.

We argue that the additional semantic requirement associated with the ACC DP cannot be a clear agent theta role, since (i) the ACC DP can be inanimate (e.g., (40)), (ii) it can be a patient in a passive construction as long as it plays some salient causal role in ensuring that the CP holds (e.g., (34)), and (iii) it does not have to be the only cause of the CP (e.g., (34), (36)).[17]

We propose instead a causal role requirement along the following lines: in a proleptic construction, the DP has to play a salient causal role in making the CP hold. For example, in (33b) the police has to act in order to arrest Yanis, in (34) Yanis has to provoke the police to arrest him, in (36) he has to convince Maria to give him the rights of her book, in (40) the computer's program has to run perfectly to resemble a perfect butler and so on. We formalize this requirement by a three-place function $C(x)(y)(w)$, where x is the denotation of the ACC DP. It takes the ACC DP, the attitude holder, a world and gives us the following denotation:

(42) Causal function $C = \lambda x_e.\lambda y_e.\lambda w.\ x$ plays a salient causal role in fulfilling y's desire in w

In the next section, we will use this causal function in the proposed entries of the proleptic verb.

[16] The relevant phrase can be found here: https://www.medium.gr/2008-09-09-08-18-48/553-h-negroponte.html
[17] Indeed, if there is no agent theta role, the ACC DP should be fine in a passive construction, provided that is has some salient causal role that causes the event described by the CP (see (34)). This is what is attested:

(41) Thelo **tus egklimaties** [na timorithun apo ton dhikasti].
Want.PRS the.ACC criminals.ACC SBJV punish.3PL from the.ACC judge.ACC
'I want the criminals to be punished by the judge.'

4. A semantic proposal

Having empirically investigated and formalized the additional semantic requirement of the ACC DP, we provide an analysis that uses the causal function, while also capturing the availability of *de dicto* readings of proleptic objects. Our analysis is an extension of Dawson and Deal's (2019) one for third readings in Tiwa proleptic constructions. In order to account for low-scope transparent readings of proleptic DPs base-generated in the matrix clause, Dawson and Deal (2019) propose an analysis in terms of semantic lowering. We adopt their analysis for third readings in MG and extend it to account for *de dicto* ones, as well as for the additional semantic requirement represented by the causal function proposed in the previous section.

We propose that the three different readings are derived by different entries of the proleptic version of the verb, each time changing the type of the second argument. Following Dawson and Deal (2019), we account for *de re* and *third* readings by positing a binding operator in the CP binding a type *e* or Generalized Quantifier (henceforth GQ) type pronoun respectively (see the syntax in (10)). Here is how the *de re* reading of (31) is derived:

(43) a. [every colleague$_w$.ACC] 2 λw [Maria t_2 wants$_w$ [OP$_1$ $\lambda w'$ *pro*$_1$ be-catholic$_{w'}$]

b. $[\![\text{want}_1]\!] = \lambda P_{\langle e,st\rangle}.\lambda y.\lambda x.\lambda w.\forall w' \in \text{BUL}(x,w) : P(y)(w')\ \&\ C(y)(x)(w')$

c. $[\![(31)]\!] = \forall x[x$ is a colleague of Maria in w $\Rightarrow \forall w' \in$ BUL(Maria, w): x is catholic in w' & x plays a salient causal role in fulfilling Maria's desire in w']

'Maria wants every colleague of hers to be Catholic' ends up being true if and only if for every x, if x is Maria's colleague in the actual world, then x is Catholic in the best worlds that satisfy Maria's desires and x plays a salient causal role to fulfil that desire. In other words, x is Catholic consciously because they chose to (e.g., thanks to Maria's apostolic mission). The *third* reading in (32) is derived in a similar way, by having the pronoun be of GQ-type:

(44) a. λw Zoi [a friend-of-mine$_w$.ACC] wants$_w$ [OP$_1$ $\lambda w'$ *pro*$_1$ win$_{w'}$ the race$_{w'}$]

b. $[\![\text{want}_2]\!] = \lambda P_{\langle e,st\rangle}.\lambda Q_{\langle et,t\rangle}.\lambda x.\lambda w.\forall w' \in \text{BUL}(x,w) : Q(\lambda y.P(y)(w')\ \&\ C(y)(x)(w'))$

c. $[\![(32)]\!] = \forall w' \in$ BUL(Zoi, w): $\exists z$ [z is a friend of mine in w & z wins the race in w' & z plays a salient causal role in fulfilling Zoi's desire in w']

How about the *de dicto* reading in (30)? Here is where MG differs from Tiwa. We argue that the pronoun has an *intensional*-GQ-*type* $\langle s, ett\rangle$ in *de dicto* cases:

(45) a. λw Petros [$\lambda w''$ exactly 3 green dogs$_{w''}$.ACC] wants$_w$ [OP$_1$ $\lambda w'$ *pro*$_1$ come$_{w'}$ to the party$_{w'}$]

b. $[\![\text{want}_3]\!] = \lambda P_{\langle e,st\rangle}.\lambda Q_{\langle s,\langle et,t\rangle\rangle}.\lambda x.\lambda w.\forall w' \in \text{BUL}(x,w) : [Q(w')]\ (\lambda y.P(y)(w')\ \&\ C(y)(x)(w'))$

c. $[\![(30)]\!] = \forall w' \in \text{BUL}(\text{Petros}, w) : \exists 3z$ [z are green dogs in w' & z come to the party in w' & z play a salient causal role in fulfilling Petros' desire in w']

In this analysis, the attitude verb is inherently relational. Based on Madurese, German and Nez Perce, the entry in (43b) is needed and based on Tiwa, (44b) is also necessary to account for third readings.[18] We further argue that based on MG, (45b) is needed to derive *de dicto*

[18]Without the causal function C, but this is a point of cross-linguistic variation. In fact, for Haitian Creole (Deprez 1992), the ACC DP in proleptic constructions denotes an *experiencer*, as argued in Rabinovitch (2023). For our purposes, this shows that the content of the function can vary cross-linguistically.

readings. What changes between the independently motivated entry in (44b) and our proposed entry in (45b) is that the world argument of the ACC DP can be bound by the attitude verb. MG completes the cross-linguistic typology, while showing us that, contrary to what has been described up to now, proleptic constructions may have *de dicto* readings. For clarity, here is how the *de dicto* reading of (30) is derived:

(46)

- VP: $\lambda x.\lambda w.\forall w' \in \text{BUL}(x,w) : \exists 3z(z$ a green dog in w' & z CTP in w' & z plays causal role in f. x's desire in $w')$
  - DP: 3 green dogs$_i$
$\lambda w''.\lambda P_{et}.\exists 3z(z$ is a green dog in w'' & $P(z))$
  - V′: $\lambda Q_{s,ett}.\lambda x.\lambda w.\forall w' \in \text{BUL}(x,w)$:
$Q(w')[\lambda y.y$ CPT in w'
& y plays a causal role in f. x's desire in $w']$
    - V: want$_3$
    - CP: $\lambda x.\lambda w'.\ x$ CTP in w'
      - Op$_i$
      - $\lambda w'.\ pro_i$ CTP in w'
        - $\lambda w'$
        - TP: pro_i comes to the party (CTP) in w

Therefore, MG shows that proleptic constructions are not always interpreted transparently. The availability of *de dicto* readings demonstrates that quantifiers in certain constructions may be interpreted lower than their base-generation site, both w.r.t. scope and w.r.t. the world argument of their NP restrictor. This suggests that, contrary to Tiwa, semantic reconstruction mechanisms are not restricted to $\langle et,t\rangle$ traces in MG, but may also apply to their $\langle s,ett\rangle$ intensions (since the world argument of the DP may be bound by the buletic alternatives of the subject).

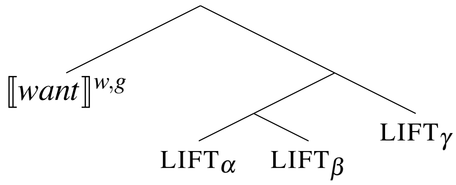
What is more, notice that what changes from one proleptic verb entry to another is the type of the second argument, i.e., type *e* in (43b), type *ett* in (44b), and finally type *s,ett* in (45b). This, as well as the empirical picture with the addition of MG suggests the existence of an implicational hierarchy, according to which if a language has a third reading for prolepsis, it also has a *de re* one and if it has a *de dicto* one, it has all other readings too. In other words, it seems that if a language has the higher-typed entry in (45b), it has the other two as well. (45b) implies (44b), which in turn implies (43b). This is illustrated in the following table:

Language	***De re***	**Third**	***De dicto***
Madurese, German, Nez Perce	✓		
Tiwa	✓	✓	
Greek	✓	✓	✓

Table 1: Implicational Hierarchy

In order to capture this implicational hierarchy, we could be tempted to suggest type-shifting rules combining with the basic/non-proleptic meaning of *want* to give us the proleptic entries. In other words, we want morphemes that progressively lift the meaning of *want*, in such a way that we cannot have a lifted meaning if we do not have all the lower types, accounting for the paradigm gaps. One possible implementation of this is to stack the morphemes one onto another in such a way that they always combine with the basic meaning of *want*:

(47)



In this implementation combining *want* with LIFT$_\alpha$ would yield the classic *de re* interpretation, with [LIFT$_\alpha$ LIFT$_\beta$] the third reading, and with [[LIFT$_\alpha$ LIFT$_\beta$] LIFT$_\gamma$] the *de dicto* one. In this way, we will predict that there is no language with the reverse German or Tiwa pattern. Therefore, to the extend that the implicational typology is correct, we account for it. Here is the basic meaning of *want* and the proposed entries for the LIFT morphemes:[19]

(48) a. $[\![want]\!]^{w,g} = \lambda p_{st}.\lambda x.\lambda w.\forall w' \in \text{BUL}(x,w) : p(w')$

b. $\text{LIFT}_\alpha = \lambda P_{st,est}.\lambda R_{e,st}.\lambda y.\lambda x.\lambda w.P(\lambda w'.R(y)(w')\ \&\ C(y)(x)(w'))(x)(w)$

c. $\text{LIFT}_\beta = \lambda M_{\langle\langle st,est\rangle,\langle est,\langle e,est\rangle\rangle\rangle}.\lambda R_{st,est}.\lambda P_{est}.\lambda Q_{ett}.\lambda x.\lambda w.R(\lambda w'.Q(\lambda y.P(y)(w')$
$\&\ C(y)(x)(w')))(x)(w)$

d. $\text{LIFT}_\gamma = \lambda M_{\langle\langle st,est\rangle,\langle est,\langle ett,est\rangle\rangle\rangle}.\lambda R_{st,est}.\lambda P_{est}.\lambda Q_{s,ett}.\lambda x.\lambda w.R(\lambda w'.Q(w')(\lambda y.P(y)(w')$
$\&\ C(y)(x)(w')))(x)(w)$

Notice that we add an extra argument in the entry for LIFT$_\beta$ and LIFT$_\gamma$, so that they only combine with LIFT$_\alpha$ and LIFT$_\beta$ respectively. This extra argument is purely syntactic, since we do not use it in the denotation and its sole function is to restrict the morphemes LIFT$_\beta$ and LIFT$_\gamma$ can combine with. This is necessary in order to account for the implicational hierarchy, since otherwise we would predict LIFT$_\gamma$ to exist at the absence of LIFT$_\beta$ in a language. However, because of this purely syntactic extra argument, this solution is equally satisfactory with proposing a three-way ambiguity of the proleptic verb. We present both solutions here without claiming that one of the two is theoretically more elegant.[20]

The most important conclusion is that prolepsis is not necessarily marking non-*de dicto* readings, but is instead a way to syntactically access the proleptic argument, which can then be restricted semantically in multiple ways. Some languages impose a *de re* reading of the proleptic object (e.g., Madurese, German, Nez Perce), others a non-*de dicto* one (e.g. Tiwa), and yet others impose a different semantic restriction (see our causal function for MG).

[19] LIFT$_\alpha$ is already proposed in Dawson and Deal (2019) for Tiwa (without the causal function C).

[20] The only reason one might prefer the LIFT morphemes is to account for the whole class of proleptic verbs without positing a three-way ambiguity for each one. Thus, depending on how productive the process is in a given language, LIFT morphemes might be more economical.

5. Conclusion

In conclusion, we argued that "quasi-ECM" constructions in MG are proleptic constructions, where the proleptic object, i.e., the ACC DP, is base-generated in the matrix clause and is co-referential with a *pro* in the subject or object position in the CP. Contrary to other proleptic constructions described so far, MG ones are not always interpreted transparently, allowing for *de dicto* readings of the ACC DP. This suggests that prolepsis is not simply a mechanism to exclude *de dicto* readings, but a way to express some marked meaning in general. We argued that in MG this marked meaning can be modeled by a causal function, imposing a semantic restriction on the ACC DP. We also provided an analysis in terms of semantic lowering, extending the account of Dawson and Deal (2019) for Tiwa, while also accounting for the semantic restriction on the ACC DP. If this analysis is correct, the availability of *de dicto* readings shows that quantifiers in certain constructions may be interpreted lower than their base-generation site, both w.r.t. scope and w.r.t. the world argument of their restrictor. This suggests that semantic lowering mechanisms are not restricted to non-intensional versions of pronouns, contrary to what we see in Tiwa. A prediction would be that semantic reconstruction behaves similarly. In a nutshell, we saw that the syntactic access to the proleptic object is used to restrict the semantics of the sentence, and what this restriction is may be a point of cross-linguistic variation.

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On the context dependence of artifact noun interpretation[1]

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Abstract. The context dependence of artifact noun category boundaries is underexplored relative to interpretational context dependence in other linguistic domains (e.g., gradable adjectives). Taking inspiration from a normative debate over the role of context in legal interpretation (in particular, the role of legislators' policy goals), we show experimentally that contextual information as to a rule's purpose systematically modulates interpreter beliefs about the category boundaries of artifact nouns contained within the rule. We propose a Bayesian pragmatic model of the context-dependent resolution of artifact noun extensions, which we compare against context-independent baselines. Our experimental and modeling results suggest the need for an explicitly context-sensitive, multi-dimensional degree semantics for artifact nouns.

Keywords: computational pragmatics, vagueness, degree semantics, nominal semantics

1. Introduction

(1) "A legal rule forbids you to take a vehicle into the public park. Plainly this forbids an automobile, but what about bicycles, roller skates, toy automobiles? . . . Are these, as we say, to be called 'vehicles' for the purpose of the rule or not?" (Hart 1958: 607).

As (1) shows, *vehicle* is vague in that it admits of borderline cases (e.g., bicycles and roller skates). By virtue of this vagueness, we expect to find "contextual variability in truth conditions" of sentences featuring the expression (Kennedy 2007: 2). This paper will offer experimental evidence – and a formal linguistic analysis – of this vagueness and context dependence.

Theorists have already extensively explored the ways in which context influences the interpretation of artifact nouns (such as *vehicle*): phenomena such as copredication (e.g., *My car is no longer manufactured but still runs great*) have motivated lexical semantic analyses that account for the range of senses that a single artifact noun may invoke in context (Pustejovsky 1995; Asher 2011). However, when we restrict our focus to the 'physical object' sense of these artifact nouns – the sense invoked by Hart in (1) – we find that there is limited work that formally characterizes the context dependence of their category boundaries.

Conversely, some other linguistic domains are relatively well-explored in this regard, especially single-dimensional gradable adjectives such as *tall*, *open*, and *dry*.[2] For our purposes, artifact nouns are notable in the following respect: although *tall* clearly makes reference to a single dimension (height), there is no single dimension to which *vehicle* intuitively refers. On

[1]We would like to thank audiences at SuB 27, XPrag 2022, CUSP 13, Stanford, and Georgia Tech for valuable feedback and discussion. We are grateful as well to our anonymous SuB reviewers for their insightful commentary. All remaining errors are our own. Corresponding author: Brandon Waldon `bwaldon@stanford.edu`. Data and code associated with this project can be found at `https://github.com/bwaldon/artifactnouns`.

[2]With regards to single-dimensional gradable adjectives, there exists a rich literature in formal semantics (Kamp 1975; Klein 1980; Kennedy 2007); experimental semantics/pragmatics (Aparicio et al. 2016; Qing et al. 2018); and computational pragmatics (Qing and Franke 2014; Lassiter and Goodman 2017).

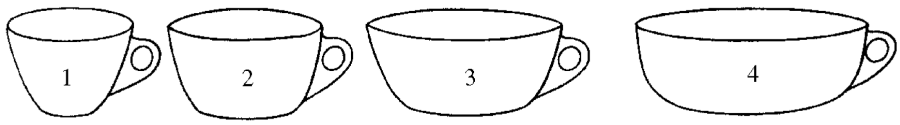
the whole, multi-dimensional predicates have been less studied than their single-dimensional counterparts when it comes to vagueness and context dependence (though see e.g., Klein 1980 and Sassoon 2013 for important exceptions pertaining mostly to multi-dimensional adjectives).

This paper seeks to redress this disparity. We first present an experiment which shows that highlighting the function(s) of artifact noun objects can serve as a cue for how to resolve the category boundaries of artifact nouns in context, in line with previous findings reviewed below. We then present a context-sensitive, multi-dimensional semantics for artifact nouns, which we embed in a probabilistic model of artifact noun interpretation. The model predicts our experimental data, and does so more accurately than a context-insensitive baseline model.

2. Producing and understanding artifact nouns in context

We will use the term 'artifact nouns' in contrast to natural kind-denoting nouns, where the former denotes entities of human invention and/or entities that, through some assimilative procedure, come to serve some human-intended function.[3] Many artifact nouns are also identified via diagnostics that distinguish them from natural kinds. Artifact nouns, for example, exhibit systematically different compounding strategies (Downing 1977; Wisniewski and Love 1998; Levin et al. 2019). While modifiers in natural kind compounds (e.g., *<u>three-toed</u> sloth*) tend to denote essential characteristics which specify a subordinate kind within the kind denoted by the bare head (such as "perceptual features or typical habitat," Levin et al. 2019: 464), modifiers in artifact compounds (e.g., *<u>coffee</u> mug*) tend to specify "the event in which the artifact is created or the event in which it is intended to be used" (ibid: 463).

Artifact category judgments have been extensively studied by cognitive psychologists (see below discussion as well as Murphy 2002 and references therein). However, relatively little work to our knowledge has investigated effects of local interpretive context on category boundary judgments for artifact nouns. To the extent this question has been asked, prior work suggests that judgments can shift when the context highlights a 'purpose' or 'function' that entities are expected to achieve. Labov (1973) had participants name objects with handles that were of various widths and fixed heights. (Labels provided by participants included *cup*, *bowl*, etc.):



In what was called the 'neutral' context of presentation, Labov found that participants provided the label *bowl* only for fairly wide objects. However, in a second context (the 'food' context), people were first asked to envision that the above objects contained mashed potatoes. Objects of relatively narrow widths received the *bowl* label more frequently in this second context.[4]

[3]The second disjunct captures the observation that, despite not having been created by humans, entities clearly belonging in the extension of *gourd* (a natural kind) may also belong in the extension of *decoration* (an artifact). However, see Sperber (2007) for discussion of cases that would problematize even this very broad sense of *artifact noun*, and perhaps any attempt to invoke 'artifact' as a theoretically useful concept.

[4]See also Feist and Gentner (2003) and Coventry et al. (1994) for studies demonstrating that preposition choice between *in* and *on* in *The X is __ the Y* depends not only on the spatial relationship between *X* and *Y* but also on the canonical function of *Y* when *Y* is an artifact. Feist and Gentner (2003), for example, find that with spatial relations held constant, *in* is more frequent in the environment *The X is __ the bowl* than in *The X is __ the plate*.

In more recent work, Grimm and Levin (2012) asked participants to judge comparatives featuring artifactual aggregate nouns such as *furniture* or *jewelry*. Participants compared two aggregations, a high-cardinality but homogenous aggregation (e.g., 5 chairs) vs. a low-cardinality but heterogeneous aggregation (e.g., a sofa, a chair, a coffee table, and a bookcase – 4 items total). In what they called a 'function-neutral' context, the authors found that the higher-cardinality aggregation tended to be judged as *more furniture* than the lower-cardinality aggregation. However, in a context that highlighted a purpose associated with the artifact noun (e.g., completely furnishing a room), lower-cardinality, heterogenous aggregations could count as *more furniture*.

The current investigation, inspired by contexts of legal decision-making, builds on the above findings. Artifact noun categories – in particular, superordinate categories – group together objects that share in abstract characteristics often described as 'functional' properties (Rosch et al. 1976; Tversky and Hemenway 1984). For example, objects nameable as 'vehicles' intuitively share in common the ability to transport people and/or things (though as Malt and Johnson 1992 note and as will be relevant to our experiment and analysis, additional characteristics may have to be selectively invoked to further distinguish superordinate category members from non-members in context, e.g., the property of having wheels or of relying on fuel sources that pollute the environment).[5] The generality of superordinate categories (Wisniewski and Murphy 1989; Murphy 2002), coupled with the observation that their unifying features may be relevant to the goals of policy-making entities (e.g., the goal to limit pollution), often make such categories natural targets of rules that express prohibitions or requirements, as in (1).

Our study exploits this property of the legal contexts in which rules targeting artifact noun categories (especially superordinate categories) are produced. Specifically, we consider whether policy goals influence interpreter beliefs regarding the domain of applicability of rules that invoke artifact noun categories. That is, we consider whether evidence as to the goals motivating the formulation of a legal rule can have a modulating effect on artifact noun interpretation, similar to previously-observed effects of highlighting expected artifact noun 'functions' in context.

In this sense, our study is also inspired by a normative debate in American jurisprudence. On one side, purposivists consider the policy goals of legislators to be relevant to legal interpretation and readily consult evidence of such goals beyond the text of the law itself. By contrast, textualists tend to minimize the relevance of such goals (Brannon 2018). Following recent work in *experimental jurisprudence* (Struchiner et al. 2020, Hannikainen et al. 2022, inter alia), we consider which of these normative frameworks more closely aligns with how laypeople actually interpret natural language in settings that simulate legal decision-making. In the final section of the paper, we consider the implications of our results for this normative debate.

3. Experiment: resolution of artifact noun extensions

The experiment investigates two hypotheses regarding the role of a particular contextual cue – the policy objective behind a legal rule – in how interpreters resolve the extensions of artifact nouns. The **Goal Insensitive** hypothesis is a null hypothesis which states that policy goals

[5] Invoking such properties might serve to exclude non-members (e.g., escalators) but may also exclude objects that one might want to treat as members of the category in some contexts (e.g., sailboats). Malt and Johnson take this tension as evidence that artifact noun categories cannot be characterized by a single functional 'core' – we take it as evidence that the properties that are relevant for determining category boundaries may vary across contexts.

are orthogonal to interpretation. On the **Goal Sensitive** hypothesis, interpreters systematically integrate beliefs about policy goals when interpreting rules that target artifact noun categories (e.g., *No vehicles...*). This hypothesis predicts that when a particular goal is made salient in a context, we should see a corresponding reflex in how the artifact noun category boundary is resolved, such that the rule is construed in a manner that advances the policy goal.

3.1. Methods

Participants. We recruited 200 particpants via Prolific (all self-reported native English speakers; US-based IP addresses; 100 minimum submissions on Prolific; minimum 95% prior approval rating). Participants were paid \$3, and median completion time was approximately 13 minutes, for a median compensation rate of approximately \$14 per hour.

Procedure and materials. Participants completed twelve trials, where each trial featured a rule randomly selected without replacement from a list of twelve researcher-designed rules.[6] These rules were separately normed for a priori plausibility.[7] Of the twelve rules, which each targeted an artifact noun category, seven expressed prohibitions (e.g., *No electronic devices are allowed in the theater*) and five expressed requirements (e.g., *Shoes must be worn in the courtyard).*

For each rule, participants were randomly assigned to one of four possible 'goal' conditions, which varied with respect to the availability and nature of contextually-available evidence as to the relevant authority's motivation for issuing the rule. In the 'goal-neutral' condition, participants read the rule with no preceding context; the remaining three conditions identified the authority's goal in passing the rule. For example, for the *No electronic devices...* rule, one of the goal conditions featured the following text above the rule: *The managers of a theater are concerned that certain objects, when brought into the theater, emit light that could distract audience members and performers.* These goals were normed for plausibility in a separate norming study.[8] We ensured that each participant saw exactly 1/3 of trials in the 'goal-neutral' condition; assignment of trials to goal condition was otherwise random.[9]

Each rule was associated with a unique set of twelve images. Images were normed for nameability.[10] On prohibition-expressing rule trials, participants were instructed to "Select each item that, CONDITION, would violate the rule"; on requirement-expressing rule trials, the instruction was to "Select each item that, CONDITION, would satisfy the rule", where CONDITION was tailored to the particular trial. For example, the instruction for the *No electronic devices...* rule was *Select each item that, if brought into the the theater, would violate the rule.*

Participants were required to select at least one object in order to complete the trial. After every trial, participants completed an 'image' attention check, which featured an image from the preceding trial plus three distractor images which never appeared in any experimental scene. Participants were asked to identify the image they had seen on the preceding trial. After every trial featuring an explicit policy goal, participants additionally completed a forced choice 'goal'

[6] Preregistered at `https://osf.io/5whfy`. We first planned for $n = 100$. Subsequently, we preregistered a plan to recruit 100 more participants to estimate response patterns with greater confidence; see `https://osf.io/ad32c`.
[7] See `https://osf.io/9njdu` for more details.
[8] See `https://osf.io/k74h3` for more details.
[9] The rules and their associated goals are presented in Appendix A.
[10] See `https://osf.io/682q7` for more details.

attention check in which they identified the featured goal. (The competitors were the other two goals that could have been combined with the rule in that scene). Participants who failed more than two image attention checks and/or more than two goal attention checks, as well as those who prematurely exited the study, were excluded from the analysis.

We ran two additional norming studies on the images from the main experiment, and we used the results from these studies in the model comparison reported in Section 4.2. In the **feature attribution** norming study, participants were asked to use a sliding scale to rate the extent to which the objects used in the main study exhibited characteristics that corresponded to the policy goals tested in the study. For example, participants were asked to report the extent to which they believed the objects shown in Fig. 1 were capable of emitting light.

In the **category membership** norming study,[11] participants used a sliding scale to rate the extent to which the objects featured in the images were members of the relevant artifact noun category. For example, participants were asked to report the extent to which they believed the objects shown in Fig. 1 were in the category *electronic device*.

For each rule, we selected a diverse set of objects according to the following qualitative typology. For each subclass, we also report the proportion of objects that exhibit a corresponding mean category membership score from the category membership norming study.[12]

Clear members (51%) were objects that were relatively uncontroversial members of the artifact noun category targeted by the rule. For example, the *No electronic devices...* item featured an image of a tablet computer. (Mean category membership scores between 0.75 and 1).

Edge cases (17%) were more controversial members of the category. For example, the *No electronic devices* item featured a flashlight, whose status as an 'electronic device' is was reported to be less certain than that of a tablet. (Scores between 0.25 and 0.75).

Clear non-members (32%) were outside the category of interest. (Scores less than 0.25).

3.2. Results

Data from 12 participants were excluded based on the exclusion criteria described in Section 3.1. To illustrate the results we obtained in our study, rates of object selection across goal conditions for 4 of 12 tested objects in the *No electronic devices...* rule scenario are displayed in Fig. 1. These include two clear members, one edge case, and one clear non-member. A visual inspection of the graphs suggests that not every object exhibited 'goal sensitivity' to the same degree. With the *No electronic devices...* rule, for example, rate of selection of the flashlight – an edge case 'electronic device' – was highest when presented alongside the goal of limiting distracting light from the theater. However, no such modulation was observed for the candle, another light-emitting object that, unlike the flashlight, clearly is not in the extension of *electronic device*. The candle was virtually never selected, irrespective of goal condition.

Some canonical electronic devices exhibted substantial modulation across goal conditions. For example, the boombox was selected most frequently in the goal-neutral condition and in the condition where participants were told that "[t]he managers of a theater are concerned that

[11]For details of the category membership and feature attribution norming studies, see `https://osf.io/hu8v7`.
[12]To calculate these mean scores, we transformed slider scale responses to values on the interval [0,1].

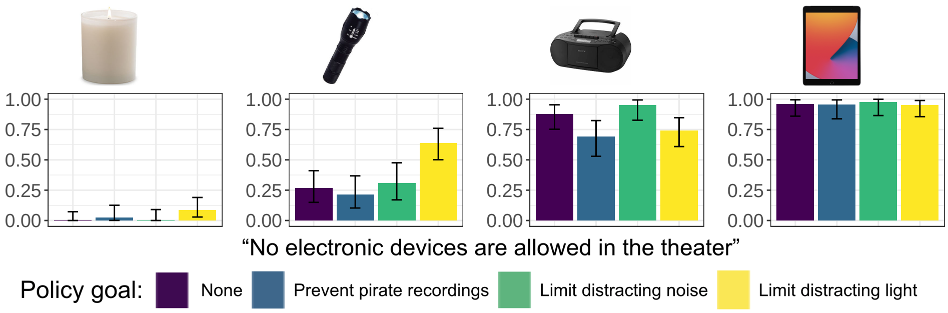


Figure 1: Mean selection rates for 4 of the 12 objects seen in the *No electronic devices...* scenario. From left to right: 1 clear non-member (candle), 1 edge case (flashlight), 2 clear members (boombox, tablet). Error bars denote 95% binomial confidence intervals.

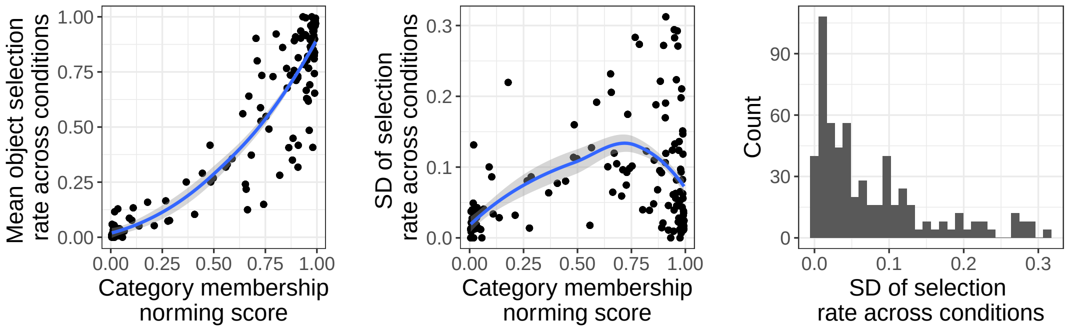


Figure 2: Left: mean object selection rate plotted against mean object category membership score (as measured in the category membership norming study). Center: between-condition standard deviation (SD) of object selection rates plotted against mean object category membership score. Right: distribution of by-object selection rate variability (as measured by SD).

certain objects, when brought into the theater, **create noise** that could distract audience members and performers" (emph. added). However, other clear category members (e.g., the tablet) exhibited very little modulation across goal conditions.

Fig. 2 shows by-object mean responses from the 'category-membership' norming study against by-object mean (left panel) and standard deviation (SD, center panel) of selection rates from the main experiment (across the four goal conditions in which each object appeared). As the left panel indicates, category membership scores and selection rates are clearly positively correlated. We conducted a Bayesian mixed effects logistic regression analysis using the `brms` package in R (Bürkner 2017), predicting log odds of object selection from a fixed effect of category membership score, with by-participant and by-item (i.e., by-rule) random intercepts as well as by-item random slopes for category membership score.[13] We found strong evidence of a positive relationship between category membership score and object selection ($\hat{\beta} = 6.65$, 95% CrI = [5.82, 7.51]).

The smoothing line fit to the center-panel plot has a weakly inverse-parabolic shape, suggesting that edge-case objects exhibited greater variability in selection rate across the four goal conditions relative to the clear category members and non-members. However, there are exceptions: some of the objects that received high scores on the category-membership norming study

[13]The maximal random effects structure justified by the experiment design that allowed the model to converge.

also exhibited substantial selection variability across conditions. We conducted a Bayesian mixed effects polynomial regression analysis predicting object selection variability (as measured by SD) from fixed effects of category membership score and category membership score squared, with by-item random intercepts. We found strong evidence of an inverse quadratic relationship between category membership and selection variability ($\hat{\beta} = -0.38$, 95% CrI = $[-0.43, -0.32]$) as well as strong evidence of a positive linear relationship ($\hat{\beta} = 0.44$, 95% CrI = $[0.38, 0.49]$).

Finally, note that the distribution of variabilities in object selection rate is heavily left-skewed (right panel of Fig. 2), with most objects ($\sim$72%) exhibiting a between-condition selection rate SD of $<$0.1. We return to this point in Section 4.2 when modeling our experimental data.

For now, we claim that the results of the experiment suggest the need for an analysis that accounts for the variability we observed among conditions that highlighted different relevant dimensions of interpretation. We will pursue an account that explains these patterns as variability in how category boundaries of artifact nouns are resolved in context. Accordingly, this account will rely on a semantics for artifact nouns whereby the extensions of such nouns are a function of multiple interpretive dimensions which may vary in importance across contexts. We will then demonstrate that, when coupled with a Bayesian probabilistic model of pragmatic interpretation, this semantics can predict the interpretive variability observed in the experiment.

4. Analysis

4.1. Semantic proposal

Our analysis extends a proposal from Sassoon and Fadlon (2017), who identify artifact nouns as a subset of a broader category of nominal *social predicates* whose denotations are degree functions that are multi-dimensional, weighted, and additive. A denotation for *vehicle* in the spirit of their analysis is provided in (2):

(2) $$[\![\text{vehicle}]\!]_{\langle d,\langle e,t\rangle\rangle} = \lambda d \lambda x.\big(w_{F_1} f_{F_1}(x) + \cdots + w_{F_N} f_{F_N}(x)\big) > d$$

On Sassoon and Fadlon's analysis, artifact nouns are multi-dimensional in the sense that their denotations reference a set of measure functions $f_{F_1} + \cdots + f_{F_N}$, where each function measures entities along a distinct dimension. These measurements are weighted by scalars $w_{F_1}, \ldots, w_{F_N}$, and the truth conditions of the predicate depend upon a weighted composite of the entity's measurements along the relevant dimensions. Following prior cognitive psychology research on concepts and categorization (Rosch 1973; Hampton 1998; Murphy 2002; Hampton et al. 2009), this composite is taken to be additive in nature; natural kinds, by comparison, are analyzed as multiplicative concepts as in (3), whereby failure to exhibit any single relevant dimension significantly penalizes an entity vis à vis category membership.

(3) $$[\![\text{duck}]\!]_{\langle d,\langle e,t\rangle\rangle} = \lambda d \lambda x.\big(w_{F_J} f_{F_J}(x) * \cdots * w_{F_K} f_{F_K}(x)\big) > d$$

[adapted from Sassoon and Fadlon 2017:29]

Sassoon and Fadlon's proposal is intended to account for their finding that artifact nouns are of intermediate acceptability in dimensional constructions (4) and degree constructions (5), in contrast to multi-dimensional adjectives (acceptable) and natural kind nouns (degraded):

(4) **Dimensional constructions (quantifying over dimensions):**

a. # This tree is a pine in {some, most, every} respect(s). *natural kind*

b. ? This place is a church in {some, most, every} respect(s). *artifact*

c. This tree/place is safe in {some, most, every} respect(s). *multidim. adjective*

[adapted from Sassoon and Fadlon 2017:18]

(5) **Degree constructions (comparatives):**

a. # This tree is more a pine than {that one, an oak}. *natural kind*

b. ? This place is more a church than {that one, an art gallery}. *artifact*

c. This tree/place is more safe than {that one, dangerous}. *multidim. adjective*

[adapted from Sassoon and Fadlon 2017:21]

Sassoon and Fadlon's theory links the acceptability of a predicate in dimensional and degree environments to that predicate's 'dimension accessibility,' i.e. the "tendency to base exemplariness judgments and classification...on dimension-counting" (2017: 2). Multi-dimensional gradable adjectives such as *healthy* strongly exhibit this property because their scales correspond to "the number of dimensions in which [the entity] is within the norm" (2017: 28). For example, *Mary is healthier than Bill* is true iff Mary meets or exceeds the standards for a greater number of 'health'-relevant dimensions than does Bill.[14]

Additive multi-dimensional nouns (such as artifacts) exhibit dimension accessibility, though more weakly than do multi-dimensional adjectives: "upon a shift... to a flattened representation of dimensions (with binary scales consisting of 0 and 1 and equal weights), [additive nouns] denote dimension-counting relations" (2017: 29). (Such a shift is less available for multiplicative nouns such as natural kinds; thus, natural kinds exhibit less dimension accessibility).

The analysis in (2) – which leaves open whether features and weights are lexicalized or supplied by context – is consistent with a theory whereby the interpretation of artifact nouns is context sensitive in simple predicative sentences (*X is a vehicle*) as well as in the sorts of quantificational environments featured in the rules in the experiment reported above (e.g., *No vehicles are allowed...*). For purposes of exposition, we decompose (2) into a measure function (following Kennedy 2007) that combines with a silent *pos* morpheme to yield a context-sensitive $\langle e,t\rangle$ function whose interpretation depends on a contextual standard of comparison:[15]

(6)
$$\big[\lambda x.[w_{F_1} f_{F_1}(x) + \cdots + w_{F_N} f_{F_N}(x) \succeq \mathbf{s}(\text{vehicle})]\big]_{\langle e,t\rangle}$$

$$\begin{array}{cc} {}_{deg}pos_{\langle\langle e,d\rangle,\langle e,t\rangle\rangle} & \text{vehicle}_{\langle e,d\rangle} \\ \lambda g\lambda x.g(x) \succeq \mathbf{s}(g) & \lambda x.w_{F_1} f_{F_1}(x) + \cdots + w_{F_N} f_{F_N}(x) \end{array}$$

However, there are at least two reasons to believe that the nature of *vehicle*'s context dependence cannot be adequately accounted for using a single context-sensitive threshold. First, we observe that a single policy goal could lead to increased selection rates for some objects relative to the goal-neutral baseline condition but decreased rates for others. To illustrate the problem this poses, call the threshold of inclusion for the category of *electronic device* in the goal-neutral baseline condition θ_B. When alerted to the goal of limiting distracting light, participants in our

[14]This analysis finds independent empirical support in the work of Sassoon (2013). However, we acknowledge that comparatives involving multi-dimensional degree constructions constitute a complicated domain. In the future, we plan to experimentally investigate the role of context in the interpretation of multi-dimensional comparatives.

[15]Following Kennedy (2007), **s** is context sensitive and maps measure functions to comparison standards.

experiment were more inclined to select the flashlight relative to baseline (suggesting a threshold lower than θ_B in that condition); however, participants were also less inclined to select objects such as the boombox in that condition (suggesting a threshold higher than θ_B). This discrepancy suggests that the value of some additional parameter shifts between contexts.

A second reason emerges from a closer examination of the comparative constructions in (5b), cf. the single-dimensional comparatives in (7):

(7) This tree is taller (more tall) than {that one, it is wide}.

The degree analysis of Kennedy (2007), inter alia, correctly predicts that the comparatives in (7) are not context-sensitive, in the sense that the sentences are readily evaluated for truth or falsity. The lack of context dependence is a consequence of the semantics of the comparative, which orders the two degrees returned by applying the sentence's constituent measure function(s) (e.g., *tall*, *wide*) to its constituent entities (e.g., *this tree*, *that one*).

However, an analogous analysis yields the wrong results for (5b) (as well as for comparisons involving multi-dimensional adjectives such as *healthy* / *optimistic*), whose interpretations are context dependent despite the presence of the comparative. Intuitively, before evaluating (5b), the interpreter must determine which dimensions of *church* / *art gallery* are relevant for interpretation, and/or the relative importance of those dimensions for the purposes of the context. That is, context sensitivity persists in artifact noun comparatives, in a manner unobserved in the case of single-dimensional gradable adjectives.

An analysis that accounts for this property of artifact nouns is offered in (8):

(8) $[\![\text{vehicle}]\!]_{\langle e,d\rangle} = \lambda x. \sum_{f \in \mathbf{F}(\text{vehicle})} f(x) * \mathbf{W}(\text{vehicle}, f)$

...where **F** is a context-sensitive function that maps $\langle e,d\rangle$-type measure functions to sets of $\langle e,d\rangle$-type measure functions. For example, **F**(*vehicle*) might return a set of contextual measure functions including a function f_P which measures entities' propensity to pollute the air.[16] **W** is a context-sensitive function that maps ordered pairs of $\langle e,d\rangle$-type functions to scalars, which weight the importance of contextual measure functions in interpretation (e.g., the importance of pollution for interpreting *vehicle*). Thus, when applying (8) to an entity `car`, one summation term will be $f_P(\texttt{car}) * W(\textit{vehicle}, f_P)$ if f_P is a relevant measure function.[17]

As (9) demonstrates, we predict that in environments where *vehicle* composes with *pos*, the interpretation depends on valuing three parameters: **F**, **W**, and **s**. For example, in quantificational environments of the sort observed by participants in the experiment, we posit that the measure function composes with *pos* to form the restrictor argument of the quantifier; thus, interpretation hinges on the valuation of all three contextual parameters.[18] Finally, we posit that the **F** and **W** parameters project in the case of the comparative construction as in (11).

[16] We remain as noncommittal as possible regarding the precise sub-lexical dimensions that factor into multi-dimensional interpretation. However, for the purposes of fitting an interpretive model to our data, we operationalize these dimensions using data from the feature attribution norming study, as detailed in Section 4.2.

[17] Unlike (6), which posits that the function **s** that provides the comparison standard is the only context-sensitive parameter relevant to artifact noun interpretation, (8) straightforwardly accounts for the observation that a single policy goal cue can lead to increased selection rates for some objects relative to the goal-neutral baseline condition but decreased rates for others. (Not all objects will exhibit contextually-relevant properties to the same degree).

[18] We revisit the consequences of this analytic move in Section 6.

(9) $\quad {}_{deg}pos(\text{vehicle}) = \big[\lambda x.[\sum_{f \in \mathbf{F}(\text{vehicle})} f(x) * \mathbf{W}(\text{vehicle}, f)] \succeq \mathbf{s}(\text{vehicle})\big]_{\langle e,t \rangle}$

(10) a. Every vehicle is prohibited from the park.

b. $\forall x \big[[\sum_{f \in \mathbf{F}(\text{vehicle})} f(x) * \mathbf{W}(\text{vehicle}, f)] \succeq \mathbf{s}(\text{vehicle}) \Rightarrow \text{prohibited-from-park}(x)\big]$

(11) a. ? [This object is] more (of) a vehicle [than that one].[19]

b. $\lambda y \lambda x.\big[\sum_{f \in \mathbf{F}(\text{vehicle})} f(x) * \mathbf{W}(\text{vehicle}, f)\big] \succ \big[\sum_{f \in \mathbf{F}(\text{vehicle})} f(y) * \mathbf{W}(\text{vehicle}, f)\big]$

$more_{\langle\langle e,d \rangle, \langle e, \langle e,t \rangle\rangle\rangle}$ $\quad$ $\text{vehicle}_{\langle e,d \rangle}$ (8)

$\lambda g \lambda y \lambda x. g(x) \succ g(y)$

4.2. Interpretive model

Following Lassiter and Goodman (2017), Qing and Franke (2014), and Tessler and Goodman (2019), inter alia, we posit that listeners who observe semantically underspecified expressions jointly infer speaker-intended meanings along with the values of the contextual parameters upon which interpretation depends (**F**, which returns the set of contextually-relevant measure functions; **W**, which returns the relative weight assigned to each such function; **s**, which returns the inclusion threshold for the artifact noun category). In line with this work, we take probability theory to be a natural formalism for linguistic inference under persistent uncertainty, which we model as an instance of Bayesian belief update (Frank and Goodman 2012, et seq):

(12)
$$\underbrace{L(o \text{ is prohibited}, \mathbf{F}, \mathbf{W}, \mathbf{s} \mid \text{“No electronic devices…”})}_{\substack{\text{Joint posterior probability that an object } o \text{ is prohibited and} \\ \text{that context parameter values = } \mathbf{s}, \mathbf{F}, \mathbf{W} \text{ (given observation of rule)}}} \propto$$
$$\underbrace{{}_{deg}pos^{\mathbf{s}}(\llbracket \text{elec. device} \rrbracket^{\mathbf{F},\mathbf{W}})(o)}_{\substack{= 1 \text{ if } o \text{ meets standards of artifact noun} \\ \text{category targeted by the rule, given} \\ \text{parameter valuation } \mathbf{s}, \mathbf{F}, \mathbf{W} \text{ (= 0 otherwise)}}} * \underbrace{P(o \text{ is prohibited})}_{\substack{\text{Prior belief that} \\ o \text{ prohibited}}} * \underbrace{P(\mathbf{s}) * P(\mathbf{F}) * P(\mathbf{W})}_{\substack{\text{Prior probability of} \\ \text{parameter values}}}$$

To evaluate the Goal Sensitive hypothesis against its null competitor, we will consider whether there is evidence that participants in our experiment assigned additional importance to interpretational dimensions that the policy goal manipulation made salient in the experiment. To answer this question, we fit the model in (12) to our experimental data, with a number of simplifying assumptions. First, we assume that the prior over the prohibition status of any object o is uniform such that $P(o$ is prohibited) = $P(o$ is not prohibited) = 0.5. Next, we assume a prior over values of **s** such that for any artifact noun predicate p, the probability that $\mathbf{s}(p) = i$ is equal to the probability that $\mathbf{s}(p) = j$ for all i, j on the interval [0,1].[20]

Finally, we assume that for each condition of the experiment, there is no a priori interpreter uncertainty regarding how to parameterize the functions **F** and **W**, as (13) exemplifies:[21]

[19] We implicitly assume here that *of* and *a* both denote $\langle\langle e,d \rangle, \langle e,d \rangle\rangle$-type identity functions.

[20] This amounts to a uniform prior over standards of comparison.

[21] A consequence of these simplifying assumptions is that our implementation of (12) is not, in fact, a joint inference model insofar as no update occurs for the **F** and **W** variables and, moreover, **s** value probabilities are uniform on both the prior and posterior distribution. In our implementation, only beliefs regarding the meaning space (the prohibition/requirement status of objects) are updated; however, (12) demonstrates how the model could be implemented under more realistic assumptions about interpreter uncertainty regarding context parameter values.

(13) **Parameter values (*No electronic devices* scene, goal = "Limit distracting light"):**

$$\mathbf{F}(\text{elec. device}) = \left[\texttt{cat}^{\textit{elec.device}},\ \texttt{emit-light}\right]$$

$$\mathbf{W}(\text{elec. device},\ \texttt{cat}^{\textit{elec.device}}) = \gamma \qquad \mathbf{W}(\text{elec. device},\ \texttt{emit-light}) = 1-\gamma$$

In conditions where participants are exposed to an explicit policy goal (e.g., the goal of limiting distracting light from the theater in the *No electronic devices…* scene), **F** maps the measure function denoted by the artifact noun predicate to two component measure functions: one that measures the extent to which entities in the domain possess the feature relevant to the mentioned goal (e.g., `emit-light`, which maps entities to a continuous scale that tracks the extent to which entities emit light), parameterized by the **feature attribution** norming study described in Section 3.1; and another measure function $\texttt{cat}^{\textit{artifact-noun}}$ that measures the extent to which entities are believed to possess the quality of being a member of the relevant artifact noun category independent of local interpretive context. (This second measure function is parameterized by the **category membership** norming study, also described in Section 3.1).

The status of the `cat` measure function warrants additional discussion. Though it is a primitive in our implementation of the interpretive model in (12), it is best understood in our framework as a proxy for a weighted composite of several atomic dimensions relevant to the interpretation of the artifact nouns under investigation. In particular, we posit that `cat` approximates those dimensions (and their relative importance) in a context where there is no rule-issuing authority and hence no policy objectives that might influence the evaluation of artifact noun categories.

With these preliminaries in mind, we can employ the modeling framework in (12) to compare the two hypotheses which motivated the experiment. On the Goal Insensitive hypothesis, we expect that observation of an explicit policy goal should not systematically modulate interpreter beliefs regarding the dimensions that are relevant to the evaluation of nouns such as *vehicle* or *electronic device*. In other words, the dimensions that interpreters believe to be relevant – and the relative importance of those dimensions – should be faithfully approximated by `cat`. On the other hand, on the Goal Sensitive hypothesis, we expect that the dimensions that reflect policy objectives (e.g., `emit-light`) are considered additionally relevant in contexts where overt policy objectives are observed.

In our framework, these hypotheses reflect possible valuations of **W**, the function that returns the weight assigned to dimensions of an artifact noun in interpretation. For contexts in which a policy objective is directly observed, as in (13), a free parameter $\gamma \in [0,1]$ weights the relative importance of the composite `cat` dimension. A γ value of 1 reflects a parameterization of **W** that exclusively identifies `cat` as relevant, consistent with the Goal Insensitive hypothesis; γ values less than 1 reflect parameterizations consistent with the Goal Sensitive hypothesis.

γ plays a similar role when modeling interpretation in the 'goal-neutral' condition, as in (14):

(14) **Parameter values (*No electronic devices* scene, goal-neutral condition):**

$$\mathbf{F}(\text{elec. device}) = \left[\texttt{cat}^{\textit{elec.device}},\ \texttt{emit-light},\ \texttt{emit-noise},\ \texttt{can-record}\right]$$

$$\mathbf{W}(\text{elec. device},\ \texttt{cat}^{\textit{elec.device}}) = \gamma$$

$$\mathbf{W}(\text{elec. device},\ \texttt{emit-light}) = p(\text{"Limit distracting light"}) * (1-\gamma)$$

$$\mathbf{W}(\text{elec. device},\ \texttt{emit-noise}) = p(\text{"Limit distracting noise"}) * (1-\gamma)$$

$$\mathbf{W}(\text{elec. device},\ \texttt{can-record}) = p(\text{"Prevent pirate recordings"}) * (1-\gamma)$$

In the 'goal-neutral' condition, we posit that interpreters consider `cat` alongside each goal-

relevant dimension according to the a priori plausibility of the dimensions' corresponding policy objectives. The plausibility function p maps goals to probabilities such that, e.g.,
$p(\text{“Limit distract. light”}) + p(\text{“Limit distract. noise”}) + p(\text{“Prevent pirate recordings”}) = 1.$[22]

4.3. Parameter estimation and model assessment

With the parameter assumptions outlined above, there remains one free parameter: γ. We estimate the value of γ using Bayesian Data Analysis (BDA). In BDA, a posterior probability distribution $P(M|D)$ over models M, given observed experimental data D, is inferred using Bayes' Rule, as shown in part (a) of (15). For our purposes, the space of possible models includes the different possible parameterizations of γ for the model described in (12), plus fixed parameter value assumptions for the other parameters. This is shown in part (b) of (15).

(15) a. $P(M|D) = P(D|M) * P(M)$ b. $P(\gamma = i|D) = P(D|\gamma = i) * P(\gamma = i)$

c. $$P(\gamma = i|D) \propto \forall o \Big[P(\underbrace{\text{selection freq. of } o}_{\substack{\text{\# of times } o \text{ selected in} \\ \text{experimental condition } C.}} | \underbrace{B(n, \underbrace{L^{\gamma=i}(o \text{ prohibited}|\text{rule})}_{\substack{\text{Marginal } L \text{ posterior probability of} \\ o\text{'s prohibition in } C\text{, with } \gamma \text{ set to } i.}})}_{\substack{\text{Binomial distribution, where} \\ n = \text{the number of participants assigned to } C.}}\Big] * P(\gamma = i)$$

Our procedure for computing a posterior distribution over γ values is more concretely formalized in part (c) of (15). A value for γ is sampled from a prior distribution, which we take to be uniform on the interval [0,1]. This allows us to compute, for each object in each associated condition, the L posterior probability that the object is prohibited (required) in that condition. We assume that the probability of any participant actually selecting an object in the experiment is equal to this probability. Since we can assume that the behavior of any individual participant is independent of the behavior of the others, we link L's output to a binomial distribution, where the number of observations is equal to the number of participants who viewed an object in a particular condition and the distribution over 'successes' can be thought of as a distribution over predicted selection frequencies for that object in that condition. Some γ values lead to binomial distributions on which the observed selection frequency is improbable; thus, these values are considered unlikely a posteriori. Other values yield distributions on which the observed selection frequency is not surprising; therefore, these values are relatively likely a posteriori.

To efficiently compute a posterior distribution over γ values, we sample from the prior using an MCMC sampling procedure implemented in WebPPL (Goodman and Stuhlmüller 2014). As the left panel of Fig. 3 shows, the γ value of 1 is outside the 95% credible interval of the posterior distribution (maximum likelihood estimate = 0.758, 95% CrI = [0.756, 0.758])[23], indicating strong evidence for $\gamma < 1$ and hence strong evidence for the Goal Sensitive hypothesis.

The Goal Sensitive hypothesis is further supported by comparing the predictions of the model given the maximum-likelihood γ value against those of the model when γ is set to 1. The former γ value yields a model with slightly higher predictive accuracy of individual object selection rates across experimental conditions than does the latter (correlation of predictions and observations r = 0.919 vs. r = 0.896, respectively). However, as mentioned in Section

[22]These values were estimated from the norming study in which policy goals were normed for plausibility.

[23]The point estimate was obtained by computing a Gaussian kernel density estimate using the `density` command in R, and the credible intervals were estimated via bootstrap sampling from the computed density function.

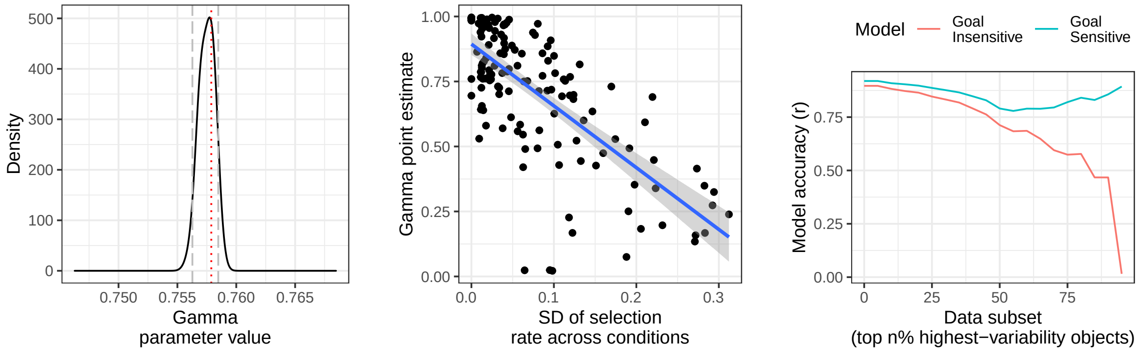


Figure 3: Left: distribution of posterior samples computed via the procedure in part (c) of (15). Dotted line indicates the maximum likelihood estimate; dashed lines indicate the bootstrapped 95% credible interval. Center: object-level γ estimates plotted against object-level variability (SD) in selection rates across conditions. Right: accuracy of the Goal Sensitive ($\gamma < 1$) and Goal Insensitive ($\gamma = 1$) models on progressively higher-variability subsets of the data.

3.2, objects differed in the extent to which they exhibited between-condition variation in their selection rates, with many objects exhibiting little variation. Therefore, in a post-hoc analysis, we investigated whether higher degrees of variation were explained by higher degrees of goal sensitivity as measured by γ. To explore this, we used the procedure in part (c) of (15) to separately fit the model to each object seen in the experiment. The individual γ estimates for each object are plotted against objects' between-condition selection variability in the center cell of Fig. 3. As evident from the figure, γ estimates and selection variability are inversely correlated, suggesting that the selection behavior for high-variability objects is best modeled by models that posit high degrees of goal sensitivity (as reflected by relatively low γ values).[24]

Unlike the Goal Insensitive model, the Goal Sensitive model makes different predictions across goal conditions; however, we sought to determine whether these predictions bore any systematic relationship to the variation we actually observed in the objects that were sensitive to the goal condition manipulation. Therefore, in a second post-hoc analysis, we investigated whether the predictive advantage of the Goal Sensitive model over the Goal Insensitive model varies as a function of the between-condition variability exhibited by the experimental data against which the models are evaluated. To test this, we used the procedure in part (c) of (15) to fit the model to the top n% highest-variability objects in the overall dataset, where $n = [95, \ldots, 5, 0]$.

For each data subset, applying the procedure in part (c) of (15) resulted in a maximum likelihood estimate of the γ parameter, which was then used to parameterize the model and predict response patterns for that subset. As the righthand cell of Fig. 3 shows, the accuracy of the Goal Insensitive model is degraded when restricting to data subsets with progressively higher between-condition selection variation. Compare this result to that of the Goal Sensitive model, which does not exhibit the same degradation even when focusing on very high-variance data.

[24]We further investigated this relationship with a Bayesian mixed effects regression model predicting object-level γ point estimates from a fixed effect of selection variability (SD), with by-item random intercepts. We found strong evidence of a negative relationship between variability and γ estimates ($\hat{\beta} = -2.41$, 95% CrI = $[-2.82, -2.00]$).

5. Contra alternative accounts

We demonstrated that a model of pragmatic interpretation grounded in a context-sensitive, multi-dimensional semantics for artifact nouns can accurately predict the data observed in the experiment. However, one might still wonder how we can be sure that goal information actually modulated beliefs about the category boundaries of artifact nouns. On an 'imprecision'-based account, policy goals are orthogonal to how the extension of an artifact noun category is determined; rather, beliefs about such goals signal how 'loosely' to interpret artifact nouns. That is, policy goals serve to modulate the 'pragmatic slack' associated with such nouns, where 'slack' measures distance from truth tolerated in context (following Lasersohn 1999).

On this account, we expect that for each artifact noun category examined in the experiment, a context-invariant 'core' set of objects should always be treated as within the category for the purposes of interpretation; policy goals, however, may selectively allow for objects strictly outside the category to be treated as 'close enough' to the category for the purposes of interpretation. A conceptual challenge for this account is to articulate the conditions of category membership such that (for example) cell phones are *electronic devices* but flashlights are not.

This account also faces an empirical challenge: many objects that were judged to be category members in norming exhibited relatively low selection rates in certain goal conditions.[25] (The boombox, for example, received an *electronic device* category membership score close to ceiling; comparable to the scores of a camcorder and smart watch). To explain this pattern, the imprecision account is committed to the claim that such objects are, strictly speaking, outside the category but merely treated as such under certain conditions.

On a domain restriction (DR) analysis, policy goal information merely suggests that the rule is limited to a certain restricted domain of entities (but the extension of, e.g., *electronic device* is invariant across contexts). DR almost certainly plays a part in rule interpretation. (For example, had a pacemaker been shown to participants, it is plausible that many participants would have considered it an *electronic device* but an exception to the *No electronic devices ...* rule).

However, an analysis that focuses entirely on DR is in tension with the observation that the decision-making contexts tested in the experiment are susceptible to meta-linguistic commentary as to what 'counts as' a member of the category denoted by the noun as in (16a), similar to contexts where thresholds of comparison for gradable adjectives may be explicitly negotiated as in (16b). This suggests that in (16a) and (16b), resolving uncertainty as to what 'counts as' an *N* is relevant for satisfying the speaker's wishes. The first sentence in (16c), however, intuitively involves DR to a discourse-salient set of bottles (ones bought for the party), but what 'counts as' a bottle of Heineken is not up for negotiation (nor is it negotiated via the DR):

(16) a. No electronic devices are allowed in the theater. (By the way: for our purposes, a flashlight counts as an electronic device.)
b. Get me a long ladder. (By the way: for our purposes, 20 feet counts as long for a ladder.)

[25] This is reflected in the upper-right quadrant of the center panel of Figure 2 and is also supported by the results of the polynomial regression analysis, which suggests that selection variance increases linearly with category membership score in addition to exhibiting an inverse parabolic relationship with that variable.

c. (Planning a party): Put all the bottles of Heineken in the fridge. (# By the way: for our purposes, nothing that my neighbors bought for their party counts as a bottle of Heineken.)

We conclude that when it comes to the interpretation of artifact nouns in rule contexts, goal sensitivity reflects (at least in part) context-sensitive resolution of category boundaries.

6. Discussion and conclusion

The results of our experiment support the claim that highlighting the functions of artifact noun objects can serve as a cue for how interpreters resolve artifact noun category boundaries in context. This observed context sensitivity motivated a semantic proposal whereby the dimensions invoked by an artifact noun – as well as the relative importance of those dimensions – can vary across contexts. This proposal was, in turn, supported by a computational pragmatic model of interpretation that accurately predicts the experimental data by virtue of being grounded in an explicitly multi-dimensional and context-sensitive truth-conditional semantics.

One might object that the semantics we have offered is too context sensitive, in that it suggests that artifact nouns lexicalize no minimal necessary conditions for category membership. Compare our proposal in (8) to that of Grimm and Levin (2017), whose analysis integrates an abilitative modal semantics for artifact nouns. On their analysis, a nominal predicate is true of an entity iff in a maximally-close accessible world, the entity participates in a 'minimal' event e_{min} that exhibits lexically-specified properties (e.g., being used for transport):

(17) a. $[\![\text{ABLE}(P(x))]\!]^{w,g,h_x,j} = 1$ iff $\exists w' \in W$ s.t.:
(i) w' is accessible from w for an individual d given h_x;
(ii) w' is maximally close to the ideal established by $j(w)$, and
(iii) $< w', d > \in [\![P]\!]$

b. $[\![\text{vehicle}]\!] := \lambda y[\text{ABLE}[x \text{ uses } y \text{ for transport in } e_{min}]]^{w,g,h_y,j}$

c. $[\![\text{car}]\!] := \lambda y[\text{ABLE}[x \text{ uses } y \text{ for transport in } e_{min} \wedge \text{has-four-wheels}(y)]]^{w,g,h_y,j}$

[Grimm and Levin (2017): pp. 4 & 7]

Grimm and Levin's (2017) analysis can straightforwardly capture entailment relations between artifact noun superordinates (e.g., *vehicle*) and basic-level expressions (e.g., *car*). On the proposal in (8), capturing these patterns requires stipulating constraints on how free parameters are valued for superordinate artifact nouns and their basic-level counterparts.

However, the assumption of total context sensitivity can be revised by imposing lexical restrictions on multi-dimensional interpretation. An option we will briefly consider privileges a primary class of essential, lexicalized dimensional properties (E_1 through E_n) over a context-dependent class of properties (in **F**) whose relevance is free to vary across contexts.

(18) $[\![\text{vehicle}]\!]^{\mathbf{F,W}}_{\langle e,d\rangle} = \lambda x. \sum_{f \in \mathbf{F}(\text{vehicle})} E_1(x) * \cdots * E_N(x) * f(x) * \mathbf{W}(\text{vehicle}, f)$
... where E_1 through E_N are essential properties of vehicle-hood.

The denotation in (18) includes an additive measure function – similar to (2) and (8). Therefore, (18) is consistent with the sort of dimension accessibility that Sassoon and Fadlon (2017) identify in order to explain the intermediate acceptability of artifact nouns in dimensional and degree constructions. However, 'essential' properties compose in a multiplicative manner with context-sensitive properties, such that failure to exhibit any single essential property significantly penalizes the composite measure value.

What are an artifact noun's 'essential' properties? Following Grimm and Levin (2017), such properties might in some cases include function-based potentialities (e.g., 'able to be used for transport'), which those authors represent with a semantics that invokes an 'associated event.' Such an event may, for some nouns, reflect a lexically-specified purpose (the 'telic' role of Pustejovsky 1995, see also Nichols 2008); in other cases, such as *cake* and *statue*,"the event of creation or manufacture... may be as important in human interaction with a particular artifact as the event of use" (Levin et al. 2019: 434, see also the 'agentive' role of Pustejovsky 1995).

A second question for a (18)-type analysis regards entailment relations between superordinate and basic-level categories. One option would be to stipulate that superordinate category membership is an essential property of corresponding basic-level category membership (e.g., to be a *car*, something must also be a *vehicle*). Another option is to say that essential properties of a basic-level category are a superset of the essential properties of the superordinate category:

(19) $[\![\text{car}]\!]^{\mathbf{F,W}}_{\langle e,d\rangle} = \lambda x. \sum_{f\in\mathbf{F}(\text{car})} E_1(x) * \cdots * E_N(x) * \cdots * E_M(x) * f(x) * \mathbf{W}(\text{car}, f)$
... where E_1 through E_N are essential properties of vehicle-hood.
... E_{N+1} through E_M are essential properties of car-hood.

However, unlike Grimm and Levin's (2017) analysis, this analysis falls short in that if X is a car, it is merely likely true that X is also a vehicle by virtue of exhibiting the properties that are essential to the latter category. To rectify this, further constraints on the valuation of the basic-level term's free parameters could be imposed in order to guarantee that the basic-level term asymmetrically entails the superordinate term. Such constraints could be thought of as meaning postulates or merely as descriptive generalizations of how such terms are interpreted in context. (For example, contexts where 'pollution' is relevant for interpretation of *car* may tend to also be contexts where it is relevant for interpretation of *vehicle*).

This project also explored an underappreciated dialectical relationship between formal semantics/pragmatics, computational linguistics, and the law. In search of an empirical domain in which to systematically investigate the context dependence of artifact noun interpretation, we identified a systematic relationship between context – in particular, the policy objectives of lawmakers – and the production of context-sensitive natural language. Inspired by a normative debate in jurisprudence regarding the role of such context in legal interpretation, we conducted an experiment to test how laypeople decide the meaning of legal rules. Our findings appear to align more closely with the prescriptions of purposivists (for whom policy goals are often germane to legal interpretation) than with those of textualists, who tend to de-emphasize cues to legislative purpose that lie beyond the letter of the law.[26]

Should the way(s) in which laypeople read the law inform how lawyers and judges read the law? As linguists, we will remain noncommittal. However, our results and analysis speak to the purposivism/textualism debate in a more nuanced manner. To see how, consider how U.S. Supreme Court Justice Antonin Scalia (a textualist) derides the legacy of *Church of the Holy Trinity vs. US*, a case which Scalia sarcastically laments "is cited to us whenever counsel

[26]See also Grinsell (2017) for a linguistic argument in support of considering policy context in the interpretation of multi-dimensional expressions (especially adjectives such as *reasonable*) as they appear in the law.

wants us to ignore the narrow, deadening text of the statute, and pay attention to the life-giving legislative intent. It is nothing but an invitation to judicial lawmaking" (Scalia 1997: 49).

Scalia's quote presupposes a dichotomy between textual meaning and the policy objectives of the text's drafters: his concern as a textualist is that judges 'override' textual meaning by giving consideration to the aims that legislators sought to achieve. However, if our analysis is on the right track (namely, that artifact nouns are semantically underspecified and that policy objectives serve as a cue for how to resolve semantic underspecification in rule interpretation contexts), then artifact nouns may be a case in which a dichotomy between 'text' (along with its conventional meaning) and 'purpose' lacks coherence.[27] If so, then the jurisprudential debate will at a minimum have to be reconceived to accommodate these linguistic facts.

A. Rules and goals tested in the experiment

No electronic devices are allowed in the theater. (The managers of a theater are concerned that ...) *1:* certain objects, when brought into the theater, create noise that could distract audience members and performers. *2:* certain objects, when brought into the theater, emit light that could distract audience members and performers. *3:* audience members might try to record performances and distribute pirate recordings online.
Festival attendees must wear a face covering. (The organizers of an outdoor street festival...) *1:* desire that attendees appear in costume. *2:* are concerned about the possibility that airborne illnesses might spread among attendees. *3:* are concerned that attendees may develop frostbite due to cold weather.
No outside food allowed in the garden. (The managers of a museum are concerned...) *1:* that certain objects, when brought into the museum's garden area, will attract nuisance insects. *2:* about visitors littering in the museum's garden area. *3:* that the restaurant located in the museum's garden area is losing business to outside competition.
Furniture brought to the waste management center can be disposed of for free. (The operators of a waste management center typically charge a fee for processing drop-offs. However, ...) *1:* they recently received a request from a local homeless shelter for objects that can be used as storage, that can be comfortably sat/slept upon, or otherwise could function as furniture for those in need. *2:* they recently devised a plan to resell viable secondhand objects at auction, rather than disposing of the objects in a landfill. *3:* they recently devised a plan to break down objects into valuable raw materials such as metal and lumber, rather than disposing of the objects in a landfill.
Students are prohibited from wearing jewelry at school. (The administrators of a public high school ...) *1:* are concerned that certain objects, when worn, pose a safety risk to students. Loose, dangling objects in particular could get caught on exercise equipment in gym class, on machinery in the school's wood shop class, or on certain appliances in the school's home economics class. *2:* are concerned about theft from lockers and common areas. In response to a recent uptick in such thefts, they seek to discourage students from bringing objects of value to school. *3:* are concerned that certain students tend to dress ostentatiously, which undermines a sense of equality among students and distracts from learning in the classroom.
No outside bags are allowed in the convenience store. (The managers of a convenience store are concerned...) *1:* about patrons contaminating food items sold at the store. It is especially important to the managers to keep food free of germs and potential allergens. *2:* about shoplifting. *3:* that certain objects, when brought into the store, are too large for patrons to safely carry without potentially knocking into shelves and creating messes in the aisles.

[27] This conclusion is reminiscent of Carston (2013), who argues that legislative purpose may be part of "the relevant contextual assumptions [that] are available to all ordinary mentally able citizens and [that] would be immediately activated by the text itself" (2013: 30-31). Even if interpreters lack access to explicit evidence of policy goals, legal text may implicitly articulate such goals, which in turn serve as cues for how to resolve linguistic uncertainty.

No pets are allowed in the apartment building. (The managers of an apartment building...) *1:* are concerned that airborne allergens in the apartments will make the units less appealing to prospective tenants in the future. *2:* have received numerous noise complaints from residents. *3:* want to protect furniture, walls, and carpeting in units and common areas from potential damage.
The restaurant is prohibited from selling sandwiches. (The owners of a strip mall have recently leased one of their storefronts to a new restaurant. However, they are concerned that the restaurant's business may directly compete with other businesses in the strip mall, including...) *1:* a Mexican restaurant. *2:* a bagel shop. *3:* a hot dog stand.
Shoes must be worn in the courtyard. (The managers of a hotel are ...) *1:* concerned that guests may accidentally step on rocks or other sharp objects when walking around in the hotel's courtyard area. *2:* concerned that when guests walk around in the hotel's courtyard area, their feet may be bitten by garden snakes. *3:* attempting to impose a dress code for the hotel's courtyard area.
Participants in the archeological dig must bring a tent. (The organizers of a planned multi-day archeological dig want to ensure...) *1:* that participants are protected against the intense sun, to minimize the risk of developing severe sunburns. *2:* that participants are protected from insects, scorpions, and other potentially dangerous pests in the area. *3:* that participants and their belongings are protected from the rain.
Customers wearing a uniform receive a 20% discount on all orders. (The managers of a restaurant seek to bolster the restaurant's image...) *1:* as a pro-military establishment. *2:* as an establishment that supports local first responders. *3:* as an establishment that caters to local working folk in the community.
No vehicles are allowed in the town square. (A small town is concerned ...) *1:* that air pollution is becoming a problem in their town square. *2:* that there is too much ambient noise in their town square. *3:* for the safety of pedestrians in their town square.

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Against the lexical view of cumulative inferences[1]

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Abstract. Ionin and Matushansky (2002) propose, based on data from comitatives in Russian, that distributivity is associated only with the spec,TP position. In this paper, I (i) present data from the Lebanese Arabic double subject construction that supports Ionin and Matushansky's conclusion that the availability of distributive readings is sensitive to syntactic position and (ii) argue for a novel theory of how this arises. In particular, I propose that pluralization operators are the only sources of cumulative inferences and that they are restricted in distribution such that they can only apply to predicates derived by movement and never to lexical predicates. I show that this predicts a set of facts from the double subject construction all indicating that there is a relationship between the availability of a distributive reading over a DP and whether that DP moves. This proposal argues against an influential approach where cumulativity is taken to be an inherent property of lexical predicates (Krifka 1992; Kratzer 2008).

Keywords: Plural predication, cumulative inferences, lexical cumulativity

1. Introduction

Ionin and Matushansky (2002) argue from the alternation between singular and plural comitatives in Russian that distributivity is associated only with the spec,TP position. In the singular comitative in (1a), only collective readings are available: (1a) is not true in a scenario where Alexandra and Boris danced alone or with different people. On the other hand, the counterpart in (1b) is true as long as both Alexandra and Boris danced. Ionin and Matushansky argue that in both (1a) and (1b), *Aleksandra s Borisom* starts out as a comitative coordination. In (1a), the first conjunct moves to spec,TP, while in (1b) the entire coordinated DP moves, thus explaining the difference in word order between (1a) and (1b). Furthermore, the verb agrees with the subject in spec,TP, giving rise to singular agreement in (1a) and plural agreement in (1b). They propose that the restriction to collective readings with singular comitatives is due to distributivity being associated only with the spec,TP position: since the coordinated DP is not in spec,TP in (1a), it can't get distributed over.

(1) a. **Aleksandra** tancevala **s** **Borisom**.
Alexandra-NOM danced.SG.F with Boris-INST
'Alexandra danced with Boris.'
b. **Aleksandra** **s** **Borisom** tancevali
Alexandra-NOM with Boris-INST danced-PL
'Alexandra and Boris danced.'

The Lebanese Arabic double subject construction (2a) exhibits an alternation with standard conjunction (2b) that bears a striking similarity to (1) above. The double subject construction (Mohammad 1989; Aoun et al. 1994) is exemplified in (2a), in which there is thematically

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one subject (*Rasha and Hadi*), but two realized DPs: the higher subject *Rasha* and the lower subject *her and Hadi*. Note that the pronoun in the first conjunct agrees in person and number with the higher subject. Crucially, the double subject construction only allows for collective readings when the two conjuncts are atomic: (2a), like (1a), is only true if Rasha and Hadi danced together. This differs from the case with standard coordination in (2b), which like (1b) is true as long as both Rasha and Hadi danced.

(2) a. **Rasha** raʔasit **hiyye w Hadi**.
Rasha danced.3SG.F **her and Hadi**
'Rasha and Hadi danced with each other.'
b. **Rasha w Hadi** raʔaso.
Rasha and Hadi danced.3PL
'Rasha and Hadi danced.'

I argue, in parallel with Ionin and Matushansky, that the only difference between (2a) and the counterpart with standard coordination in (2b) is the position of the conjoined DP: in (2a), *Rasha* moves to spec,TP, leaving behind a resumptive pronoun in its base position, while in (2b) the entire conjoined DP moves to spec,TP. This alternation manifests here with a standard conjunction rather than the comitative found in Russian. Furthermore, the presence of the resumptive pronoun provides evidence that the higher subject moved from within the coordinated DP. The double subject construction therefore supports Ionin and Matushansky's conclusion that the availability of a distributive reading is sensitive to syntactic position.

Ionin and Matushansky's account leaves unanswered the question of how it comes about that distributivity is only associated with the DP in spec,TP. In this paper, I investigate this question through looking in detail at the meaning restrictions in the double subject construction. I adopt a theory of plural predication where the pluralization operator * (Link 1983) is the source of the distributive reading in (2b) and argue that all pluralization operators, including * and **, can only apply to predicates derived by movement. I argue that in (2a), the conjoined DP *Rasha w Hadi* must be interpreted in its base position and therefore can't scope above a pluralization operator in order to be distributed over. On the other hand in (2b), the conjoined DP undergoes movement from its base position to spec,TP and therefore can take scope above a pluralization operator. This proposal is able to predict a range of additional data beyond the basic case in (2) and the cases that Ionin and Matushansky consider, including co-distributive readings that arise when both conjuncts are plural and the availability of distributive readings in the double subject construction in certain cases when auxiliaries are present.

I show that this conclusion that the availability of distributive readings over a DP is sensitive to the scope of that DP is incompatible with a prominent view that argues that lexical predicates are inherently pluralized (Krifka, 1992; Kratzer, 2008 a.o.). Plural predication in natural language gives rise to a certain set of inferences, called cumulative inferences. This is illustrated for 1-place predicates in (3a). One view on the source of inferences like (3a) attributes them to a universal property of lexical predicates (Krifka, 1992; Kratzer, 2008 a.o.). The generalization to draw from these examples is that whenever a predicate is true of a set of subparts of a plurality that add up to the plurality, then it is true of the plurality. This can be formalized as shown in (3b) for 1-place predicates.

(3) a. Context: John and Mary are students.

⟦John danced⟧ ∧ ⟦Mary danced⟧ $\rightarrow_C$ ⟦The two students danced⟧

b. **Cumulativity universal:** For any lexical predicate $P_{\langle\alpha,t\rangle}$,
$$\forall x_\alpha y_\alpha[(P(x) \wedge P(y)) \rightarrow P(x \oplus y)]$$

Another view is that predicates are not inherently cumulative, but rather pluralization operators, which modify predicates and make them cumulative, are solely responsible for cumulative inferences. For 1-place predicates, this operator is Link's * operator (4a). * closes the extension of a predicate under sum formation (Link 1983). For example, when both a and b are atomic individuals *f(a⊕b) is true under the conditions given in (4b).

(4) a. $[\![*]\!]= \lambda f_{\langle\alpha,t\rangle}.\lambda x.\exists g_{\langle\alpha,t\rangle}[[\forall y[g(y)=1 \rightarrow f(y)=1] \wedge x = \bigoplus g]$

b. *f(a⊕b)= 1 iff (f(a)∧ f(b)) ∨ f(a ⊕ b).

To see how this view generates cumulative inferences, consider the example in (3a). If ⟦dance⟧ is true of John (j) individually and Mary (m) individually (a), ⟦*dance⟧ will be true of j and m individually but also of their sum (j⊕m). The starred predicate is therefore always true of a plurality when the unstarred predicate is true of the subparts of that plurality. Starred predicates necessary allow for distributive readings, since a starred predicate can be true of a plurality in virtue of it being true of its atomic subparts.

(5) a. ⟦dance⟧ = { j, m }

b. ⟦*dance⟧={ j, m, j⊕m }

I will argue that a satisfactory account of the meaning restrictions in the double subject construction is incompatible with lexical cumulativity. Assuming that the predicate ⟦dance⟧ applies to the plurality denoted by *her and Hadi* in (2a), lexical cumulativity incorrectly predicts that we should get a distributive reading in (2a). In particular, lexical cumulativity would ensure that (2a) is true as long as it is true that Karim danced and that Rasha danced, therefore incorrectly predicting that (2a) is true in a distributive scenario where Karim and Rasha danced with different people or alone. On the other hand, the proposal I argue for assumes that pluralization operators are the only sources of cumulative inferences. Therefore, by ensuring that pluralization operators can't scope below the lower conjoined DP in (2a), we can predict the restriction to collective readings in the double subject construction.

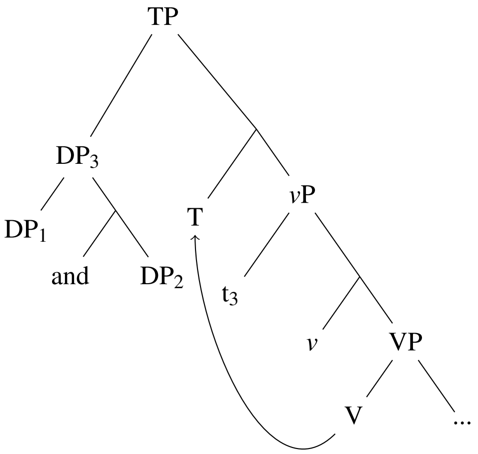
The rest of the paper is structured as follows. In section 2, I argue for a set of syntactic assumptions regarding the double subject construction and show the differences in meaning between the double subject construction and standard coordination when the two conjuncts are atomic. In section 3, I present my intial proposal and extend it to cases where the two conjuncts are plural. In section 4, I discuss the interplay between restrictions on movement and on the distribution of pluralization operators required to derive the LFs proposed in section 3 and argue for the restriction that pluralization operators can only apply to derived predicates. Section 5 concludes by discussing further implications of my proposal beyond cumulative inferences.

2. The LA double subject construction

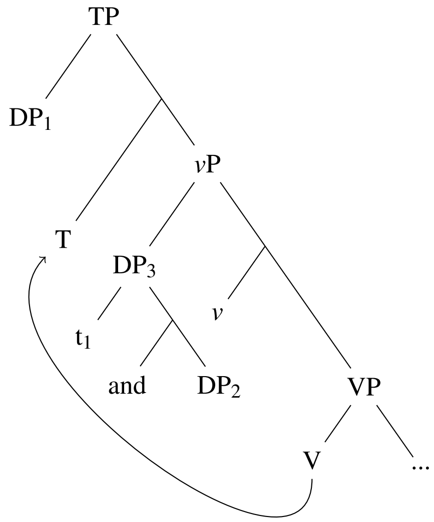
2.1. Syntax of the double subject construction

In this section, I argue that the double that the double subject construction and the counterpart with standard coordination have the structures in (6) and (7) respectively. In particular, the conjoined DP is always base-generated in spec,*v*P. In the double subject construction, the first conjunct moves to spec,TP, leaving behind a resumptive pronoun which is pronounced in the base position. On the other hand, in the counterpart with standard coordination, the whole conjoined DP moves to spec,TP and nothing is pronounced in the base position. Additionally, the verb moves from V to T in both. This derives the word orders we observe in (2a) and (2b).[2]

(6)



(7)



There is syntactic evidence that both the higher and lower DPs in the double subject construction are in fact in subject positions. One might wonder whether the double subject construction simply involves topicalization or left-dislocation rather than movement of the first conjunct to spec,TP. Two pieces of evidence show that the higher DP does in fact move to a subject position (spec,TP). First, the verb in the double subject construction obligatorily agrees with the higher DP, as illustrated in (2a) above, but verbs don't in general agree with topicalized DPs in LA.[3]Additionally, negative quantifiers can't be topicalized (Cable 2010), as shown in (8b) for LA, but a negative quantifier can be the higher subject of the double subject construction (8a).

(8) a. wala telmiz daras howwe w Hadi.
no student studied.3SG.M him and Hadi.
No student studied with Hadi.

b. *wala telmiz, Rima ħikit maʕ-o.
no student, Rima talked.3SG.F with-him.

As for the lower DP, we can also show that it is in a subject position, as evidenced by the fact that it can also be the target of an agreement probe when auxiliaries are present, and it can control the subject of an obligatory subject control verb, such as *try*. As shown in (9), when the lower subject precedes the verb (this happens when auxiliaries are present), the verb can agree with the lower subject. In (10), we see that the lower subject can control a PRO in the embedded subject position of the obligatory subject control verb 'try'. The coordinated DP in

[2]Note that word order is somewhat flexible in Lebanese Arabic, so other word orders are available in (2a) and (2b). I will not discuss the issue of how alternative word orders are derived in this paper.

[3]There is evidence that what we see in (2a) is not first conjunct agreement, which would be a possible confound here. In particular, first conjunct agreement is not possible when modifiers which require a plural subject, like *together*, are present (Aoun et al. 1994), but with the double subject construction we obligatorily get agreement with the higher subject even when *together* modifies the verb.

(10) is in the higher clause, as shown by the fact both Hadi and Karim are both the agents of *try*. I therefore conclude that the lower DP is also in a subject position (spec,*v*P).

(9) Karim ke:n howwe w Hadi ʕam yilʕabo
Karim was.3SG.M him and Hadi PROG play.3PL
'Karim and Hadi were playing.'

(10) Karim jarrab howwe w Hadi yħaddro ʕasha.
Karim tried.3SG.M him and Hadi make.3PL dinner
'Karim and Hadi tried to make dinner.'

I have therefore provided evidence that for the trees assumed in (6) and (7). Note that the only difference between the double subject construction and standard coordination under these assumptions is whether the first conjunct or the entire conjoined DP moves to spec,TP.

2.2. Meaning restrictions

This section discusses a preliminary set of meaning restrictions that arise in the double subject construction. I show that when the two conjuncts denote atomic individuals, only collective readings are available. To illustrate this, I begin by considering the behavior of the double subject construction with a class of predicates that are underspecified with respect to whether they give rise to a distributive or collective interpretation. One classical example of such a predicate is *lift the piano*. Consider the example in (11) where *lift the piano* is predicated of a plural DP. (11) can be true in either the collective scenario in 1 or the distributive scenario in 2.

(11) The two students lifted the piano.
  a. **Scenario 1**: The two students lifted the piano together.
  b. **Scenario 2**: Each of the two students independently lifted the piano.

The analogous example to (11) where the subject is a conjoined DP again can be true in either a distributive or collective scenario. This is shown with standard conjunction in Lebanese Arabic in (12). This parallel between definite plurals and conjoined DPs motivates an analysis of DP conjunction as denoting a plural individual.[4]

(12) Rasha w Hadi ħimlo l piano.
Rasha and Hadi lifted.3PL the piano
'Rasha and Hadi lifted the piano.'
  a. **Scenario 1**: Rasha and Hadi lifted the piano together.
  b. **Scenario 2**: Rasha walked in and lifted the piano by herself and then Hadi came in later and lifted the piano by himself.

Unlike standard coordination in (12), the double subject construction only allows for the collective reading. As shown in (13), the counterpart of (12) with the double subject construction can only be true in a scenario where Rasha and Hadi lifted the piano together.[5,6] Given that

[4]See Schein (2017) for an alternative which argues *and* is always a sentential connective.
[5]The order of object (*the piano*) and the lower DP (*him and Hadi*) in (13) is interchangeable.
[6]Several speakers reported that the string in (13) does allow for a distributive reading if there is a pause after *piano* and focus on the pronoun *hiyye*. There is evidence that this is a completely different construction, which could potentially be due to ellipsis. For example, this reading is no longer available when the conjoined DP is in the scope of a negative quantifier, as in (8a), or in a polar question, while the standard collective reading with the

we have been assuming that the only difference between standard coordination and the double subject construction is the scope of the conjunctive DP, this difference in meaning is surprising. In particular, taking the double subject construction at face value, we can conclude that the availability of distributive readings must be sensitive to scope.

(13) Rasha ħimlet l piano hiyye w Karim.
Rasha lifted.3SG.F the piano her and Karim
'Rasha lifted the piano with Karim.'
a. **Scenario 1**: Rasha and Hadi worked together to lift the piano.
b. #**Scenario 2**: Rasha walked in and lifted the piano by herself and then Hadi came in later and lifted the piano by himself.

The double subject construction shows similar restrictions with other predicates. To illustrate this with a simple predicate, consider the examples with *dance* in (14) and (15). Again, we see that the standard coordination can be true in either a scenario where the Rasha and Hadi danced together or in one where they each danced alone or with different people. On the other hand, the double subject construction is only true in **Scenario 1** where they danced together.

(14) **Scenario 1**: There was a party and Rasha and Hadi danced together.

a. Rasha w Hadi raʔaso.
Rasha and Hadi danced.3PL
'Rasha and Hadi danced.'

b. Hadi raʔas howwe w Rasha.
Hadi danced him and Rasha
'Hadi danced with Rasha.'

(15) **Scenario 2**: There was a party; Rasha and Hadi danced with different people.

a. Rasha w Hadi raʔaso.
Rasha and Hadi danced.3PL
'Rasha and Hadi danced.'

b. #Hadi raʔas howwe w Rasha.
Hadi danced him and Rasha.
'Hadi danced with Rasha.'

The data discussed so far in which the two conjuncts are singular parallels how Ionin and Matushansky (2002) characterize the meaning restrictions imposed by singular comitatives in Russian. It is not obvious how the Lebanese Arabic double subject construction can be attributed to such a comitative construction. In particular, *w* is used for standard cases of conjunctions, and Lebanese Arabic does have a dedicated comitative preposition *maʕ*, shown in (16a). Unlike *w*, *maʕ* can't intervene between two DPs (16b), suggesting that it is a VP rather than a DP adjunct.

(16) a. Rasha ʔakalit maʕ Hadi.
Rasha ate.3SG.F with Hadi
'Rasha ate with Hadi.'

b. *Rasha maʕ Hadi ʔakalo.
Rasha with Hadi ate.3PL

We can reasonably conclude that the only difference between standard coordination and the double subject construction in Lebanese Arabic is the scope of the lower subject. In order to capture the meaning restrictions in the double subject construction, we therefore have to have a theory where whatever is responsible for distributive readings is sensitive to the scope of the subject. In the next section, I develop such an analysis, based on Ionin and Matushansky (2002) proposal where distributivity is taken to be associated with the spec,TP position.

double subject construction remains in these environments.

3. Proposal

I will start by outlining a baseline theory of plural predication. I assume that predicates enter the derivation unpluralized and therefore that lexical cumulativity does not hold. Unpluralized predicates can still apply to pluralities, and there can be lexical restrictions on when an unpluralized predicates is true of a plurality. To make things more concrete, consider a predicate like $[\![$lift the piano$]\!]$. This view predicts that that the cumulative inference in (17) doesn't hold. Nevertheless, $[\![$ lift the piano $]\!]$ can be true of a plurality under certain conditions (those where the plurality collectively lifted the piano).

(17) $[\![\text{lift the piano}]\!](a) \wedge [\![\text{lift the piano}]\!](b) \not\to [\![\text{lift the piano}]\!](a \oplus b)$

Given this view where lexical predicates are not cumulative, pluralization operators must be the sources of cumulative inferences. I assume that pluralization operators, like *, are present in the syntax and are solely responsible for cumulative inferences with plural predication. The lexical entry for * is repeated in (18), where $\bigoplus g$ denotes the sum of all x s.t. g(x)=1.

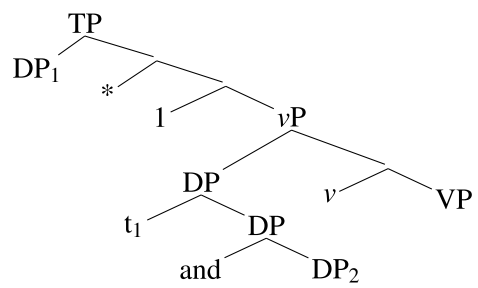
(18) $[\![*]\!] = \lambda f_{\langle e,t\rangle}.\lambda x.\exists g_{\langle e,t\rangle}[[\forall y[g(y) = 1 \to f(y) = 1] \wedge x = \bigoplus g]$ (Link 1983)

Under this view of plural predication, the meaning restrictions in the double subject construction can be made to follow from ensuring that the lower subject can't take scope above a * operator. In what follows, I begin to outline a theory that delivers this result. As mentioned in the introduction, my proposal adopts from Ionin and Matushansky the idea that only the higher DP in spec,TP can be distributed over but embeds this within a particular theory of how distributive readings arise compositionally and what restricts the availability of distributivity. I show in this section that this proposal is able to explain the basic cases where the second conjunct is atomic (Section 3.1), in addition to what happens when the second conjunct is plural, where I argue that the second conjunct can QR and take scope above a pluralization operator (Section 3.2).

3.1. Preliminary proposal

I propose the preliminary LF in (19) for the double subject construction. The higher subject is in spec,TP, while the pronoun in the first conjunct is locally bound below the * operator. Crucially, * takes scope below the higher subject but above the lower subject in the double subject construction. On the other hand, with standard coordination, the coordinated subject in spec,TP scopes above *. I propose that * can only apply to predicates derived by movement, therefore ruling out an alternative LF where * applies directly to the VP below the conjoined DP in spec,*v*P. I will return in section 4 to the questions of how we ensure that conjoined DP in (19) can't move and take scope above a * operator and why an alternative theory where we simply stipulate that * has to be right below spec,TP makes incorrect predictions.

(19)



While the LF in (19) can be derived by movement of the lower subject to a position higher than * and predicate abstraction below * (following a similar derivation to Sauerland, 1998; Beck and Sauerland, 2000), the relationship between the higher and the lower subject does not have to be due to movement. In particular, it could be that the higher subject is externally merged and the lower pronoun bound by an abstractor below the * operator. This has the advantage of avoiding a violation of the coordinate structure constraint (CSC), which bans movement out of a conjoined DP. In particular, one might have thought that what licenses movement out of the first conjunct in the double subject construction is the presence of a resumptive pronoun in the position of the lower copy, but resumptive pronouns do not seem to be able to rescue CSC violations in general, as shown in (20) for LA.

(20) *maʕ min ʔakalit Rasha howwe w Hadi?
with who ate.3SG.M Rasha him and Hadi

We are now in a position to evaluate how the meaning restrictions when the lower conjunct is singular follow from this account. I assume, following Link (1983), that in a conjunction of two individuals, ⟦and⟧ takes the two individuals as arguments and returns their sum (21).[7] The truth-conditions in (22a) and (22b) are predicted for the standard coordination and the double subject construction respectively when the two conjuncts are atomic. In particular, in the double subject construction, the unpluralized predicate applies to the plurality, but in standard coordination, the pluralized predicate ⟦*VP⟧ applies to the plurality.

(21) $[\![\text{and}]\!] = \lambda x.\lambda y.x \oplus y$

(22) a. **Normal coordinated subject:**
$[\![\text{Karim and Hadi [* 1 [t}_1\text{] VP]}]\!] = 1$ iff $(*\lambda x.[\![\text{VP}]\!](x))(\text{k}\oplus\text{h}) =$
1 iff $[\![\text{*VP}]\!](\text{k}\oplus\text{h}) = 1$ iff $\mathbf{[\![VP]\!]\ (k\oplus h)=1 \vee ([\![VP]\!]\ (k)=1 \wedge [\![VP]\!](h)=1)}$

b. **Double subject construction:**
$[\![\text{Karim [* 1 [t}_1\text{ and Hadi] VP]}]\!] = 1$ iff $(*\lambda x.[\![\text{VP}]\!](x\oplus \text{h}))(\text{k}) =$
1 iff $\mathbf{[\![VP]\!]\ (k\oplus h)=1}$

Looking at the examples with *dance*, repeated in (23), we can now predict the differences in truth-conditions between standard coordination and the double subject construction. As shown in (24a), (23a) is predicted to be true if either ⟦dance⟧ is true of both Rasha and Hadi or if it is true of the plurality denoted by the conjunction. On the other hand, (23b) is predicted to be only true if ⟦dance⟧ is true of the plurality (24b). If we assume that ⟦dance⟧ is true of a plurality if and only if the plurality collectively participated in the dancing (i.e. danced together), we predict the differences in truth-conditions between (23a) and (23b): (23b) can only be true if Rasha and Hadi danced together (Scenario 2) while (23a) can also be true when ⟦dance⟧ is true of Rasha and Hadi separately (for example, in Scenario 1). Crucially, this account allows the unpluralized predicates to be true of a plurality under a restricted set of conditions, here in the collective scenario.

[7] Note that we need to rule out the availability of an alternative LF with a Boolean ⟦and⟧, where the two conjuncts are lifted to GQs, an operation that is arguably independently needed for coordinated DPs like *Mary and every professor* (Link 1987) . This LF would give rise to a distributive reading regardless of the scope of the conjunction. One possibility is that lifting individuals of type e to GQs is only available when a DP of type e and a quantifier DP are being conjoined, but this issue deserves more careful consideration.

(23) a. Rasha w Hadi raʔaso.
Rasha and Hadi danced
Scenario 1: Rasha and Hadi danced with different people.
Scenario 2: Rasha and Hadi danced together.
b. Rasha raʔasit hiyye w Hadi.
Rasha danced her and Hadi
#Scenario 1: Rasha and Hadi danced with different people.
Senario 2: Rasha and Hadi danced together.

(24) a. $[\![(23a)]\!]= 1$ iff $([\![\text{dance}]\!](r)=1 \wedge [\![\text{dance}]\!](h)=1) \vee [\![\text{dance}]\!]\ (r\oplus h)= 1$
b. $[\![(23b)]\!]= 1$ iff $[\![\text{dance}]\!](r\oplus h) = 1$

These restrictions on when a predicate can be true of a plurality are incompatible with lexical cumulativity. Taking the example with *dance* in (23b), we clearly see that the cumulative inference does not hold over the lower conjunction (25): the predicate $[\![\text{dance}]\!]$ applies to the plurality r⊕h in (23b), and in the scenario given in (25), $[\![\text{dance}]\!]$ is true of Rasha (r) (25a) and true of Hadi (h) (25b) without it being true of their sum (r⊕h) in the double subject construction. We therefore see that under the syntactic assumptions I motivated above, we can't account for the restrictions while maintaining lexical cumulativity.

(25) Scenario: Rasha and Hadi danced with different people.
a. Rasha danced: True
b. Hadi danced: True
c. Rasha danced her and Hadi: Not True

One possible response in defense of lexical cumulativity is that there is an ambiguity in the lexical entry of *w* (*and*) rather than a difference in scope that is responsible for the meaning differences between the double subject construction and standard coordination. Under this account, there would be two different lexical entries for *w*, where the one used in the double subject construction somehow blocks a distributive interpretation. I return to this question in section 4 and show that distributive readings are in fact available in the double subject construction under certain conditions where the lower subject can take scope above a * operator. This shows that it is not any idiosyncracy of this construction that forces the collective reading but rather the fact that the lower subject has to scope below * in the cases we have seen so far.

Since the predicate applies to the conjoined DP before * applies, the double subject construction provides us a window to directly observe the lexical meaning of predicates before they are pluralized, something which is not possible in a language like English where the subject always scopes higher than the * operator. In order to identify underspecified or collective predicates in English, the standard diagnostic is to test whether the predicate can be true of a plurality without being true of the atomic parts of that plurality. For example, in (26), *lift the piano* is true of *John and Mary* (j⊕m) without being true of *John* (j) and *Mary* (m) individually. We can therefore conclude that $[\![\text{lift the piano}]\!]$ can be true of plural individuals when unpluralized.

(26) Scenario: Mary and John lifted the piano together.
a. Mary and John lifted the piano.
b. #Mary lifted the piano.
c. #John lifted the piano.

It is possible that there is a class of predicates which can be true of plural individuals when unpluralized but nevertheless gives rise to distributive inferences, making it impossible to identify them in the same way as *lift the piano* above. Consider the example with *eat* in (27). We know that *eat* licensed distributive inferences such that whenever *John and Mary ate* is true, *John ate* and *Mary ate* are also true. Therefore, we can't test whether unpluralized ⟦eat⟧ can be true of a plurality with the test used above for *lift the piano*. It could be that ⟦eat⟧ can only apply to atomic individuals (27a) or that ⟦eat⟧ applies to pluralities too under certain conditions (27b). When ⟦eat⟧ is pluralized, these two lexical entries are collapsed, so we can't directly detect in English whether $[\![\text{eat}_1]\!]$ or $[\![\text{eat}_2]\!]$ corresponds to the correct lexical entry for *eat*.

(27) Scenario: John and Mary ate together.
  a. $[\![\text{eat}_1]\!] = \{\text{j, m}\}$
  b. $[\![\text{eat}_2]\!] = \{\text{j, m, j}\oplus\text{m}\}$
  c. $[\![{}^*\text{eat}_1]\!] = [\![{}^*\text{eat}_2]\!] = \{\text{j, m, j}\oplus\text{m}\}$

The double subject construction allows us to distinguish $[\![\text{eat}_1]\!]$ from $[\![\text{eat}_2]\!]$. In (28), we see that *Karim ate him and Rasha* is true in a scenario where Karim and Rasha ate together but not in a scenario where they ate separately. This shows that unpluralized ⟦eat⟧ can be true of a plurality but only when the plurality ate together. Thus, we can conclude that *eat* is in fact an underspecified predicate in that it can be true of both atomic individuals and pluralities when unpluralized, such that $[\![\text{eat}_2]\!]$ corresponds to the correct extension in (27).

(28) Karim ʔakal howwe w Rasha.
  Karim ate him and Rasha
  'Karim ate with Rasha.'
  a. **Scenario 1**: Karim and Rasha ate together.
  b. #**Scenario 2**: Karim and Rasha ate separately.

The account proposed here predicts that we should be able to get a distributive reading over the higher subject in the double subject construction. This is because the higher subject takes scope above the * operator. This prediction is borne out, as shown in (29). (29) is true in Scenario 1, where there is distributivity only over the higher subject and in Scenario 2, where the 3 individuals collectively lifted the piano. On the other hand, it is not true in Scenario 3, which requires distributivity over each of the 3 individuals. This is exactly what is predicted, as shown by the truth-conditions in (30). In particular, (29) is predicted to be true if ⟦lift the piano⟧ is true of the plurality r⊕h⊕k or if it is true of r⊕k and h⊕k separately.

(29) Rasha w Hadi ħimlo l piano henne w Karim.
  Rasha and Hadi lifted.3PL the piano them and Karim
  'Rasha and Hadi lifted the piano with Karim.'
  a. **Scenario 1:** Rasha and Hadi each lifted the piano with Karim.
  b. **Scenario 2:** Rasha, Hadi and Karim lifted the piano together.
  c. #**Scenario 3:** Rasha, Hadi and Karim each lifted the piano separately.

(30) $[\![(29)]\!] = 1 \text{ iff } ({}^*(\lambda x.\ [\![\text{lift-the-piano}]\!](x\oplus\text{k})))(\text{r}\oplus\text{h}){=}1 \text{ iff}$
  $[\![\text{lift-the-piano}]\!](\text{r}\oplus\text{h}\oplus\text{k}) \vee ([\![\text{lift-the-piano}]\!](\text{r}\oplus\text{k}) \wedge [\![\text{lift-the-piano}]\!](\text{h}\oplus\text{k}))$

3.2. Extension: when the second conjunct is plural

Assuming that the second conjunct does not move from its base position at LF, the account predicts that there can't be a distributive reading over the second conjunct in the double subject construction, since it takes scope below *. This prediction is not borne out. Consider the example in (31). The LF proposed in (19) predicts that (31a) is true iff unpluralized ⟦met⟧ is true of the plurality composed of Mary and all of the students. Assuming that ⟦met⟧ is true of a plurality iff they all met together, we predict that (31a) should only be true if Mary met with all of the students together. In fact, (31a) is true in any scenario where Mary met with all the students, whether individually or in groups. For the distributive reading in (31) to be predicted, the DP *the students* has to QR to a position above the * operator in order to get distributed over.

(31) **Scenario** Mary was supposed to have one-on-one meetings with a set of students and faculty, but she only had meetings with the students.
a. Mary jtamaʕit hiyye w l tle:miz.
Mary met.3SG.F her and the students
'Mary met with the students.'

In cases where both of the conjuncts are plural, we get co-distributive readings with respect to the first and second conjunct positions. This will be made more explicit below, but to consider a concrete example, we see that (32a) can be true in a scenario where the actors danced with the singers in pairs. Again, if the second conjunct stays in its base position, (32a) is predicted not to be true in this scenario.

(32) **Scenario**: Everyone had to pick partners to dance with. There were 10 actors and 10 singers and the actors all decided to pick singers as their partners.
a. l mmasli:n raʔaso henne w l mitirbi:n.
the actors danced.3PL them and the singers
'The actors danced with the singers.'

Crucially, for (32a) to be true, it has to be that for every actor, there is a singer that they danced with, and for every singer, there is an actor that they danced with. This differs from the counterpart standard conjunction, which doesn't impose any requirement on who danced with who. For example, in the scenario in (33), where all of the actors and singers danced but only some actors danced with singers, the double subject construction in (33a) can't be uttered felicitously, while the counterpart standard coordination (33b) can. The double subject construction therefore seems to be imposing a restriction here which can't be captured by simply allowing distributivity over the conjunction as a whole. Instead, we seem to be maintaining the collective reading with respect to the pairs of actor-singers while allowing us to distribute to individual events of actors and singers dancing together.

(33) **Scenario**: Everyone had to pick partners to dance with. There were 10 actors and singers and 4 of the actors decided to pick singers as their partners, while the other 6 danced with other actors, leaving the other 6 singers to pick each other as partners.
a. #l mmasli:n raʔaso henne w l mitirbi:n.
The actors danced.3PL them and the singers
'The actors danced with the singers.'
b. l mmasli:n w l mitirbi:n raʔaso.
The actors and the singers danced.3PL

'The actors and the singers danced.'

This co-distributive reading is parallel to the cumulative readings observed with transitive predicates (Scha 1981). For example, (34) is true iff (roughly) every student killed a mosquito and (roughly) every mosquito was killed by a student.[8] In order to capture these cumulative readings, Krifka (1986) proposes that a 2-place version of the * operator is needed, which he calls **. The operator ** closes the extension of a 2-place predicate under sum-formation. The lexical entry for ** is given in (35).

(34) The students killed the mosquitos.

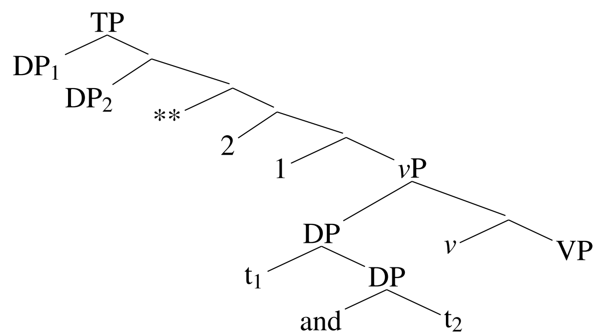
(35) $[\![**]\!] = \lambda f_{\langle e,\langle e,t\rangle\rangle}.\lambda x.\lambda y.\exists g[[\forall x', y'[g(x')(y') = 1 \rightarrow f(x')(y') = 1] \wedge x = \bigoplus \lambda x.\exists y[g(x)(y)] \wedge y = \bigoplus \lambda y.\exists x[g(x)(y)]]$

Applying $[\![**]\!]$ to the predicate $[\![\text{killed}]\!]$ in (34) predicts the co-distributive reading of (34). The truth-conditions are given in (36): there is a set of mosquitos which were killed by students in $[\![\text{the students}]\!]$ and the sum of individuals in that set adds up to $[\![\text{the mosquitos}]\!]$, and there is a set of students which killed mosquitos in $[\![\text{the mosquitos}]\!]$ and the sum of individuals in that set adds up to $[\![\text{the students}]\!]$. In other words, (36) is correctly predicted to be true if and only if every student killed a mosquito and every mosquito was killed by a student.

(36) $[\![**]\!]([\![\text{killed}]\!])([\![\text{the mosquitos}]\!])([\![\text{the students}]\!])$=1 iff
$\exists g[[\forall x', y'[g(x')(y') = 1 \rightarrow [\![\text{killed}]\!](x')(y') = 1] \wedge [\![\text{the mosquitos}]\!] = \bigoplus \lambda x.\exists y[g(x)(y)]$
$\wedge [\![\text{the students}]\!] = \bigoplus \lambda y.\exists x[g(x)(y)]]$

The co-distributive reading therefore suggests the ** is at play in the cases where both conjuncts in the double subject construction are plural. I argue that the data in this section can be accounted for if we assume that the second conjunct covertly moves to a position higher than the pluralization operator, tucking in below the higher subject and creating a two-place predicate that the cumulativity operator ** can apply to. The resulting LF is given in (37), where ** applies to a two-place predicate created by predicate abstraction over the indices 1 and 2 and both conjuncts scope above **. This LF is analogous to structures proposed by Sauerland (1998) and Beck and Sauerland (2000) to account for certain co-distributive readings which arise over derived predicates.

(37)



Consider now the example in (32a) (*the actors danced them and the singers*). The truth-conditions in (38) are predicted: (32a) is true iff every actor danced or is part of a plurality of actors that danced with at least one singer and every singer danced or is part of a plurality of

[8]I'm putting aside the availability of non-maximal readings for the purposes of this paper.

singers that danced with at least one singer. Therefore, in a situation where some of the actors danced with each other and not with singers, (32a) is correctly predicted to not be true. The co-distributive reading over the two conjuncts is therefore correctly predicted.

(38) $[\![$*the actors danced them and the singers*$]\!]$= 1 iff
$(^{**}\lambda y.\lambda x.[\![\text{dance}]\!](x\oplus y))([\![\text{actors}]\!])([\![\text{the singers}]\!])$=1

There is a question here about whether covert movement of the second conjunct to create the structure in (37) is obligatory, at least when the second conjunct is plural. In particular, one could imagine that there is an alternative LF available where the second conjunct is below the * operator at LF and where we do not get distributive readings over the second conjunct. This type of analysis will make the double subject construction ambiguous in cases where the lower subject is plural. In the cases that we have looked at so far, we can't tell whether QR of the second conjunct is obligatory. This is because in upward-entailing environments, the proposition denoted by (37) is asymmetrically entailed by the one corresponding to leaving the second conjunct in its base position. [9]

The LF in (37) also predicts the correct truth-conditions for the simpler cases discussed earlier. When both conjuncts denote atomic individuals, the contribution of ** is trivial and we get only collective readings (39). This allows us to capture the basic facts in section 2 even when ** is present. When one of the subjects is singular and the other is plural, we correctly predict that we can get distributivity only over the plural conjunct but not the conjunction as a whole, as shown in (40). This allows us to predict that we can get a distributive reading over the second conjunct in cases like (31).

(39) $(^{**}\lambda y.\lambda x.f(x\oplus y))(\text{b})(\text{a}) \leftrightarrow f\,(\text{a}\oplus\text{b})$, when a and b are atomic individuals.

(40) $(^{**}\lambda y.\lambda x.f(x\oplus y))(\text{b})(\text{a}) \leftrightarrow (^{*}\lambda y.f(\text{a}\oplus y))(\text{B})$, when a is an atomic individual but B is a plurality.

The final theory adopted here requires covert movement out of the second conjunct, which raises the issue of how this CSC-violating movement is licensed. While I won't be able to offer a satisfactory answer to why the CSC can be violated in the double subject construction, I provide independent evidence that covert movement of the second conjunct is in fact licensed. In particular, when the two conjuncts are quantifiers, we can get both surface scope readings where the quantifier in the first conjunct scopes over the one in the second conjunct and inverse scope reading where the quantifier from the second conjunct takes the higher scope. This is illustrated in (41). Given that QR out of the second conjunct is independently needed to account for cases like (41), this provides support for the account proposed in this section, where the second conjunct QRs.

(41) 3 tle:miz jtamaʕo henne w kel ʔiste:z.
3 students met them and every teacher
Surface scope reading: 3 students are such that they met with every teacher.
Inverse scope reading: Every teacher is such that 3 students met with them.

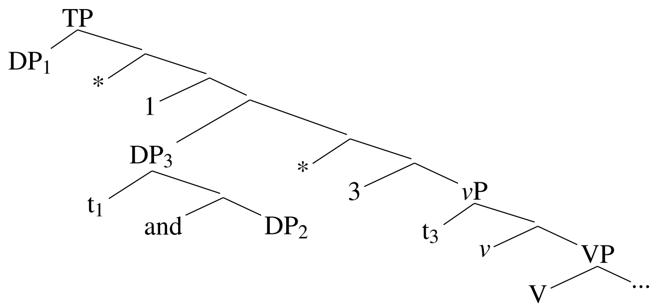
[9] This relates to a larger question of whether plural DPs must always move to a position above a pluralization operator. In order to answer this, we have to consider the behavior of the double subject construction in downward-entailing environments, which I'm doing in ongoing work.

4. Deriving the desired LF

In section 3, I proposed that the correct truth conditions for the double subject construction are predicted given an LF where the pluralization operator must scope above *v*P and the conjoined DP is interpreted in its base position in spec,*v*P. The success of the proposal therefore relies on the assumption that the conjoined DP can't move out of *v*P to a position where it can be interpreted above a * operator. In this section, I will consider in more detail what restrictions on movement and on the distribution of * are required to ensure that the lower subject must always be interpreted below * in the cases we have looked at so far. I argue that the conjoined DP in the basic cases can't move out of its base position due to independently motivated constraints on movement, and I present further data where the conjoined DP can in fact move from its base position in the double subject construction and where we do get a distributive reading.

Given that the second conjunct can QR to a position above * in (37), this raises the question of why the conjoined DP can't QR to an intermediate position between spec,*v*P and the higher subject in spec,TP, where it can be interpreted above a * operator. An example of such an LF is given in (42). Note that the LF in (42) would incorrectly predict a distributive reading for the double subject construction, since the conjoined DP scopes above a * operator.

(42)



One direct way to rule out the LF in (42) is to stipulate that in each clause, there is a single position in the clausal spine where * can be inserted, such that * can only occur below the higher spec,TP in (42). This would predict that when there are distributive readings over multiple DPs in a single clause, the DPs have to move above a single n-place starred predicate, creating a structure like (37). This ensures that the conjoined DP can't move to a position where it can be distributed over. Namely, if there is a single * operator below DP_1, the conjoined DP (DP_3) would have to move above that operator to be distributed over, but this requires DP_3 to move above the binder index 1, and we would end up with an unbound trace (t_1) at LF.

The initial explanation proposed above commits us to a very stringent requirement on the distribution of *. I will argue for an alternative below, where LFs like (42) are ruled out by a generalized version of the ban on improper movement in the examples we have seen so far. This allows us to maintain a less stringent requirement on the distribution of pluralization operators, where they can apply to any predicate derived by movement. The explanation I propose predicts that when there are intermediate A-positions between spec,*v*P and spec,TP, an LF like (42) should be licensed. I argue that this prediction is borne out when auxiliaries are present, where we can get a distributive reading over the conjoined DP in the double subject construction under certain conditions.

I assume that there as an agreement probe on T which has an EPP feature. When the subject is not a coordinated DP, the probe always agrees with the subject in spec,*v*P and moves it to spec,TP. When the subject is a conjoined DP, the probe can optionally target either the first conjunct or the entire conjoined DP, triggering movement of whichever DP it targets. Therefore, in the double subject construction, the probe targets the first conjunct, moving it to spec,TP and the verb agrees with the first conjunct. On the other hand, with standard conjunction, the probe targets the entire conjoined DP, which moves to spec,TP. This explains the correlation we see between agreement and whether the first conjunct or the whole coordinated DP moves. Crucially, this movement from spec,*v*P to spec,TP is an instance of A-movement.

In order to derive an LF like (42), the conjoined DP has to first QR to an intermediate position between spec,*v*P and spec,TP and then the first conjunct has to move to spec,TP. Note that the first step of this movement would be an instance of A-bar movement, while the second, which is triggered by the agreement probe on T is an instance of A movement. This kind of derivation has been independently argued to be unlicensed, violating a generalized version of the ban on improper movement which targets sub-extraction. In particular, chains of movement where A movement targets a sub-constituent of a phrase which has undergone A-bar movement have been argued not to be licensed (43) (Sakai 1994; Abels 2007; Keine 2020).

(43) **Improper sub-extraction:** A-extraction out of an A-bar moved constituent is not possible.

Note that this ban on the LF in (42) relies on an assumption that the first step of movement where the conjoined DP moves to an intermediate position is an instance of A-bar movement. If the conjoined DP can move to an intermediate A-position between spec,*v*P and spec,TP, there would be no violation of (43) and we would be able to get a distributive reading in the double subject construction. This commits us to a strong position about the availability of intermediate A positions.[10] I will argue below that when auxiliaries are present, they make available intermediate A-positions, licensing an LF like (42) where the lower subjects moves to an intermediate position and gets distributed over.

Consider the example in (44). (44) makes available a distributive reading in the double subject construction, as shown by the fact that it is true in the distributive scenario below, where Rasha and Hadi are dancing with different people. I propose that this is due to the presence of the auxiliary, which makes available an intermediate A position for the coordinated DP to move to, thus allowing it to take scope above a * operator. In (44) the verb can also optionally agree with the higher subject *Rasha*, but in this case the distributive reading is no longer available. We therefore see a correlation between agreement and the availability of the distributive reading.

(44) **Scenario**: Rasha and Hadi were both dancing yesterday but with different people.
Rashe ke:nit hiyye w Hadi ʕam yiriso mbe:riħ.
Rasha was.3SG.F her and Hadi PROG dance.3PL yesterday
'Rasha and Hadi were dancing yesterday.'

Note that in (44) we still have the double subject construction, but there is an added auxiliary present *ke:nit* and the lower subject intervenes between the auxiliary and the main verb.

[10]An alternative is to propose that if there are intermediate A-positions they must target the same DP that the probe on T targets. If movement is always triggered by a probe, one way to implement this could be by assuming that intermediate probes on A-positions must inherit the probe on T and therefore agree with the same DP that the probe on T agrees with.

Note also that the auxiliary and verb mismatch in agreement: the auxiliary agrees with the higher subject *Rasha*, getting third-person singular marking, while the main verb agrees with the lower conjoined DP, getting third plural agreement. We therefore conclude that there are two agreement probes here, one corresponding to agreement on the verb and one corresponding to agreement on the auxiliary.

In the case where we have an auxiliary present like (44), we still see a correlation between distributivity and movement. If the lower DP follows that main verb as shown in (45), the distributive reading is no longer available, as shown by the fact that (45) can't be used in the distributive scenario. Here, both the auxiliary and the main verb agree with the higher subject.

(45) **Scenario**: Rasha and Hadi were both dancing yesterday but with different people.
#Rasha ke:nit ʕam terʔos hiyye w Hadi mbe:riħ.
Rasha was.3SG.F PROG dance.3SG.F her and Hadi yesterday
'Rasha was dancing with Hadi yesterday.'

We therefore see a correlation between movement, agreement and the availability of a distributive reading. Let's consider the two cases in (44) and (45). The availability of the distributive reading in (44) can be explained if the presence of the auxiliary makes available an additional A position. In (44), the agreement probe corresponding to the main verb targets the whole conjoined DP, moving it to to the specifier position corresponding to the probe. The * operator can therefore occur below the moved DP and the distributive reading is predicted to be available. On the other hand, in (45), since both the auxiliary and the main verb agree with the higher subject, the probe corresponding to both targets the higher subject and the conjoined DP remains in its base position. In this case, the conjoined DP can't scope above a pluralization operator and therefore only the collective reading is available in (45).

This relationship between movement of the conjoined DP and the availability of the distributive reading over that DP provides evidence for the restriction on the distribution of * repeated in (46). In the basic cases we saw in section 2, where no intermediate A-positions are available, the conjoined DP has to be interpreted in its base position and therefore * can't apply below it. On the other hand, when intermediate A-positions are available, as in (44) and (45), * can apply below the lower subject if it moves to the intermediate A-position (44) but not if it stays in its base position (45). An alternative proposal that requires * to apply specifically below spec,TP can't account straightforwardly for these facts.[11]

(46) **Restriction on * :** Pluralization operators can only modify derived predicates (i.e. predicates formed by predicate abstraction).

The data with the auxiliaries therefore further solidifies the conclusion that it is the scope of the conjoined DP and not any idiosyncrasy of the double subject construction that results in the unavailability of the distributive reading, since the distributive reading is in fact available with the double subject constructions when the conjoined DP can take scope above *.

To summarize, I argued that in the double subject construction, the higher DP undergoes A-movement out of the conjoined DP, thus requiring that the conjoined DP to stay in its base

[11]It is possible to argue that in (44), there is a bi-clausal structure, where the conjoined DP is in spec,TP of the lower clause. This would allow us to maintain a theory where * applies specifically below spec,TP but requires additional assumptions about the structure corresponding to (44).

position unless intermediate A positions are available. I proposed that pluralization operators can only modify derived predicates and therefore can't apply below the conjoined DP unless it moves, thus deriving the meaning restrictions in the double subject construction. This proposed restriction on * raises some interesting conceptual questions: why should the distribution of * be sensitive to whether a predicate is derived by movement or not and do we see similar restrictions on * in the nominal domain for example?

5. Conclusion

This paper has argued that the meaning restrictions in the double subject construction can be explained straightforwardly if we abandon lexical cumulativity and restrict the distribution of pluralization operators such that they can only apply to predicates derived by movement. The account proposed here is able to predict a range of data, including the interpretation of the double subject construction when the conjuncts are plural and the relationship between the availability of the distributive reading and whether the lower DP moves out of its base position when auxiliaries are present. In short, the availability of a distributive reading over a DP is determined by whether it can move and take scope above a pluralization operator.

I will end with some notes about how the double subject construction can be used to tease apart the contribution of pluralization operators and lexical semantics beyond cumulative inferences, which were the focus of this paper. In particular, if some property of plural predication is due to the lexical semantics of the verb, then the account proposed here predicts that it should behave the same in the double subject construction and standard coordination, since in both cases the verb applies to the plural conjoined DP. On the other hand, if it is due to the contribution of pluralization operators, then we should not observe it over the lower subject in the double subject construction which has to scope below pluralization operators. I briefly discuss one such application to homogeneity below.

The phenomenon of homogeneity is illustrated in (47): neither (47a) nor its negated counterpart in (47b) is true in a scenario where only one of Karim and Rasha danced. This apparent truth-value gap is referred to as *homogeneity*, where there seems to be a requirement that the atomic subparts of the plurality *Karim and Rasha* are homogeneous with respect to whether or not the predicate is true of them. In parallel to the debate about the sources of cumulative inferences, there is a debate about the source of homogeneity. Križ (2015) argues that homogeneity is an inherent property of lexical predicates, where roughly speaking the predicate *dance* in (47) is true of a plural individual if all atomic subparts of it danced and false if no atomic subparts of it danced. On the other hand, alternative approaches argue that pluralization operators are responsible for homogeneity (Schwarzschild 1994; Bar-Lev 2019).

(47) a. Karim and Rasha danced is **true iff** both Karim and Rasha danced.
b. It is not the case that Karim and Rasha danced is **true iff** neither of them danced.
c. **Neither is true iff** only one of Karim and Rasha danced.

The double subject construction allows us to test whether homogeneity comes from the lexical semantics of the verb or from pluralization operators. If it is the latter, then we expect that there will be no homogeneity over the conjoined DP in the double subject construction, since the predicate that applies to the conjoined DP is unpluralized. On the other hand, if it is the former, then we expect the double subject construction and standard coordination to behave the same with respect to homogeneity. In fact, as we see in (48), there is no homogeneity over the lower conjoined DP in the double subject construction: (48) is true in scenarios where only Rasha danced, where only Karim danced and where both Rasha and Karim danced but not together. The interaction of the double subject construction with negation therefore supports a theory where pluralization operators such as * and ** are the only sources of homogeneity.

(48) Karim ma raʔas howwe w Rasha.
Karim NEG dance.PST.PFV.3SG.M him and Rasha.
Karim and Rasha didn't dance together.

Similar tests can be applied to other phenomena where there is disagreement about the division of labor between lexical semantics and pluralization operators. These include whether the interpretation of reciprocals requires distributivity operators and the role of pluralization operators in deriving cumulative readings with transitive predicates.

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Distribution Relative to Events in Dynamic Semantics[1]

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Abstract. The goal of this paper is to introduce a new way of implementing distributivity to dynamic semantics. Novel evidence that supports the necessity of the new apparatus is provided from Japanese and English. The evidence comes from a split antecedence in conjunction, which has not been discussed or accounted for in the literature. The proposed system accounts for the referential dependency by distributing over events and, in turn, over the participants of events.

Keywords: Dynamic Semantics, Distributivity, Split Antecedent, Japanese, English

1. Introduction: Distributivity with Conjunction

This paper aims to introduce to dynamic semantics a new way of implementing distributivity. Distributivity has been discussed in the development of dynamic semantics by Beaver (1994) and Brasoveanu (2007, 2008) (under the label of *slicing* by Beaver and *distributive update* by Brasoveanu). I will present novel data for which the above theories do not have an account.

The data point is represented by the Japanese sentences in (1)[2] and the English sentences in (2).[3] Throughout this paper, anaphoric relations are explicated by superscript and subscript indices: antecedents carry a superscript index, and anaphors carry a subscript index.

(1) a. *Alex*^{u_1}*-ga saru*^{u_2}*-o mi-te, Bill*^{u_3}*-ga roba*^{u_4}*-o mi-ta.*
Alex-NOM monkey-ACC see-AND Bill-NOM donkey-ACC see-PAST
'Alex saw a monkey, and Bill saw a donkey.'

b. *Dotiramo sore*$_{??}$*-o tsukamae-ta.*
Each it-ACC catch-PAST
'Each of them caught it.'

(2) a. Alex^{u_1} saw a^{u_2} monkey, and Bill^{u_3} saw a^{u_4} donkey.

b. Each of them$_{u_1,\,u_3}$ caught it$_{??}$.

The (b)-sentences mean that 'for every x such that x is either Alex or Bill, x caught the animal (x saw).' Under the currently available theories cited above, no way of indexing *it* / *sore* results in this reading. Either u_2 or u_4 alone is insufficient because the pronouns have to refer to both the monkey and the donkey. Indexing them with u_2 and u_4 both does not result in a satisfactory result for two reasons. Firstly, the indexation goes against the singular morphology of the pronouns. Secondly, even if this indexing were allowed, the sentence would not receive the intended reading. Replacing the singular pronoun with a plural pronoun, which uncontroversially bears more than one index, the sentence would have a different reading from the above

[1]I would like to thank Stefan Kaufmann, Chris Tancredi, Jon Gajewski, Magda Kaufmann, and SuB27 reviewers for numerous suggestions, comments, and advice. All remaining errors are my own.

[2]Below, all non-English examples are in Japanese.

[3]The acceptability of this sentence varies across English speakers. For some speakers, the example with temporal pronouns in (8) is more acceptable. I set this variance aside for now, aiming at characterizing a grammar of English that allows this reading. As long as the reading in question is obtained with *it*, the parallel reading is also obtained with personal pronouns. Probably for pragmatic reasons, the reading in question is degraded when the antecedents of pronouns are proper names. I also have to leave this fact untouched below.

sentence, as shown in (3) and (4). The salient reading of the (b)-sentences is the one which is true if Alex and Bill caught both the monkey and the donkey. This reading arguably results from indexing the plural pronouns with u_2 and u_4. Now, in (1) and (2), if the singular pronouns can carry two indices and if these singular pronouns are interpreted as if they were plural pronouns, the sentences should also receive this reading. This prediction is not borne out. The plural interpretation is not available in (1) or (2).

(3) a. *Alex*^{u_1}*-ga saru*^{u_2}*-o mi-te, Bill*^{u_3}*-ga roba*^{u_4}*-o mi-ta.*
Alex-NOM monkey-ACC see-AND Bill-NOM donkey-ACC see-PAST
'Alex saw a monkey, and Bill saw a donkey.'

b. *Dotiramo sore-ra*$_{u_2,\, u_4}$*-o tsukamae-ta.*
Each it-PL-ACC catch-PAST
'Each of them caught them.'

(4) a. Alex^{u_1} saw a^{u_2} monkey, and Bill^{u_3} saw a^{u_4} donkey.

b. Each of them$_{u_1,\, u_3}$ caught them$_{u_2,\, u_4}$.

A critical aspect of the reading of (1)/(2) in question is that it hinges on the quantifier (*dotiramo / each*) in the subject position. The sentences do not receive the reading in parallel sentences not containing a quantifier, as in (5) and (6). In section 2, I pursue a dynamic system that predicts the reading of (1)/(2) with a single index on the pronouns. The proposal relies on quantification, so the behavior observed here is predicted.

(5) a. Alex saw a monkey, and Bill saw a donkey.

b. #The boys took a picture of it.

(6) a. *Alex-ga saru-o mi-te, Bill-ga roba-o mi-ta.*
Alex-NOM monkey-ACC see-and Bill-NOM donkey-ACC see-PAST
'Alex saw a monkey, and Bill saw a donkey.'

b. #*Karera-wa sore-o tsukamae-ta.*
They it-ACC catch-PAST
'They caught it.'

It is worth noting here that the same paradigm is obtained with temporal, locational, and event pronouns. Sentence (7b), for instance, means that 'for each x such that x is either Alex or Bill, x got a phone call at a time t at which x is in the station or the park.' These sentences also raise the indexation issue. The analysis proposed below also accounts for these sentences.

(7) a. *Alex-wa 5-ji*$^{\tau_1}$*-ni eki-ni i-te, Bill-wa 6-ji*$^{\tau_2}$*-ni kooen-ni i-ta.*
Alex-TOP 5-time-at station-in be-and Bill-TOP 6-time-at park-in be-PAST
'Alex was in the station at 5, and Bill was in the park at 6.'

b. *Dotiramo sono*$_{??}$*-toki denwa-wo to-tta.*
Each that-time call-ACC take-PAST
'Each of them took a phone call then.'

(8) a. Alex was in the station at 5$^{\tau_1}$, and Bill was in the park at 6$^{\tau_2}$.

b. Each of them got a phone call at that time$_{??}$ / then$_{??}$.

(9) a. Alex was in the park at five, and Bill was in the station at six.
b. Each of them saw a weird animal there.

(10) a. Alex caught a monkey, and Bill caught a donkey.
b. Each of them did it quickly.

Two comments are in order here about the novelty of the data presented in (1)/(2). Firstly, a similar sentence was pointed out by Stone (1992) and has been discussed by Elbourne (2001, 2005) and Brasoveanu (2007) under the label of *split antecedent*. The sentence is in (11a). A crucial difference between this sentence and (1)/(2) is that the former has a disjunction (in the antecedent of the conditional), while the latter has a conjunction (in the (a)-sentences). The difference is crucial because the explanation given for (11a) does not apply in the case of conjunction. In particular, Brasoveanu (2007) achieved a dynamic analysis of the sentence with the indexation shown in (11b), where the two indefinites in the disjunct share the same index and the pronoun *it* retrieves a reference through that index. In section 3.1, I will outline how this analysis works and why it does not extend to (1)/(2). For now, it is sufficient to note that Brasoveanu's analysis hinges on the assumption that disjunction is not internally dynamic, which is not the case for conjunction.

(11) a. If Alex sees a monkey or a donkey, he waves to it.
b. If Alex^{u_1} sees a^{u_2} monkey or a^{u_2} donkey, he$_{u_1}$ waves to it$_{u_2}$.

Secondly, the pronouns in (1)/(2) should not be analyzed as paycheck pronouns, at least in Japanese. This is because, as Kurafuji (1998) observes, a paycheck interpretation is not available for *sore*. A theory should have an account of the reading without appealing to the paycheck resolution.

(12) a. *Taro-igaino-daremo-ga zibun-no kurejittokaado-o tsuma-ni watasi-ta.*
Taro-except-everyone-NOM self-GEN credit.card-ACC wife-DAT give-PAST
'Everyone except Taro gave his credit card to his wife.'

b. #*Taro-wa sore-o haha-ni watasita.*
Taro-TOP it-ACC mother-DAT gave
Intended: 'Taro gave it (= his credit card) to his mother.'

The rest of this paper is organized as follows. In section 2.1, I introduce Compositional Discourse Representation Theory (Muskens 1996) on which my proposal is based. Then in section 2.2. I present the proposal to account for (2). Section 3 is devoted to discussion. In section 3.1, I compare the current proposal with the pluralized dynamic system in Brasoveanu (2007, 2008), which accounts for the split antecedence with disjunction; in section 3.2 I compare the proposal with a *d*-type analysis of anaphora (Cooper 1979; Heim 1990; Elbourne 2001, 2005). Section 3.3 points out some remaining issues. Section 4 concludes.

2. Proposal

2.1. Compositional DRT

I base my proposal on Compositional Discourse Representation Theory (CDRT; Muskens 1996), which is a compositional extension of DRT (Kamp 1979, 1981; Kamp and Reyle 1993).

CDRT represents the meaning of a sentence using the collapsed box notation as in (14a), which has the DRT correlate in (14b).

(13) A student came in. He sang.

(14) a. $[\, u \mid \texttt{student}\{u\},\ \texttt{came\_in}\{u\},\ \texttt{sang}\{u\}]$

b.
$$\boxed{\begin{array}{l} \qquad u \\ \hline \texttt{student}(u) \\ \texttt{came\_in}(u) \\ \texttt{sang}(u) \end{array}}$$

The collapsed box notation is compositionally built using Muskens's (1996) Dynamic Ty2 logic. I illustrate necessary definitions and abbreviations.

The dynamic Ty2 has the set of basic types in (15). I extend Muskens's (1996) set by adding v and i to basic types. Unlike other dynamic analyses (e.g., Heim 1982b; Groenendijk and Stokhof 1991), it takes assignment functions as of basic type s. An assignment should be regarded not as a function but as a labeled list of entities. Complex types are built in the same way as the usual Ty2. I abbreviate the complex types frequently used as in (16).

(15) Basic types
a. t for truth values
b. e for individuals
c. v for events
d. i for times
e. s for assignments

(16) Abbreviations: Types
a. $\mathbf{t} : \langle s, \langle s, t \rangle \rangle$
b. $\mathbf{e} : \langle s, e \rangle$
c. $\mathbf{v} : \langle s, v \rangle$
d. $\mathbf{i} : \langle s, i \rangle$

Discourse referents (drefs) for individuals $u, u_1, u_2, ...$ are of type $\mathbf{e}$, i.e., se, a function from assignments to individuals. Similarly, drefs for events $\varepsilon, \varepsilon_1, \varepsilon_2 ...$ are of type $\mathbf{v}$ (sv), drefs for times $\tau, \tau_1, \tau_2 ...$ are of type $\mathbf{i}$ (si). In the definitions of the following abbreviations, I use δ as a meta-variable to represent a dref of some type. That is, δ is of type $\mathbf{e}$, $\mathbf{v}$, or $\mathbf{i}$ (where δ_1 and δ_2, for instance, are not necessarily of the same type).

The collapsed box notation has the form (17a), an abbreviation of (17b).

(17) a. $[\delta_1, ..., \delta_n \mid C_1, ..., C_m]$
b. $[\delta_1] ; ... ; [\delta_n] ; [C_1] ; ... ; [C_m]$

$[\delta]$ is an introduction of a new dref (i.e., updating an input assignment f into g such that g differs from f at most in the value assigned to δ; $f \rightarrow_\delta g$). $C_1, ..., C_n$ are conditions of type st, and $[C_1], ..., [C_m]$ are DRS of type $\mathbf{t}$ (s, st).

(18) $[\delta] \ := \ \lambda f_s . \lambda g_s .\ f \rightarrow_\delta g$,
where $f \rightarrow_\delta g$ iff g differs from f at most in the value assigned to δ

(19) Atomic Conditions
a. $R\{\delta_1, ..., \delta_n\} \ := \ \lambda f_s .\ R(\delta_1(f), ..., \delta_n(f))$
b. $\delta_1 = \delta_2 \ := \ \lambda f_s .\ \delta_1(f) = \delta_2(f)$

(20) Atomic DRS

a. $[R\{\delta_1,...,\delta_n\}] := \lambda f_s.\lambda g_s.\ f = g \wedge R\{\delta_1,...,\delta_n\}(g)$

b. $[\delta_1 = \delta_2]\ :=\ \lambda f_s.\lambda g_s.\ f = g\ \wedge\ \delta_1(f) = \delta_2(f)$

For D_1, D_2 of type **t**, $D_1;D_2$ is a dynamic conjunction.

(21) Dynamic Conjunction
$D_1;D_2\ :=\ \lambda f_s.\lambda g_s.\ \exists h_s : D_1(f)(h)\ \wedge\ D_2(h)(g)$

Given the above definitions, the box in (14) is interpreted as (22), using the definitions in (23). (I assume a sequence of sentences is conjoined by dynamic conjunction.)

(22) $[\ u \mid \texttt{student}\{u\},\ \texttt{came\_in}\{u\},\ \texttt{sang}\{u\}]$
$\rightsquigarrow\ \lambda f_s.\lambda g_s.\ f \to_u g\ \wedge\ \texttt{student}(u(g))\ \wedge\ \texttt{came\_in}(u(g))\ \wedge\ \texttt{sang}(u(g))$

(23) a. $a^u \rightsquigarrow\ \lambda P_{\mathbf{et}}.\lambda Q_{\mathbf{et}}.\ [u]\,;P(u)\,;Q(u)$

b. *student* $\rightsquigarrow\ \lambda u_{\mathbf{e}}.\ [\texttt{student}\{u\}]$

c. *came_in* $\rightsquigarrow\ \lambda u_{\mathbf{e}}.\ [\texttt{came\_in}\{u\}]$

d. *sang* $\rightsquigarrow\ \lambda u_{\mathbf{e}}.\ [\texttt{sang}\{u\}]$

e. $he_u \rightsquigarrow\ \lambda f_s.\ u(f)$

The truth of a DRS is defined in (24). A DRS is true w.r.t. an input assignment f iff there is an output assignment g such that g meets the conditions. This is the case in (22) iff there is some g (that differs from f at most in the value assigned to u and) that assigns to u some individual x such that x is a student, x came in, and x sang. The truth condition necessitates the existence of such x. Hence, the 'existential force' of an indefinite is encoded in the system.

(24) Truth
A DRS $D_{s,st}$ is *true* w.r.t. an input assignment f iff there is an assignment g such that $D(f)(g) = 1$.

Other connectives and quantifications are also defined in the standard DRT way. Relevant to the present purpose is the dynamic conditional on which the definition of the universal quantification is built.

(25) Dynamic Conditional
$D_1 \Rightarrow D_2\ :=\ \lambda f_s.\ \forall g_s : D_1(f)(g) \to \exists h_s : D_2(g)(h)$

(25) states that for all ways of updating f into g by D_1, there must be some h such that h makes D_2 true w.r.t. g. Based on this, we can define an English universal quantifier *every*. It calls for a test of whether for all outputs g produced by introducing a new dref, subject to restrictor P, there is some assignment h that makes the scope Q true.

(26) *every*
$\rightsquigarrow\ \lambda P_{\mathbf{et}}.\lambda Q_{\mathbf{et}}.\ ([u]\,;P(u)) \Rightarrow Q(u)$

In order to treat plural pronouns such as *them* in *each of them*, I take the domain of individuals (D_e) to contain plural individuals. Plural individuals are sums of two or more individuals (Link

1983: among many others). The sum of individuals $\mathtt{a}$ and $\mathtt{b}$ is expressed as $\mathtt{a} \oplus \mathtt{b}$. For this study, I define *they/them* as (27).[4]

(27) $\textit{they/them}_{u_1 \oplus u_2} \rightsquigarrow \lambda f_s.\ u_1(f) \oplus u_2(f)$

Combining the definition of universal quantification and the plural pronouns, we can define *each* (in *each of them*) as follows. It calls for a test of whether for all output g produced by introducing a new dref u', if the new dref is an atomic part of u, there is some assignment h that makes the scope $P(u')$ true.

(28) $\textit{each} \rightsquigarrow \lambda u_{\mathbf{e}}.\lambda P_{\mathbf{et}}.\ ([u'];[u' <_A u]) \Rightarrow P(u')$ (To be revised)

(29) $u' <_A u \rightsquigarrow \lambda f_s.u'(f) <_A u(f)$ ($<_A$ is the *atomic-part-of* relation.)

Now we can see the issue raised in the previous section. Consider (2) with the following indexation. Sentence (b) is translated into (30).

(2) a. Alex^{u_1} saw a^{u_2} monkey, and Bill^{u_3} saw a^{u_4} donkey.
b. Each of them$_{u_1,\ u_3}$ caught it$_{??}$.

(30) $([u'];[u' <_A u_1 \oplus u_3]) \Rightarrow [\mathtt{caught}\{u', u_{??}\}]$
$\rightsquigarrow [u' \mid u' <_A u_1 \oplus u_3] \Rightarrow [\mathtt{caught}\{u', u_{??}\}]$

(30) calls for a test whether for any way of updating f into g by introducing u', where u' is an atomic part of $u_1 \oplus u_3$, there is some h that renders $\mathtt{caught}(u', u_{??})(g)(h)$ to be true. The process is visualized as (31). To get the intended reading in the current theory, the index for *it* has to vary: it should be u_2 when $\mathtt{c} = \mathtt{a}$, and u_4 when $\mathtt{c} = \mathtt{b}$. It is unclear how to achieve this.

(31) a. (a saw m, b saw d)

	u_1	u_2	u_3	u_4
f	a	m	b	d

b. (c $<_A$ a $\oplus$ b)

	u_1	u_2	u_3	u_4	u'
g	a	m	b	d	c

2.2. Proposal: CDRT with Events and Event Distribitivity

I propose to solve the problem posed by (1) and (2) by (i) introducing event drefs (Kamp 1979, 1981) and (ii) letting *each* quantify over individuals and events. In addition to the individual restrictor *of them*, *each* optionally obtains a second restrictor, E. I take E as a covert plural event pronoun. Then *each* with the two restrictors calls for the following test:

[4]For simplicity, I analyze the plural pronouns as of type **e**. The definition can be altered to introduce plural drefs (Brasoveanu 2007, 2008) as (i). If we do so, we should change the definition of *each* accordingly.

(i) $\textit{they/them}^{u}_{u_1 \oplus u_2} \rightsquigarrow \lambda P_{\mathbf{et}}.\ \lambda f_s.\ [u];[u = u_1 \oplus u_2];P(u)$

(ii) $\textit{each} \rightsquigarrow \lambda \mathbb{P}_{\mathbf{et,t}}.\lambda Q_{\mathbf{et}}.\ ([u'];\mathbb{P}(\lambda u.\ [u' <_A u])) \Rightarrow Q(u')$

(32) each of [them$_{u',u''}$, E$_{\varepsilon',\varepsilon''}$], P

a. For every way of updating the input f into g by
$[u,\ \varepsilon \mid u <_A u' \oplus u'',\ \varepsilon < \varepsilon' \oplus \varepsilon'',\ \underline{\theta(\varepsilon, u)}]$ (Restrictor)

b. There is some h: g is updated into h by $[\underline{\delta_1, ..., \delta_n \mid \theta(\varepsilon, \delta_1)\ , ...,\ \theta(\varepsilon, \delta_n)},\ P(u)]$ (Scope)

The crucial parts are underlined. Since *each* quantifies over individuals and events, in processing the restrictor it introduces two new drefs, u and ε, where u is an atomic part of $them_{u',u''}$, and ε is of $E_{\varepsilon',\varepsilon''}$. The two drefs are further conditioned to have some thematic relation, represented as $\theta(\varepsilon, u)$. In processing the scope, it further introduces an arbitrary number of drefs $\delta_1, ..., \delta_n$, all of which have a thematic relation with ε. Finally, $P(u)$ is processed.[5]

The proposal works in the following way. Let verbs introduce an event dref. Then the indexation in (33a) results in the assignment (33b).

(33) a. Alex^{u_1} saw$^{\varepsilon_1}$ a^{u_2} monkey, and Bill^{u_3} saw$^{\varepsilon_2}$ a^{u_4} donkey.

b.

	u_1	u_2	ε_1	u_3	u_4	ε_2
f	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$

($\mathtt{e}_1$: a saw m, $\mathtt{e}_2$: b saw d)

At this point, notice that a and m are ‘paired’ through a thematic relation to $\mathtt{e}_1$, and b and d are ‘paired’ through a thematic relation to $\mathtt{e}_2$. These ‘pairings’ are visualized as (34). The relations will be important in deriving the reading of (1)/(2) in question.

(34) a. $\mathtt{a} \leftrightarrow_\theta \mathtt{e}_1 \leftrightarrow_\theta \mathtt{m}$

b. $\mathtt{b} \leftrightarrow_\theta \mathtt{e}_2 \leftrightarrow_\theta \mathtt{d}$

Each is restricted by $them_{u_1,\, u_3}$ and $E_{\varepsilon_1,\, \varepsilon_2}$. Processing the restrictor of *each* introduces u_5 and ε_3 to f in (33b). u_5 must be an atomic part of $u_1 \oplus u_3$, and ε_3 must be an atomic part of $\varepsilon_1 \oplus \varepsilon_2$. There are four ways to value u_5 and ε_3 then: $\langle \mathtt{a}, \mathtt{e}_1 \rangle$, $\langle \mathtt{a}, \mathtt{e}_2 \rangle$, $\langle \mathtt{b}, \mathtt{e}_1 \rangle$, $\langle \mathtt{b}, \mathtt{e}_2 \rangle$. However, u_5 and ε_3 are further subject to the thematic-relation condition. This thematic relation limits the valuation, and we only obtain two of the four, namely $\langle \mathtt{a}, \mathtt{e}_1 \rangle$ and $\langle \mathtt{b}, \mathtt{e}_2 \rangle$. (35) visualizes the thematic relations.

(35) $u_5 \leftrightarrow_\theta \varepsilon_3$

a. $\mathtt{a} \leftrightarrow_\theta \mathtt{e}_1$

b. $\mathtt{b} \leftrightarrow_\theta \mathtt{e}_2$

Processing the restrictor thus results in g in (36). By the thematic rleations, $\mathtt{c} = \mathtt{a}$ iff $\mathtt{e}_3 = \mathtt{e}_1$, and $\mathtt{c} = \mathtt{b}$ iff $\mathtt{e}_3 = \mathtt{e}_2$.

[5]It is easy to restrict the arbitrariness of the introduction of $\delta_1, ..., \delta_n$. For instance, if we impose a presupposition that $\delta_i \neq u$, for any $1 \leq i \leq n$, then each δ_i has to store an entity different from u does, preventing a reintroduction of the entity stored in u. Also, we can impose $\delta_i \neq \delta_j$ if $i \neq j$. This prevents the same entity from being stored in multiple positions in $\delta_1, ..., \delta_n$. The combinations of these two presuppositions require that processing the scope introduces (at most) all and only drefs distinct from u and thematically related to ε.

(36)

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3
g	a	m	e_1	b	d	e_2	c	e_3

$(c <_A a \oplus b,\ e_3 <_A e_1 \oplus e_2,\ \theta(c, e_3)\ )$

Processing the scope introduces an arbitrary number of drefs. These drefs introduced in the scope are all subject to the thematic condition. These drefs must be thematically related to the event stored in ε_3. Suppose here that the scope introduces one individual dref, u_6. u_6 stores some individual f. Suppose further that the pronoun in question *it* has u_6 as an index. Since *it* is a pronoun for non-humans, its use is felicitous when u_6 stores a non-human, here m or d. The value of u_6 is again determined by the thematic condition. When ε_3 stores e_1, u_6 stores m; when ε_3 stores e_2 ε_3 stores d. The thematic relation is visualized as in (37), and the output of processing the scope is schematized as in (38).

(37) $u_5 \leftrightarrow_\theta \varepsilon_3 \leftrightarrow_\theta u_6$

a. $a \leftrightarrow_\theta e_1 \leftrightarrow_\theta m$

b. $b \leftrightarrow_\theta e_2 \leftrightarrow_\theta d$

(38)

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	ε_4
h	a	m	e_1	b	d	e_2	c	e_3	f	e_4

$(\theta(f, e_3)$, e_4: c caught f)

Thus, the test is passed and the sentence is true iff a catches m and b catches d, deriving the intended reading.

Summarizing the proposal, the sentence in question should obtain the following indexation.

(39) a. Each of [them$_{u_1,\, u_3}$ E$_{\varepsilon_1,\, \varepsilon_2}$] caught$^{\varepsilon_4}$ it$_{u_6}$.

b.

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3
g	a	m	e_1	b	d	e_2	c	e_3

$(c <_A a \oplus b,\ e_3 <_A e_1 \oplus e_2,\ \theta(c, e_3)\ )$

c.

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	ε_4
h	a	m	e_1	b	d	e_2	c	e_3	f	e_4

$(\theta(f, e_3)$, e_4: c caught f)

The crucial aspect of the proposal is the introduction of u_5, ε_3, and u_6, which are subject to the thematic-relation condition. Unpacking the quantification, it effectively creates assignments h and h' below and distributively updates these assignments by the scope. Thus, I call it *event distribution*. Note that the current proposal only requires a single index, u_6 here, for *it* to obtain the intended reading.

(40) a.

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	
h	a	m	e_1	b	d	e_2	a	e_1	m	$\leftarrow$ *u_5 caught it$_{u_6}$*

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	
h'	a	m	e_1	b	d	e_2	b	e_2	d	$\leftarrow$ *u_5 caught it$_{u_6}$*

Two comments are in order here. First, notice that the index u_6 in (41) is *familiar* in the sense of Heim (1982a). The index is already in the domain of an input assignment against which the sentence containing u_6 is evaluated (because of the dref introduction in the scope), so it is not novel. Secondly, the proposal predicts the five readings for (41b). Below, the ordered pair $\langle \mathtt{x}, \mathtt{y} \rangle$ represents the `talked_to` relation.

(41) a. Alex saw Bill, and Chris saw Dan.
b. Each of them talked to him.
(i) $\langle \mathtt{a}, \mathtt{b} \rangle, \langle \mathtt{c}, \mathtt{d} \rangle$
(ii) $\langle \mathtt{a}, \mathtt{a} \rangle, \langle \mathtt{b}, \mathtt{b} \rangle$
(iii) $\langle \mathtt{a}, \mathtt{b} \rangle, \langle \mathtt{d}, \mathtt{b} \rangle$
(iv) $\langle \mathtt{b}, \mathtt{a} \rangle, \langle \mathtt{c}, \mathtt{d} \rangle$
(v) $\langle \mathtt{b}, \mathtt{a} \rangle, \langle \mathtt{d}, \mathtt{c} \rangle$

Reading (i) is what we have been pursuing. Reading (ii) is predicted but not available for the sentence. I argue that this reading is ruled out by Binding Condition B, especially by the version of Reinhart and Reuland (1993). In their definition, a semantically reflexive predicate must be reflexive-marked by an inherently reflexive predicate or a reflexive pronoun. Reading (ii) is reflexive, but the predicate is not reflexive-marked. Hence the reading is ruled out.

The remaining three readings should be predicted and available. It's worth noting here that, in general, some semantically available readings are pragmatically hard to obtain. For instance, to obtain (iii), *them* has to get the indices of *Alex* and *Dan*, which is, I believe, already odd. Even in a more semantically simple sentence, e.g., *Alex saw Bill, and Chris saw Dan. They talked to them*, hardly allows the reading where *they* is anteceded by *Alex* and *Dan*. The near unavailability is not governed by semantics, however. Semantics allows such indexation, but the indexation is not felicitous pragmatically. I claim the same reasoning goes for readings (iii)–(v).

Consider the Japanese sentence in (42) to confirm this point. Japanese has scrambling and scrambling changes pragmatic saliency. In (42), *dotira* quantifies over (i.e., is anteceded by) *Alex* and *Bill*, where the former is the subject of the first conjunct, and the latter is the object of the second conjunct. This reading is in principle available without scrambling but is facilitated by scrambling.

(42) a. *Alex-wa saru-o mi-ta. Bill-o, roba-ga t keritobasi-ta.*
Alex-TOP monkey-ACC see-PAST Bill-ACC donkey-NOM *t* kick-PAST
'Alex saw a monkey, and a donkey kicked Bill.'
b. *Dotira-mo sore-o tsukamae-ta.*
Each-all it-ACC catch-PAST
'Each caught it.'

2.3. Formalizing the Proposal

Following Champollion (2016a, b), I take the domain of events (D_v) to contain plural events. Plural events are the sum of two or more events. The plural event pronoun E above thus should be defined as (43).

(43) $E_{\varepsilon_1,\varepsilon_2} \rightsquigarrow \lambda f_s.\ \varepsilon_1(f) \oplus \varepsilon_2(f)$

I adopt the Neo-Davidsonian event semantics (Parsons 1990: a.o.) and follow Champollion (2015) in that verbs existentially quantify over events. In the current dynamic framework, it means that verbs introduce a new event discourse referent. The definitions below makes use of *continuation* as done by Champollion (2015). The simple sentence *a man sleeps* has the following derivation.

(44) a. $sleeps^{\varepsilon} \rightsquigarrow \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ [\varepsilon]\,;[\mathtt{sleep}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;V(\varepsilon)$

b. $man \rightsquigarrow \lambda u_{\mathbf{e}}.[\mathtt{man}\{u\}]$

c. $a^{u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{vt}}.\ [u]\,;P(u)\,;\mathbb{Q}(u)(V)$

(45) a. $a^{u}\ man \rightsquigarrow \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{vt}}.\ [u]\,;[\mathtt{man}\{u\}]\,;\mathbb{Q}(u)(V)$

b. $a^{u}\ man\ sleeps^{\varepsilon} \rightsquigarrow \lambda V_{\mathbf{vt}}.\ [u]\,;[\mathtt{man}\{u\}]\,;[\varepsilon]\,;[\mathtt{sleep}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;V(\varepsilon)$

The (dynamicized) closure saturates the remaining variable **true**, which is true of any event.

(46) **true** $\rightsquigarrow \lambda \varepsilon_{\mathbf{v}}.[\mathtt{true}\{\varepsilon\}]$

(47) **true** a^{u} *man sleeps*$^{\varepsilon}$

$\rightsquigarrow [u]\,;[\mathtt{man}\{u\}]\,;[\varepsilon]\,;[\mathtt{sleep}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;[\mathtt{true}\{\varepsilon\}]$

$\rightsquigarrow [u]\,;[\mathtt{man}\{u\}]\,;[\varepsilon]\,;[\mathtt{sleep}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]$

$\rightsquigarrow [u,\ \varepsilon \mid \mathtt{man}\{u\},\ \mathtt{sleep}\{\varepsilon\},\ \mathtt{subject}\{\varepsilon,u\}]$

Now I define *each* with two restrictors as follows. The thematic-relation condition is stated using two-place predicate θ, which I define as (49). It is true of a pair of an event and an individual iff there is some two-place predicate of an event and an individual (e.g., `subject`, `object`, and `time`) that is true of the pair.

(48) *each*

$\rightsquigarrow \lambda u'_{\mathbf{e}}.\lambda \varepsilon'_{\mathbf{v}}.\lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{v}}.([u]\,;[\varepsilon]\,;[u <_{A} u']\,;[\varepsilon <_{A} \varepsilon']\,;[\theta(u,\varepsilon)])$

$\Rightarrow ([\delta_1,...,\delta_n]\,;[\theta\{\varepsilon,\delta_1\},...,\theta\{\varepsilon,\delta_n\}]\,;\mathbb{Q}(u)(V))$

(49) $\forall e_v \forall x_e\ [\theta(e,x) = 1 \leftrightarrow \exists P_{v,et}[P(e,x) = 1]]$

The above definition straightforwardly accounts for the sentence interpretation in question by implementing the event distribution outlined above. Notice that in the derivation below, u_6 is introduced in the scope as an instance of the arbitrary introduction $[\delta_1,...,\delta_n]$.

(50) a. Alex^{u_1} saw$^{\varepsilon_1}$ a^{u_2} monkey, and Bill^{u_3} saw$^{\varepsilon_2}$ a^{u_4} donkey.

b. Each of [them$_{u_1,\ u_3}$ E$_{\varepsilon_1,\ \varepsilon_2}$] caught$^{\varepsilon_4}$ it$_{u_6}$.

(51) a. $caught^{\varepsilon_4}\ it_{u_6} \rightsquigarrow \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ [\varepsilon_4]\,;[\mathtt{caught}\{\varepsilon_4\}]\,;[\mathtt{subject}\{\varepsilon_4,u\}]\,;[\mathtt{object}\{\varepsilon_4,u_6\}]$

b. *Each of* [$them_{u_1,\ u_3}\ E_{\varepsilon_1,\ \varepsilon_2}$]

$\rightsquigarrow \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{v}}.\ ([u]\,;[\varepsilon]\,;[u <_{A} u_1 \oplus u_3]\,;[\varepsilon <_{A} \varepsilon_1 \oplus \varepsilon_2]\,;[\theta\{u,\varepsilon\}])$

$\Rightarrow ([\delta_1,...,\delta_n]\,;[\theta\{\varepsilon,\delta_1\},...,\theta\{\varepsilon,\delta_n\}]\,;\mathbb{Q}(u)(V))$

c. *Each of* [*them*$_{u_1,\ u_3}$ $E_{\varepsilon_1,\ \varepsilon_2}$] *caught*$^{\varepsilon_4}$ *it*$_{u_6}$
$\rightsquigarrow\ \lambda V_{\mathbf{v}}.\ ([u]\,;[\varepsilon]\,;[u <_A u_1 \oplus u_3]\,;[\varepsilon <_A \varepsilon_1 \oplus \varepsilon_2]\,;[\theta\{u,\varepsilon\}])$
$\Rightarrow ([u_6]\,;[\theta\{\varepsilon,u_6\}]\,;[\varepsilon_4]\,;[\mathtt{caught}\{\varepsilon_4\}]\,;[\mathtt{subject}\{\varepsilon_4,u\}]\,;[\mathtt{object}\{\varepsilon_4,u_6\}]\,;V(\varepsilon))$

d. **true** *Each of* [*them*$_{u_1,\ u_3}$ $E_{\varepsilon_1,\ \varepsilon_2}$] *caught*$^{\varepsilon_4}$ *it*$_{u_6}$
$\rightsquigarrow\ ([u]\,;[\varepsilon]\,;[u <_A u_1 \oplus u_3]\,;[\varepsilon <_A \varepsilon_1 \oplus \varepsilon_2]\,;[\theta\{u,\varepsilon\}])$
$\Rightarrow ([u_6]\,;[\theta\{\varepsilon,u_6\}]\,;[\varepsilon_4]\,;[\mathtt{caught}\{\varepsilon_4\}]\,;[\mathtt{subject}\{\varepsilon_4,u\}]\,;[\mathtt{object}\{\varepsilon_4,u_6\}]\,;V(\varepsilon))$
$\rightsquigarrow\ [u,\ \varepsilon \mid u <_A u_1 \oplus u_3, \varepsilon <_A \varepsilon_1 \oplus \varepsilon_2, \theta(u,\varepsilon)]$
$\Rightarrow [u_6,\ \varepsilon_4 \mid \theta\{\varepsilon,u_6\},\ \mathtt{caught}\{\varepsilon_4\},\ \mathtt{subject}\{\varepsilon_4,u\},\ \mathtt{object}\{\varepsilon_4,u_6\}]$

The proposal can easily be extended to temporal and other domains. Consider, for instance, the definition of temporal adverbs and pronouns below.

(52) a. *at five*$^\tau$ $\rightsquigarrow\ \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{ev},\mathbf{t}\rangle\rangle}.\lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ [\tau]\,;[\mathtt{at\_five}(\tau)]\,;\mathbb{Q}(u,\lambda\varepsilon.[\mathtt{time}\{\varepsilon,\tau\}]\,;V)$
b. *then*$_\tau$ $\rightsquigarrow\ \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{ev},\mathbf{t}\rangle\rangle}.\lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ \mathbb{Q}(u,\lambda\varepsilon.[\mathtt{time}\{\varepsilon,\tau\}]\,;V)$

This definition yields (53), for instance, where the temporal adverbs introduce a temporal dref, and the temporal pronoun picks the referent up.

(53) a. *was in a park at five*
$\rightsquigarrow\ \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.[\tau]\,;[\mathtt{at\_five}(\tau)]\,;[\varepsilon]\,;[\mathtt{in\_park}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;[\mathtt{time}\{\varepsilon,\tau\}]\,;V$
b. *got*$^\varepsilon$ *a phone call then*$_\tau$
$\rightsquigarrow\ \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.[\mathtt{got\_phone\_call}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;[\mathtt{time}\{\varepsilon,\tau\}]\,;V$

The sentence with the temporal pronoun in (8) is worked out as (54). Notice that *each* introduces τ_3 where it introduced u_6 in a previous example. This is possible because the definition of *each* does not specify the type (or number) of drefs it introduces in processing the scope. Still, the value of the dref introduced is constrained by the thematic-relation condition. The value is either *at five* or *at six*, depending on the value of ε. The analysis can be extended for the examples with temporal and event pronouns in (9)/(10) in an obvious way.

(54) a. Alex^{u_1} was$^{\varepsilon_1}$ in the station at 5^{τ_1}, and Bill^{u_1} was$^{\varepsilon_2}$ in the park at 6^{τ_2}.
b. Each [of them$_{u_1,\ u_2}$, $E_{\varepsilon_1,\ \varepsilon_2}$] got a phone call then$_{\tau_3}$.

(55) *each of them got a phone call then*
$\rightsquigarrow\ [u,\ \varepsilon \mid u <_A u_1 \oplus u_2,\ \varepsilon <_A \varepsilon_1 \oplus \varepsilon_2,\ \theta(u,\varepsilon)]$
$\Rightarrow [\tau_3,\ \varepsilon_3 \mid \theta\{\varepsilon,\tau_3\},\ \mathtt{got\_phone\_call}\{\varepsilon_3\},\ \mathtt{subject}\{\varepsilon_3,u\},\ \mathtt{time}\{\varepsilon_3,\tau_3\}]$

Intuitively, what the event distribution does is to 'collect' the participants, times, and relevant components of a particular event. This is made possible by combining the thematic-relation condition and the arbitrary dref introduction $\delta_1,...,\delta_n$. Since a quantifier causes the event distributivity, the degradation of the reading without a quantifier is also accounted for.

Summarizing this section, I proposed that *each* (dynamically) quantifies over individuals and events. The proposal explains the interpretation of (2), for which previous theories do not have an account.

3. Comparisons and Remaining Issues

3.1. Comparison 1: Pluralized CDRT

As pointed out in the introduction, a similar sentence to (1)/(2) has been discussed in the literature, with a disjunction. The sentence in (11a), repeated here, is an example. With a Pluralized Compositional DRT (PCDRT), Brasoveanu (2007) successfully analyzes this sentence with the indexation shown in (11), where the two indefinites in the disjuncts bear the same index, u_2. In this section, I demonstrate that the analysis of (11a) in PCDRT cannot be extended to (1)/(2). Since the technical detail of PCDRT is quite involved, I will only carry out the discussion informally. The version of PCDRT used for illustration below is the one in Brasoveanu (2007), but the same problem arises for different versions and for other systems like *slicing* of Beaver (1994) and the *distributive operator* of Nouwen (2003).

(11) a. If Alex sees a monkey or a donkey, he waves to it.
b. If Alex^{u_1} sees a^{u_2} monkey or a^{u_2} donkey, he$_{u_1}$ waves to it$_{u_2}$.

PCDRT is a pluralized CDRT based on the plural dynamic predicate logic proposed by van den Berg (1996). It works with *a set* of assignments (called an *information state*). Thus, sentences denote a binary relation between sets of assignments, $\langle F, G\rangle$. As in non-pluralized dynamic systems, the input F is tested or updated into G according to conditions imposed by a sentence. An introduction of new drefs and tests are performed according to the following definition, where new drefs are introduced for each $f \in F$. The second conjunct in (56a) ensures that the process does not add arbitrary new assignments to the output G. Tests are also performed individually. Conditions C_i typically have the form of an n-place predicate P as in (56b). It tests if each $f \in F$ passes the test. For instance, the update by (57a) can be visualized as (57b).

(56) $[u_1, ..., u_n \mid C_1, ..., C_m]$
a. $[u] := \lambda F_{st}.\lambda G_{st}.\ \forall f \in F(\exists g \in G(f \to_u g)) \ \wedge\ \forall g \in G(\exists f \in F(f \to_u g))$
b. $P\{u_1, ..., u_n\} := \lambda F_{st}.\ F \neq \varnothing \ \wedge\ \forall f \in F : P(u_1(f), ..., u_n(f))$

(57) a. $[u_1,\ u_2 \mid \mathtt{dog}\{u_1\},\ \mathtt{cat}\{u_2\}, \mathtt{chased}\{u_1, u_2\}]$

b.

G	u_1	u_2	...	
g_1	$\mathtt{d}_1$	$\mathtt{c}_1$	...	($\mathtt{d}_1$ is a dog, $\mathtt{c}_1$ is a cat, $\mathtt{d}_1$ chased $\mathtt{c}_1$)
g_2	$\mathtt{d}_2$	$\mathtt{c}_2$	...	($\mathtt{d}_2$ is a dog, $\mathtt{c}_2$ is a cat, $\mathtt{d}_2$ chased $\mathtt{c}_2$)
g_3	$\mathtt{d}_3$	$\mathtt{c}_3$	...	($\mathtt{d}_3$ is a dog, $\mathtt{c}_3$ is a cat, $\mathtt{d}_3$ chased $\mathtt{c}_3$)
...	....	...	...	

To see how PCDRT accounts for (11), it is necessary to discuss disjunctions and conditionals. Simplifying somewhat, disjunction in PCDRT sumps up the outputs of each disjunct. That is, the update by $D_1 \vee D_2$ produces G such that $G = K \cup H$ where $D(F)(K) = 1$ and $D(F)(H) = 1$ for some input F. Thus, the disjunction in (58a) produces (58b). For simplicity, I take every disjunction as a sentential disjunction.

(58) a. Alex^{u_1} sees a^{u_2} monkey or (Alex sees) a^{u_2} donkey.

b.

G	u_1	u_2	
g_1	$\mathtt{a}$	$\mathtt{d}$	($\mathtt{a}$ is Alex, $\mathtt{d}$ is donkey, $\mathtt{a}$ sees $\mathtt{d}$)
g_2	$\mathtt{a}$	$\mathtt{m}$	($\mathtt{a}$ is Alex, $\mathtt{m}$ is monkey, $\mathtt{a}$ sees $\mathtt{m}$)

Notice that the definition of disjunction is internally static: D_2 does not take the output of D_1 as an input. This is why in (58a), the reuse of the index u_2 does not cause any issues. If it were internally dynamic, either the second occurrence of u_2 would overwrite the referential information stored by the first one, or the reuse leads to a violation of some condition such as the Novelty Condition (Heim 1982b), resulting in infelicity.

The PCDRT treatment of conditionals $D_1 \Rightarrow D_2$ is similar to CDRT as long as irrelevant complexities are ignored. It calls for a test whether for any G such that $D_1(F)(G)$ holds for some input F, there is K such that $D_2(G)(K)$ holds.

The split antecedence case in (11) is analyzed as follows. The antecedent of the conditional creates G in (59) as an output. Then for each $g \in G$, it is tested if g satisfies the conditions of the consequent. Since the test is performed distributively over the assignments in G, the pronoun it_{u_2} refers to d and m at the same time, resulting in the intended interpretation.

(59) a. If Alex^{u_1} sees a^{u_2} monkey or (Alex sees) a^{u_2} donkey, he$_{u_1}$ waves to it$_{u_2}$.

b.

G	u_1	u_2	
g_1	a	d	(a waves to d)
g_2	a	m	(a waves to m)

It is easy to see that the account hinges on the internal staticity of the disjunction. One may wonder at this point then if we can postulate an internally dynamic conjunction by which the anaphora in (1)/(2) is resolved in the same way PCDRT resolves the split antecedent in disjunction. Although this is in principle possible, it does not offer us a fully general solution for (1)/(2). This is because the same anaphoric relation is obtained even when internal dynamicity is forced in the antecedent conjunction, as in (60).

(60) a. A man saw a monkey, and his brother saw a donkey.
b. Each of them caught it.

An analysis with an internally static conjunction would face difficulty in analyzing this sentence. Thus, this datapoint further justifies t justifies the introduction of the event distributivity.

3.2. Comparison 2: *d*-type theory

E-type / *d*-type theory (Cooper 1979; Heim 1990; Elbourne 2001, 2005; a.o.) is an option competing with a dynamic system in accounting for anaphoric relations. I argue that these theories do not make correct predictions because of the problem of indistinguishable participants.

The theory subsumes two assumptions. Firstly, pronouns are syntactically complex. They are decomposed into [D [P s]] at LF, where D is a covert definite determiner, P is a contextually-supplemented description, and s is a situation variable. Secondly, quantifiers quantify over pairs of an individual and a (minimal) situation.

Suppose under this theory that propositions are predicates of situations of type *st* (where s is a type for situations). Then a simple and informal version of the theory defines *every* as follows.

(61) *every P Q*
$\rightsquigarrow$ for every $\langle x, s\rangle$ where x is an individual and s is a minimal situation in which $P(x)(s) = 1$, there is an extended situation s' of s such that $Q(x)(s') = 1$.

Suppose further the following translations of English phrases. In (62b), *it* is decomposed at LF, and the predicate *donkey* is filled in by the context. (See Elbourne (2001) for a more principled way of filling in the description part. He argues that the description overtly appears in syntax and undergoes ellipsis.) The definite determiner there is supposed to induce the uniqueness presupposition. Thus, it is a predicate true of a pair $\langle x,s\rangle$ iff x beats the unique donkey in s.

(62) a. *man who owns a donkey*
$\rightsquigarrow \lambda s.\lambda x.\exists y\, [\texttt{man}(x,\ s) \wedge \texttt{donkey}(y,\ s) \wedge \texttt{own}(x,\ y,\ s)]$
b. *beats it* (LF: *beats* [*D* [*donkey s*]])
$\rightsquigarrow \lambda s.\lambda x.\texttt{beats}(x, \iota y[\texttt{donkey}(y,s)], s)$

Combining the definition of *every* above, the canonical donkey sentence is analyzed as in (63). Since s and s' are minimal situations, they contain only one donkey. The uniqueness presupposition is satisfied in each such situation. The analysis results in the reading where each donkey owner beats the donkey(s) s/he owns.

(63) *every man who owns a donkey beats it*
$\rightsquigarrow$ For every $\langle x,s\rangle$ where x is an individual and s is a minimal situation in which
$\exists y\, [\texttt{man}(x,\ s) \wedge \texttt{donkey}(y,\ s) \wedge \texttt{own}(x,\ y,\ s)]$
is true, there is an extended situation s' of s such that
$\texttt{beats}(x, \iota y[\texttt{donkey}(y,s')], s')$.
is true.

Now consider our sentence (2). Following Elbourne (2001, 2008), suppose that the description part of the decomposed *it* has a predicate *donkey-or-monkey*. Suppose further *each* quantifies over individuals and situations. The domain of the individual quantification is provided by the overt restrictor *of them*. The domain of situation quantification is provided contextually. Here, the covert restrictor C contains situations where either Alex saw a monkey or Bill saw a donkey. I define *each* as (64). The condition $\texttt{exists}(x,s)$ works as a situation counterpart of the thematic-relation condition. It is true iff x exists in s. Now (65a) is analyzed as shown.

(64) *each* [*of them*, *C*] *P*
$\rightsquigarrow$ For all $\langle x,s\rangle$ where s is a minimal situation such that $s \in C$, $x <_A$ *them*, and $\texttt{exists}(x,s)$, there is an extended situation s' such that $P(x,s') = 1$.

(65) a. Alex saw a monkey, Bill saw a donkey.
b. Each [of them, C] caught it. (LF: ... caught [D [monkey-or-donkey s]]) $\rightsquigarrow$
For all $\langle x,s\rangle$ where s is a minimal situation such that
s is a situation where either Alex saw a monkey or Bill saw a donkey, and
x is an atomic part of $\texttt{Alex} \oplus \texttt{Bill}$, and
$\texttt{exists}(x,s) = 1$,
There is an extended situation s' of s such that
x caught the unique donkey or monkey in s'

Since s is a minimal situation and is subject to the condition $\texttt{exist}$, it contains either Alex and one monkey, or Bill and one donkey. The situation s' is an extended situation of s such that the uniqueness presupposition is satisfied. Thus, *it* correctly picks up an animal in the relevant situation.

However, this theory cannot handle cases like (66) and (67), which raises the problem of indistinguishable participants.

(66) a.

Roba-ga	*betsu-no*	*roba-ni,*	*saru-ga*	*betsu-no*	*saru-ni*
donkey-NOM	another-GEN	donkey-DAT	monkey-NOM	another-GEN	monkey-DAT

sooguu-sita.
encounter-PAST

‘A donkey encountered another donkey, and a monkey encountered another monkey.’

b.

Dotiramo	*sore-ni*	*kamitsui-ta.*
each	it-DAT	bite-PAST

‘Each bit it.’

(67) a. A donkey saw another donkey. A monkey saw another monkey.

b. Each of them bit it.

If analyzed similarly, the quantifiers here quantify over situations containing two donkeys or two monkeys. The uniqueness presupposition in the pronoun thus fails to be satisfied. The problem of indistinguishable participants is now replicated with the new data, and it is unclear how the theory overcomes it.

Notice that the dynamic analysis does not face this problem because the uniqueness presupposition does not exist there. The proposal works similarly as illustrated in section 2.

3.3. Remaining Issues

Finally, I lay out three remaining empirical issues. Firstly, not all quantifiers allow the reading for which we needed the event distribution. Though the reading is obtained with equal acceptability with *neither* and *both*, it is degraded with *all*, *every*, *none*, and *most*. This is the case for Japanese counterparts of these quantifiers as well. We can differentiate these quantifiers by defining them differently, by encoding the event distributivity only into the former group. However, it is unclear why the quantifiers are divided in this way.

Secondly, the reading in question is not obtained in sentences where a quantifier does not take surface scope over a pronoun, as shown in (68). Given that the quantifier can take scope over the pronoun at LF via quantifier raising, the sentence should also have the intended reading. This is reminiscent of Weak Crossover – the reference of *it* ‘depends’ on the quantifier crossing over it in a loose sense, in that the reference of *it* is only defined with the event distributivity induced by a quantifier. It is interesting to see if Chierchia’s (2020) dynamic account of Weak Crossover can be extended to handle this degradation.

(68) a. Alex saw a monkey, and Bill saw a donkey.

b. #It was caught by each of them.

Thirdly, there are cases where the anaphoric relation in question is obtained with violating the thematic-relation requirements. In (69a), a monkey and a donkey are not participants of the meeting events. Thus, letting *each* be anaphoric to these events does not help obtain the anaphoric relation. The same goes for (70). There, the relevant individuals and the animals are participants of different events – *Alex* and *Bill* are participants of the asking events, and a monkey and a donkey are of the catching events. To deal with these cases, we may need to replace *events* in the proposal with *situations*. (Note that even with situations, the dynamic system makes a different and better prediction regarding the indistinguishable participant case.) See Tancredi (2001) for justification to introduce dynamic situations to a non-pluralized dynamic system.

(69) a. Alex met a monkey's owner, and Bill met a donkey's owner.
b. Each of them wanted to buy it.

(70) a. Alex asked Mary to catch a monkey, and Bill asked her to catch a donkey.
b. Each of them wanted to pet it.

Another empirical question regards the analysis of (71), which contains a quantifier in each conjunct.[6]

(71) (This camp is about fostering a sense of responsibility.)
a. This year, every boy was assigned a cat, and every girl was assigned a rabbit.
b. Each of them had to take care of it on a daily basis.

The problem is that the relevant event drefs for assigning events are introduced under the scope of *every*, which is standardly assumed to be external static. Thus, the drefs are not accessible from *each*. The problem is avoided by adopting a pluralized dynamic system, which makes drefs introduced under the scope of a universal quantifier available for future discourse.

4. Conclusion

In this study, I proposed a new treatment of distributivity within dynamic semantics. Novel data was pointed out, to which the proposed operation of the event distributivity offers an analysis. The present proposal is compared with a pluralized dynamic system and *d*-type analysis. It is shown that the event distributivity is still necessary because the alternatives do not offer an analysis of the data.

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Pluractionality via competition: VV in Mandarin Chinese[1]

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Abstract. This paper provides a pragmatic mechanism for deriving pluractionality of the Mandarin VV sequence formed with certain types of verbs. We propose: (i) Syntactically, VV is an instantiation of V-(NUMERAL)-CLASSIFIER, where the second V serves as a cognate verbal classifier. (ii) Semantically, VV denotes an unspecified quantity of events, with the unit of counting being the event itself. (iii) Based on this semantic analysis, pluractionality of VV formed with certain verbs can be derived through its competition with V-one-V. Meanwhile, we address the semantics of event-internal and event-external verbal classifiers (i.e., *xia* vs. *ci*). Our analysis of cognate classifiers can be further extended to the nominal domain.

Keywords: verbal classifiers, countability, atomicity, cumulativity

1. Introduction

Verbs in Mandarin Chinese can be followed by what appears to be a reduplicative morpheme, forming a sequence that contains two instances of the same verb (henceforth VV). VV formed with certain verbs expresses event-internal pluractionality (cf. Deng 2013). For example, *qiao qiao* 'knock knock' and *ti ti* 'kick kick' in (1) convey that there are several knocks or kicks required to be performed by the addressee.

(1) a. ni **qiao** **qiao** men.
you knock knock door
'You give some knocks on the door.'[2]

b. ni **ti** **ti** men.
you kick kick door
'You give some kicks to the door.'

While this seems to align with the cross-linguistic connection between pluractionality and verbal reduplication (see Newman 2012 for an overview), the structure and meaning of VV remain contested, particularly regarding (i) whether VV is formed via morphological reduplication (Li and Thompson 1981) or has a phrasal structure (Chao 1968), and (ii) whether VV expresses aspectual (Wang 1954) or quantitative meaning (Zhu 1982). Furthermore, we would like to point out that none of the previous analyses can fully account for the following puzzles.

Puzzle I: Numerals and aspectual markers can be inserted between the two Vs, such as the numeral *yi* 'one' and the aspectual marker *le* in (2).

(2) a. ni **qiao** yi **qiao** men.
you knock one knock door
'You give some knocks on the door.'[3]

b. ta **qiao**-le **qiao** men.
he knock-PERF knock door
'He gave some knocks on the door.'

[1] We sincerely thank Ian Roberts and Theresa Biberauer for their invaluable guidance and unwavering support. Our appreciation also goes to Rajesh Bhatt, Jonathan Bobaljik, Rui Guo, Sabine Iatridou, Manfred Krifka, Mingming Liu, Paul Portner, and Yoad Winter for their insightful suggestions and stimulating discussions. We are also grateful to the reviewers of SuB 27, the audience at SuB 27, CreteLing 2022, Cambridge, and Peking University for comments and questions. This work is funded by the Cambridge International Scholarship (Cambridge Trust).
[2] Given that *time*-adverbials in English are ambiguous between event-internal and event-external readings (i.e., event-counting vs. occasion-counting), we circumvent translations like 'knock *n* times', but make use of translations such as 'give *n* knocks' to unambiguously indicate event-internal readings.
[3] In (2a), *yi* 'one' is unstressed and has the reading of 'at least one', merely indicating the existence of events. Further elaboration on the semantics of numerals will be provided in Section 4.2.

Puzzle II: Not all verbs can form VV. Activities can form VV, but statives and achievements cannot.[4] Compare (1) with (3).

(3) a.*ta **shi shi** haoren.
he be be good.person
Int.: 'He is a good person.'

b.*ta **dao dao** lundun.
he reach reach London
Int.: 'He reaches London.'

Puzzle III: Not all instances of VV express pluractionality. For example, *deng deng* 'wait wait' in (4a) and *xiang xiang* 'think think' in (4b) cannot be construed as multiple occurrences of waiting events or thinking events, but rather as a single event that extends over some time, implying a durative reading.

(4) a. ni **deng deng** wo.
you wait wait me
'You wait for me for a while.'

b. ni **xiang xiang** zhe ge wenti.
you think think this CL issue
'You think about this issue for a while.'

Puzzle IV: It remains unclear how pluractionality is derived in VV formed with certain activities. Note that the plural interpretation is not exclusive to VV formed with semelfactive verbs. VV formed with activities like *ca* 'wipe', *rou* 'rub', *mo* 'caress', *zhuai* 'tug', *dong* 'move', *bo* 'tuck', *tui* 'push', *la* 'pull', and *zhuan* 'turn' also exhibit pluractionality, as in (5).

(5) a. ta **ca**-le **ca** zhuozi.
he wipe-PERF wipe table
'He gave the table some wipes.'

b. ta **rou**-le **rou** houbei.
he rub-PERF rub back
'He gave his back some rubs.'

c. ta **mo**-le **mo** wo-de tou.
he caress-PERF caress I-MOD head
'He gave some caresses to my head.'

d. ta **zhuai**-le **zhuai** ziji-de xiuzi.
he tug-PERF tug self-MOD sleeve
'He gave his sleeve some tugs.'

This research aims to analyse the structure and meaning of VV and to derive pluractionality of certain VV. We first review the previous analyses (Section 2), then argue that VV is an instantiation of V-(NUMERAL)-CLASSIFIER (henceforth V-NUM-CL), with the second V serving as a cognate verbal classifier, addressing **Puzzle I** (Section 3). We further propose that VV denotes an unspecified quantity of events with the unit specified as the event itself (Section 4). **Puzzle II** and **Puzzle III** are attributed to cumulativity and stable atomicity of events, which are represented as functional heads in the projection of verbal classifiers. Our semantics then enables us to derive the pluractionality of VV formed with certain activities through pragmatic competition with V-one-V, thereby solving **Puzzle IV** (Section 5). Finally, we delve into the motivation for cognate verbal classifiers and extend our analysis to the nominal domain (Section 6).

2. Previous analyses

2.1. Structure of VV: Reduplication vs. Syntactic construction

VV has been viewed as reduplication (Li and Thompson 1981; Paris 2013) and assumed to be either stocked in the lexicon (Deng 2013) or morphologically derived (Zhu 1982). Nonetheless, the reduplication analysis encounters the challenges of **Puzzle I** and **Puzzle II**. First, the linearization problem of the inserted numerals and aspectual markers in (2) has been either left unresolved (Deng 2013) or simply ascribed to ad hoc phonological rules (Yang and Wei 2017). Second, the reduplication analysis struggles to account for the incompatibility of different verbs with VV in (3), since reduplication is not expected to be sensitive to the Aktionsart of verbs.

[4] Accomplishments in Mandarin Chinese are expressed by phrases rather than simplex verbs (Huang 2014). Given that VV typically applies to simplex verbs, our discussion will be focused on activities, achievements, and statives.

An alternative approach treats VV as a syntactic construction, with the first instance of V being a verb and the second, a verbal classifier (Fan 1964; Chao 1968; Xiong 2016). The syntactic approach essentially analyses VV as an instantiation of V-(NUM)-CL. The parallels between VV and V-NUM-CL will be discussed in Section 3.1. In Mandarin, verbal classifiers encode units for counting in the domain of events. For instance, the verbal classifier *xia* in (6a) provides a unit for counting kicks, comparable to the nominal classifier *ge* for pears in (6b).

(6) a. ti san **xia**
kick three CL
'give three kicks'

b. san **ge** li
three CL pear
'three pears'

Within the domain of events, there exists a distinction between events and occasions, resulting in two levels of counting: event-internal and event-external (Cusic 1981). In English, this distinction manifests as scopal difference of *time*-adverbials (Andrews 1983; Cinque 1999), as illustrated in (7). In Mandarin, this distinction is lexically encoded in two types of verbal classifiers (Deng 2013; Donazzan 2013; Zhang 2017; Liao 2018). As demonstrated by (8), *xia* provides a counting unit for events, whereas *ci* provides a counting unit for occasions. We will revisit this issue in Section 3.1 and 4.1.

(7) a. He kicked the door three times four times. (three events, four occasions)
b. Four times, he kicked the door three times.

(8) a. ta ti-le si **ci** men, mei ci ti san **xia**.
he kick-PERF four CL_{occ} door each CL_{occ} kick three CL_{evt}
'He kicked the door on four occasions, and on each occasion he gave three kicks.'
b. *ta ti-le si **xia** men, mei xia ti san **ci**.
he kick-PERF four CL_{evt} door each CL_{evt} kick three CL_{occ}
Int.: 'He kicked the door on four occasions, and on each occasion he gave three kicks.'

The syntactic approach holds two advantages over the reduplication analysis. First, it resolves the insertion issue of numerals and aspectual markers (**Puzzle I**) by treating the second V as a verbal classifier. Second, it may provide a potential explanation for the compatibility pattern of VV with different verbs (**Puzzle II**) through the s-selection of a functional head. The details of the explanation will be further explored in Section 4.2. [5]

2.2. Meaning of VV: Aspect vs. Quantity

Regarding the meaning of VV, it has been suggested that VV conveys particular aspectual information such as delimitativeness (Li and Thompson 1981), short duration (Wang 1954), or tentativeness (Chao 1968; Yang and Wei 2017).[6] According to the delimitativeness view, events conveyed by VV are either low in frequency or short in temporal length, whereas the short duration view emphasises only the latter. However, the denotation of VV is not necessarily tied to low frequency or short duration. As shown by (9) and (10), *ca ca* 'wipe wipe' and *xiang xiang* 'think think' can occur in contexts where the wiping events and the thinking events take a considerable amount of time. As for tentativeness, it is in fact a context-dependent

[5] Another potential analysis within the syntactic approach suggests that the second V is the phonological realisation of an aspectual head (cf. Yang and Wei 2017). This hinges on the idea that VV encodes certain aspectual information, an assumption that, as we will show in Section 2.2, lacks solid empirical support.

[6] While delimitativeness, short duration, and tentativeness are not conventionally considered as aspect, they have been classified as such in previous studies due to their pertinence to temporal properties.

reading of VV observed only in irrealis contexts. For instance, VV in (5) does not exhibit tentativeness. Even in irrealis contexts, (9) and (10) demonstrate that the events denoted by VV can be sufficient, certain, and decisive, contrary to the notion of tentativeness.

(9) diban zheme zang, dei ca yi ge xingqi, ni haohao **ca** **ca**.
floor this dirty require wipe one CL week you sufficiently wipe wipe
'A floor this dirty needs a week of wiping. Give it a sufficient number of wipes.'

(10) ni zixi **xiang xiang** zhe ge wenti, bu xiang qingchu jiu bie zou.
you carefully think think this CL issue not think clearly then not leave
'You think about this issue thoroughly. Otherwise, you won't be allowed to leave.'

This paper will entertain an alternative view, the quantity-based approach, which contends that the core meaning of VV is centred around counting/quantity rather than temporal properties of events. Within this approach, various proposals have been made regarding the meaning of VV, including conveying small quantity in occurrences (Zhu 1982), unspecified quantity (Li 1964), vague quantity (Cheng 1988), and event plurality (Deng 2013). For the small quantity view, as we have seen in (9), the denotation of VV is not necessarily small in quantity. The other three views acknowledge the pluractionality of certain VV like *qiao qiao* 'knock knock'. To support this point, we present three pieces of evidence: (i) such VV can be associated with *dou* that introduces universal quantification (cf. Lee 1986; Lin 1998; a.o.), as in (11); (ii) such VV can be referred back to by plural definites instead of singular definites, as in (12); (iii) such VV is unacceptable in singular-event scenarios, as shown by (13).

(11) ta **qiao**-le **qiao** men, dou qiao-zai-le boli-shang.
he knock-PERF knock door all knock-on-PERF glass-LOC
'He gave some knocks on the door, all of which were on the glass panel.'

(12) ta **qiao**-le **qiao** men. ta qiao-de na {ji / #yi} xia hen qing.
he knock-PERF knock door he knock-MOD the several one CL_{evt} very gentle
'He gave some knocks on the door. Those knocks were very gentle.'

(13) #baochi anjing. buyao qiao hao ji xia men, **qiao** **qiao** men.
keep quiet don't knock very several CL_{evt} door knock knock door
Int.: 'Keep quiet. Don't give multiple knocks on the door; give one knock on the door.'

Nevertheless, the quantity-based approach leaves **Puzzle III** and **IV** unresolved, namely, why *deng deng* 'wait wait' does not exhibit pluractionality, and why *qiao qiao* 'knock knock' does.

To summarise, for the structure of VV, the syntactic approach holds advantages over the reduplication analysis; for the meaning of VV, the quantity-based approach proves to be more solid than the aspect-based approach. On the basis of the syntactic approach and the quantity-based approach, we will further address the four puzzles introduced in Section 1. Now let us first elaborate on the syntactic structure of VV.

3. Syntax of VV

3.1. VV: V-(NUM)-CL under the guise of reduplication

As previously noted in Section 2.1, treating VV as reduplication falls short when addressing **Puzzle I** and **II**. More evidence from Mandarin and the earlier stages of its development suggests that VV has an internal syntactic structure.

First, more than one word is allowed to occur in between the two Vs, including the numeral *yi* 'one', the perfective marker *le*, and the resultative morpheme *shang*.

(14) ta **dan**-le yi **dan** shen-shang-de chentu.
he whisk-PERF one whisk body-LOC-MOD dust
'He gave some whisks to remove the dust from his body.'

(15) fanshi ren-de dongxi, beijingren dou neng **wan**-shang yi **wan**.
all human-MOD thing Beijinger all can play-RESULT one play
'For every handicraft, Beijingers can play with it for a while.'

Second, while the numeral between VV is limited to *yi* 'one' in Mandarin, numeral-insertion is rather productive in late Medieval and early Modern Chinese. [7]

(16) jiang mashaoer qu na menxian-shang **qiao** san **qiao**.
take spoon go that threshold-LOC knock three knock
'Use the spoon to give three knocks on that threshold.'
(*Taohuanv po fa jia Zhougong*, Drama, 1200s A.D.)

Numeral insertion suggests that the second V of VV is a verbal classifier. We would like to present additional evidence to demonstrate that VV is actually an instantiation of V-(NUM)-CL. First, the second V in VV exhibits a complementary distribution with NUM-CL.

(17) ta **qiao**-le **qiao** (***ji** **xia**) men jiu zou-le.
he knock-PERF knock several CL$_{evt}$ door then leave-PERF
'He gave some knocks on the door and then left.'

Second, V-(one)-V and V-(one)-CL share the same licensing condition for *yi*-ellipsis. When the numeral *yi* 'one' is not focused, it solely conveys the existence of events (see Section 4.2), and thus can be omitted without changing the meaning.

(18) a. ni **qiao** (yi) **qiao** men.
you knock one knock door
'You give some knocks on the door.'

b. ni **qiao** (yi) **xia** men.
you knock one CL$_{evt}$ door
'You give some knocks on the door.'

Third, both VV and V-(NUM)-CL allow for *le*-insertion, and the aspectual marker *le* cannot be attached to the whole construction, as shown in (19) and (20). The position of *le* suggests that only the first V of VV occupies the V head.

(19) a. ta **qiao**-le **qiao** men.
he knock-PERF knock door
'He gave some knocks on the door.'

b. *ta **qiao** **qiao**-le men.
he knock knock-PERF door
Int.: 'He gave some knocks on the door.'

(20) a. ta **qiao**-le **xia** men.
he knock-PERF CL$_{evt}$ door
'He gave some knocks on the door.'

b. *ta **qiao** **xia**-le men.
he knock CL$_{evt}$-PERF door
Int.: 'He gave some knocks on the door.'

Fourth, the second V of VV aligns with the event-internal classifier *xia*, not the event-external classifier *ci* (see Section 2.1). As (21) illustrates, VV conveys event counting instead of occasion counting.

[7] In Mandarin, the numeral *yi* 'one' between VV does not have alternatives. Consequently, it cannot be focused or stressed, and it only gets the *at least* reading. By contrast, in late Medieval and early Modern Chinese, numerals between VV have alternatives and thus can get the *exactly* reading. This issue will be discussed in Section 4.2.

(21) a. ta **qiao**-le **qiao** men, mei {*ci / xia} dou hen qing.
he knock-PERF knock door each CL_{occ} CL_{evt} all very gentle
'He gave some knocks on the door, and each knock was very gentle.'

b. ta **qiao**-le ji **xia** men, mei {*ci / xia} dou hen qing.
he knock-PERF several CL_{evt} door each CL_{occ} CL_{evt} all very gentle
'He gave several knocks on the door, and each knock was very gentle.'

Fifth, VV and V-NUM-CL_{evt} exhibit a similar pattern in their compatibility with different verbs, as demonstrated by our investigation of 170 verbs summarised in Table 1. Specifically, statives are not compatible with VV or V-NUM-CL. Achievements are rejected by VV or V-NUM-CL_{evt} yet compatible with V-NUM-CL_{occ}. Activities can be divided into two types: Activities I (*qiao* 'knock') can occur in VV and V-NUM-CL, and VV formed with Activities I is pluractional. Activities II (*deng* 'wait') can be found in VV and V-one-CL_{evt} but not V-three-CL_{evt}, and VV formed with Activities II is not pluractional.

Class	Example	VV	V-one-CL_{evt}	V-three-CL_{evt}	V-NUM-CL_{occ}
Statives	*shi* 'be'	− **shi shi*	− **shi yi xia*	− **shi san xia*	− **shi san ci*
Achievements	*dao* 'reach'	− **dao dao*	− **dao yi xia*	− **dao san xia*	+ *dao san ci*
Activities I	*qiao* 'knock'	$+_{pluractional}$ *qiao qiao*	+ *qiao yi xia*	+ *qiao san xia*	+ *qiao san ci*
Activities II	*deng* 'wait'	$+_{not\,pluractional}$ *deng deng*	+ *deng yi xia*	− **deng san xia*	+ *deng san ci*

Table 1: Compatibility of counting constructions with verbs

Together, the evidence supports our claim that VV is in fact V-one-CL_{evt} with an omitted unfocused *yi* 'one'. The second V of VV is a cognate verbal classifier providing a counting unit for events, akin to the event-internal verbal classifier *xia*.

3.2. NUM-CL is an adjunct

In line with Huang, Li, and Li's (2009) adjunct-based analysis, we argue that NUM-CL_{evt} (including NUM-V) in V-NUM-CL_{evt} is an adjunct rather than an argument of the verb. First, NUM-CL_{evt} is optional.

(22) a. ni **qiao** (yi **qiao**) men.
you knock one CL_{KNOCK} door
'You give some knocks on the door.'

b. ni **qiao** (yi **xia**) men.
you knock one CL_{evt} door
'You give some knocks on the door.'

Second, NUM-CL_{evt} can compose with predicates whose argument slots are saturated, such as ditransitive verbs with both direct and indirect objects, suggesting that NUM-CL_{evt} is not an argument of the verb.

(23) a. ni **jiao** (yi) **jiao** wo shuxue.
you teach one CL_{TEACH} me math
'You teach me math a bit.'

b. ni **jiao** (yi) **xia** wo shuxue.
you teach one CL_{evt} me math
'You teach me math a bit.'

Third, in contrast with indefinite arguments, NUM-CL_{evt} lacks the *de re* reading, indicating its adjunct status (Landman 2004, 2006). In (24a), the indefinite object can take either the narrow or the wide scope, while in (24b), NUM-CL$_{evt}$ can only take the narrow scope.[8]

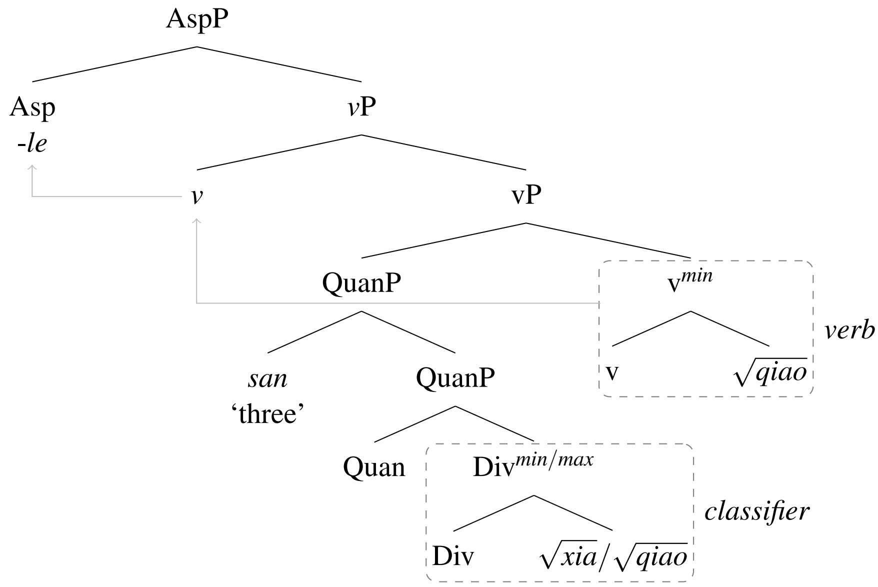
(24) a. mei ge ren dou xiang qu yi ge Beijing guniang.
every CL people all want marry one CL Beijing girl
'Everyone wants to marry a girl from Beijing.' *want* > 1
'There is a girl from Beijing who everyone wants to marry.' 1 > *want*

b. mei ge ren dou xiang qiao yi xia men.
every CL people all want knock one CL$_{evt}$ door
'Everyone wants to give a knock on the door.' *want* > 1
#'There is a knock which everyone wants to give on the door.' #1 > *want*

3.3. Structuring V-NUM-CL

We have argued that VV is an instantiation of V-(NUM)-CL$_{evt}$, and NUM-CL$_{evt}$ is an adjunct of V. Since NUM-CL$_{evt}$ encodes event counting, we assume that NUM-CL$_{evt}$ is situated structurally inside *v*P (cf. Cinque 1999; Zhang 2017). In the spirit of Borer (2005), we further propose that NUM-CL is represented as Quan(tity)P, as (25) illustrates.

(25)



QuanP is an adjunct to the verb. Internally, QuanP is headed by Quan, which takes a numeral as its specifier and a verbal classifier Div(ision)$^{min/max}$ as its complement.[9] For the linear order, we follow Huang et al.'s (2009) analysis and treat *le* as an affix at the Asp head; the verb moves up to *v*, eventually landing in the Asp head. This gives us the desired order of V-NUM-CL$_{evt}$ as well as the linear adjacency of the verb and the aspectual marker *le*, thereby resolving the

[8] Manfred Krifka (p.c.) suggests that the observed absence of the *de re* reading for NUM-CL$_{evt}$ could be attributed to the inherent difficulty in identifying specific knocking events. Yet, this does not seem to be the case in Mandarin, as events can be identifiable, particularly with the use of demonstratives *zhe* 'this' and *na* 'that'.

(i) mei ge ren dou xiang qiao **na yi xia**.
every CL people all want knock that one CL$_{evt}$
'Everyone wants to give that knock.'

[9] Following Chomsky (1995), a functional category can be both maximal and minimal. Hence, it is reasonable to postulate that Div$^{min/max}$ is a complex head which is simultaneously maximal and minimal.

le-insertion problem in **Puzzle I**.[10]

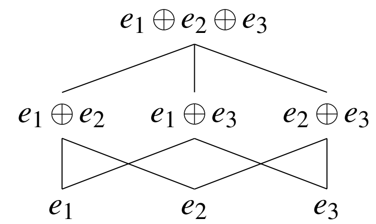
As for verbs and verbal classifiers, we adopt core assumptions from Distributed Morphology (Marantz 1997, 2007; Embick and Marantz 2008; a.o.) and assume that terminal nodes can be decomposed into roots and categorizers. A categorizer provides a categorial label for the root that it combines with, and the root carries lexical information. In this way, a verb and a verbal classifier are syntactically isomorphic, sharing the same template (categorizer + root). A root, e.g., $\sqrt{qiao}$ 'knock', can merge with the verbal categorizer (v) or the categorizer for classifiers (Div). This provides a feasible mechanism for deriving the identical lexical form of the cognate verbal classifier and the verb. The motivation for merging the same root with v and Div will be explored in Section 6.

4. Semantics of V-NUM-CL

4.1. Ontology of events

Before delving into the semantics of V-NUM-CL, let us lay out our background assumptions about events and verbs. First, following the general assumption that a verb denotes a set of events (Parsons 1990; Krifka 1992; a.o.), and Krifka's (1989) idea that there is a semi-lattice structure in the domain of events, we assume that a verb denotes a structured set of events, as schematised in (26). That is, the denotation of a verb may include atomic events and complex events. Atomic events have no sub-events, and complex events are sums of atomic events.[11]

(26)



Second, verbs with different lexical aspects can be characterised by different types of event sets, as in (27). Statives like *shi* 'be' denote a set of states (notated as *s*) rather than events (notated as *e*). Achievements like *dao* 'reach' denote a set of atomic events. Given that achievements express a single punctual event, two achievement events cannot be cross-temporally identical when they count as the same event for the purpose of enumerating events (Lund 2021). Therefore, there are no complex achievement events. Activities like *qiao* 'knock' and *deng* 'wait' denote a set of events that include both atomic events and complex events, since activity events can be cross-temporally identical.

(27) $[\![shi]\!] = \{s_{be1}, s_{be2}, s_{be3}, \ldots\}$ Statives
$[\![dao]\!] = \{e_{reach1}, e_{reach2}, e_{reach3}, \ldots\}$ Achievements
$[\![qiao]\!] = \{e_{knock1}, e_{knock2}, \ldots, e_{knock1} \oplus e_{knock2}, \ldots\}$ Activities
$[\![deng]\!] = \{e_{wait1}, e_{wait2}, \ldots, e_{wait1} \oplus e_{wait2}, \ldots\}$ Activities

Third, occasions, at least in Cusic's (1981) sense, can be characterised as groups of events with

[10] We do not treat the verbal classifier as a head in the Extended Projection of V, contra Zhang (2017). Empirically, we have argued that NUM-CL$_{evt}$ is an adjunct in Section 3.2. Technically, treating the verbal classifier as a head would block the V-to-*v*-to-Asp movement, thus failing to account for the linear adjacency of V and *le*, as in (19) and (20), and the linear order of V-NUM-CL$_{evt}$-O, as in (21b).

[11] We take verbs as born plural. Otherwise, this could be manipulated with Link's (1983) pluralising operator $*$.

the group forming operator $\uparrow$ (Link 1984; Landman 1989a, b).[12] A group of events is an atom that contains at least one atomic event or one complex event.

(28) Group of events: $\uparrow(e), \uparrow(e_1 \oplus e_2), \ldots$ Occasions

The widely recognized distinction between event-internal and event-external, which is lexically manifested in Mandarin verbal classifiers (Section 2.1), can now be recast in terms of events and groups of events. Specifically, *xia* (CL_{evt}) provides a counting unit for events, whereas *ci* (CL_{occ}) does so for groups of events.

4.2. Composition of V-NUM-CL

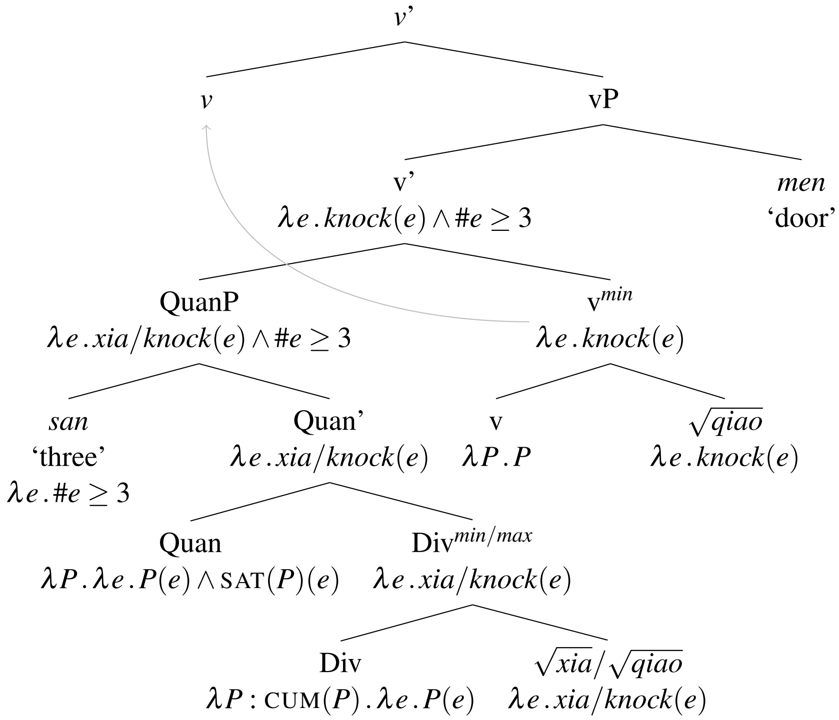
In this section, we deal with the semantic composition of V-NUM-CL_{evt}, taking *qiao san xia* and *qiao san qiao* in (29) as examples.

(29) a. ni **qiao san xia** men.
you knock three CL_{evt} door
'You give three knocks on the door.'

b. jiang mashaoer qu na menxian-shang **qiao san qiao**.
take spoon go that threshold-LOC knock three knock
'Use the spoon to give three knocks on that threshold.'
(*Taohuanv po fa jia Zhougong*, Drama, 1200s A.D.)

Adopting Neo-Davidsonian event semantics (Parsons 1990; Carlson 1984; a.o.), we treat verbs as one-place predicates of events. They are combined with the thematic arguments via predicate modification, with all arguments introduced by thematic role heads. (30) illustrates our proposal of the semantic composition of V-NUM-CL_{evt}.

(30)



[12] See also Wągiel (2018) for a mereotopological analysis of groups, which defines a group as a cluster, namely, a plurality of transitively connected entities.

4.2.1. Cumulativity and Puzzle II

Given the decomposition of a verb into a root and a categorizer, we assume, for simplicity, that the root denotes a set of events, and the verbal categorizer introduces an identity function. As for verbal classifiers, it is worth noting that they are grammaticalized out of verbs (Liu 1959), and especially, cognate verbal classifiers share the same lexical form as verbs. Hence, we put forward that verbal classifiers share the same semantic type as verbs. More precisely, the root of a verbal classifier also denotes a set of events, and the categorizer Div selects a certain type of roots, in light of the compatibility pattern of VV and V-NUM-CL in Table 2 (**Puzzle II**).

Class	Example	VV	V-one-CL_{evt}	V-NUM-CL_{occ}
Statives	*shi* 'be'	$-$	$-$	$-$
Achievements	*dao* 'reach'	$-$	$-$	$+$
Activities	*qiao* 'knock', *deng* 'wait'	$+$	$+$	$+$

Table 2: Compatibility of counting constructions with verbs (extracted from Table 1)

To account for the compatibility pattern, we propose that the categorizer Div s-selects roots via the cumulativity presupposition (cf. Scha 1981; Schein 1986), as in (31). The cumulativity presupposition requires the input of Div to contain complex events (i.e., divisible events).

(31) **Cumulativity of events**

$$\text{CUM}(P) \stackrel{\text{def}}{=} \forall e[P(e) \rightarrow \forall e'[P(e') \rightarrow P(e \oplus e')]]$$

Essentially, the categorizer Div determines what types of roots can form a verbal classifier, which further results in the compatibility of VV and V-NUM-CL with different verbs. Given the cumulativity presupposition, Div exclusively selects activity roots, as only activity roots have complex events in their denotations. Specifically, only activity roots (e.g., $\sqrt{qiao}$ 'knock', $\sqrt{deng}$ 'wait') can form verbal classifiers; stative roots like $\sqrt{shi}$ 'be', denoting a set of states rather than events, do not match the type of the input of Div; achievement roots like $\sqrt{dao}$ 'reach' denote a set of events consisting only of atomic events, and thus fail to meet the cumulativity presupposition. Consequently, only activity roots can form VV.

One special case of activity roots selected by Div is $\sqrt{xia}$. In Ancient Chinese, the verb *xia* 'move down' denotes a set of events with a downward trajectory, as in (32a). Then, it undergoes semantic bleaching and is used as a dedicated verbal classifier. Since the verbal classifier *xia* provides a natural counting unit for all activity events, it is reasonable to assume that the denotation of bleached $\sqrt{xia}$ is the union of all the activity roots, as in (32b).[13]

(32) a. $[\![\sqrt{xia}]\!] = \{e_{down1}, e_{down2}, e_{down1} \oplus e_{down2}, \ldots\}$ (verb *xia*)

b. $[\![\sqrt{xia_{bleached}}]\!] = \{e_{activity1}, e_{activity2}, e_{activity1} \oplus e_{activity2}, \ldots\}$ (classifier *xia*)

$= \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots, e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

Now we can explain why V-one-CL_{evt} (i.e., V-one-*xia*) only permits activities to serve as its main verb. In our analysis, one-CL_{evt} and V are combined via predicate modification, as will be demonstrated in Section 4.2.2. Since the denotation of $\sqrt{xia_{bleached}}$ includes only activity events, and its intersection with the set of events denoted by V cannot be empty, the denotation of V must include activity events. As a result, V must be activities.

[13] The denotation of $\sqrt{xia_{bleached}}$ in (32b) satisfies the cumulativity presupposition in (31), as the sum operator only applies to entities of the same kind and there are no complex events like $e_{knock} \oplus e_{wait}$.

Note that there are no achievement events in the denotation of $\sqrt{xia}_{bleached}$. According to the cumulativity presupposition in (31), the input of Div must contain members that are summable. Since achievement events are not summable (Section 4.1), they are excluded from the denotation of $\sqrt{xia}_{bleached}$. Hence, for V-one-*xia*, V cannot be achievements.

As for V-NUM-CL$_{occ}$ (i.e., V-NUM-*ci*), the denotation of the verbal classifier *ci* is assumed to be as follows (cf. Liao 2018; Li 2019).

(33) $[\![\sqrt{ci}]\!] = \{\uparrow(e_{knock1}), \uparrow(e_{knock2}), \uparrow(e_{knock1} \oplus e_{knock2}), \uparrow(e_{knock1}) \oplus \uparrow(e_{knock2}), \ldots$
$\uparrow(e_{wait1}), \uparrow(e_{wait2}), \uparrow(e_{wait1} \oplus e_{wait2}), \uparrow(e_{wait1}) \oplus \uparrow(e_{wait2}), \ldots$
$\uparrow(e_{reach1}), \uparrow(e_{reach2}), \uparrow(e_{reach1}) \oplus \uparrow(e_{reach2}), \ldots\}$

The denotation of *ci* differs from that of *xia* in two aspects. First, *ci* targets groups of events (Section 2.1), so $\sqrt{ci}$ denotes a set of groups of events. Before merging with NUM-*ci*, V is first combined with the group forming operator ↑, rendering a set of groups of events. Since the intersection of NUM-*ci* and ↑V is a non-empty set, V cannot be statives, which do not match the type of NUM-*ci*. Second, the denotation of $\sqrt{ci}$ contains sums of groups of achievement events. As discussed in Section 4.1, there are no sums of achievement events within one occasion. However, among multiple occasions, there do exist sums of groupified achievement events like $\uparrow(e_{reach1}) \oplus \uparrow(e_{reach2})$. This is why achievements, in addition to activities, can serve as the main verb in V-NUM-*ci*.

4.2.2. Stable atomicity and Puzzle III

Let us proceed to the other functional head in (30), Quan, which takes the output of Div, namely, verbal classifiers formed with activity roots. Quan is related to the differences between the two types of activities with respect to the interpretation of VV and the restriction on numerals, as illustrated in Table 3. First, VV formed with Activities I (*qiao* 'knock') exhibits pluractionality, while VV formed with Activities II (*deng* 'wait') does not (**Puzzle III**). Second, Activities I are compatible with any numerals in V-NUM-CL$_{evt}$, whereas for Activities II, the numeral is limited to *yi* 'one'.[14]

Class	Example	VV	V-one-CL$_{evt}$	V-three-CL$_{evt}$	V-NUM-CL$_{occ}$
Activities I	*qiao* 'knock'	$+_{pluractional}$	$+$	$+$	$+$
Activities II	*deng* 'wait'	$+_{not\,pluractional}$	$+$	$-$	$+$

Table 3: Compatibility of counting constructions with activities (extracted from Table 1)

To account for the pattern above, we propose two flavours of Quan that diverge in terms of stable atomicity, that is, whether an atomic event remains atomic across contexts (cf. Chierchia 2010). As defined by (34) and (35), Quan$_1$ yields a set of events with members composed of stable atoms, whereas Quan$_2$ yields a set of events with members composed of unstable atoms.

(34) **Stable atomicity of events**
$\text{SAT}(P)(e) \overset{\text{def}}{=} \exists e'[e' \sqsubseteq e \wedge P(e') \wedge \forall c[\neg \exists e'' \text{ in } c[e'' \sqsubset e']]]$

(35) a. $[\![\text{Quan}_1]\!] = \lambda P.\lambda e.P(e) \wedge \text{SAT}(P)(e)$
b. $[\![\text{Quan}_2]\!] = \lambda P.\lambda e.P(e) \wedge \neg\text{SAT}(P)(e)$

[14] The same pattern is also observed in V-NUM-V in early Modern Chinese. V-NUM-V formed with Activities I allows for any numerals, while V-NUM-V formed with Activities II is only compatible with *yi* 'one'.

For an intuitive illustration, consider knocking events (stable atoms) versus waiting events (unstable atoms). An atomic knocking event is stable in the sense that in different contexts it remains minimal and has no subevent that can be considered as a knocking event. By contrast, atomic waiting events vary across different contexts. For instance, imagine a scenario where John waited for Mary for an hour, then went to the restroom, and later returned to wait for her for an additional hour. In this case, John's waiting can be construed either as a single waiting event or as two distinct waiting events.

Events with stable atoms can be precisely counted, whereas events with unstable atoms are too vaguely specified to be counted. In our analysis, the difference in respect of the counting result can be represented as a requirement of Quan on the numerals in its specifier position. Following Horn (1972), Gazdar (1979), Levinson (1983), and others, we adopt an *at least* semantics for numerals, as in (36).[15] Consequently, Quan$_1$ allows for precise counting results and thus can take any numerals as its specifier; Quan$_2$ confines its specifier to the unfocused *yi* 'one' with an *at least* reading, which merely indicates the existence of events.

(36) a. $[\![$*yi* 'one'$]\!] = \lambda e\,.\,|\{e' \,|\, e' \leq_{atom} e\}| \geq 1 = \lambda e\,.\,\#e \geq 1$

b. $[\![$*san* 'three'$]\!] = \lambda e\,.\,|\{e' \,|\, e' \leq_{atom} e\}| \geq 3 = \lambda e\,.\,\#e \geq 3$

Note that we analyse NUM-CL$_{evt}$, as well as numerals, as intersective modifiers rather than quantifiers. The evidence comes from two facts. First, there is no observation of quantifier raising of NUM-CL$_{evt}$; see (24). Second, when combined with other plurals, NUM-CL$_{evt}$ gets a scopeless, cumulative reading (cf. Landman 2000, 2004, 2006), as shown by (37).

(37) a. ta qiao-le liang shan men si xia.
he knock-PERF two CL door four CL$_{evt}$
'He gave a total of 4 knocks on 2 doors.'

b. ta ti-le liang ge ren si xia.
he kick-PERF two CL people four CL$_{evt}$
'He gave a total of 4 kicks to 2 people.'

Now we are equipped to explain the differences between two types of activities. For V-NUM-CL$_{evt}$ (i.e., V-NUM-*xia*), recall that the denotation of $\sqrt{xia}_{bleached}$ contains all activity events and Div does not alter its input. When *xia* merges with Quan$_1$, the output is restricted to a set containing only the events composed of stable atoms, which is the union set of the events denoted by Activities I. In this case, the verb in V-NUM-CL$_{evt}$ can only be Activities I. Since Quan$_1$ can take any numerals as its specifier, V-NUM-CL$_{evt}$ formed with Activities I does not impose any constraints on numerals.

(38) Illustration of *qiao san*$_{\mathrm{F}}$ *xia* 'knock three CL$_{evt}$'[16]

a. $[\![\mathrm{Div}]\!]([\![\sqrt{xia}]\!]) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots, e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

b. $[\![\mathrm{Quan}_1]\!]([\![\mathrm{Div}]\!]([\![\sqrt{xia}]\!])) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots\}$

c. $([\![san_{\mathrm{F}}]\!])([\![\mathrm{Quan}_1([\![\mathrm{Div}]\!]([\![\sqrt{xia}]\!]))) = \{e_{knock1} \oplus e_{knock2} \oplus e_{knock3}, \ldots\}$

d. $([\![qiao]\!])(([\![san_{\mathrm{F}}]\!])([\![\mathrm{Quan}_1([\![\mathrm{Div}]\!]([\![\sqrt{xia}]\!])))) = \{e_{knock1} \oplus e_{knock2} \oplus e_{knock3}, \ldots\}$

When *xia* merges with Quan$_2$, the output is restricted to a set of events composed of unstable atoms, which is the union set of the events denoted by Activities II. In this case, the verb in V-NUM-CL$_{evt}$ can only be Activities II. Given that Quan$_2$ only allows for the unfocused *yi*

[15] See Bylinina and Nouwen (2020) for an overview of numeral semantics.

[16] Numerals with the subscript F are focused and have an *exactly* reading, whereas numerals with the subscript UF are unfocused and have an *at least* reading. See Section 4.2.3 for details.

'one' to be its specifier, the numeral in V-NUM-CL$_{evt}$ formed with Activities II is limited to the unfocused *yi* 'one'.

(39) Illustration of *deng yi*$_{\text{UF}}$ *xia* 'wait one CL$_{evt}$'

a. $[\![\text{Div}]\!]([\![\sqrt{xia}]\!]) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots, e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

b. $[\![\text{Quan}_2]\!]([\![\text{Div}]\!]([\![\sqrt{xia}]\!])) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

c. $([\![yi_{\text{UF}}]\!])([\![\text{Quan}_2([\![\text{Div}]\!]([\![\sqrt{xia}]\!]))) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

d. $([\![deng]\!])(([\![yi_{\text{UF}}]\!])([\![\text{Quan}_2([\![\text{Div}]\!]([\![\sqrt{xia}]\!])))) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

It is worth mentioning that for V-NUM-CL$_{occ}$ formed with Activities II, the numeral is not limited to the unfocused *yi* 'one'. For example, *deng san ci* 'wait three CL$_{occ}$' is grammatical, denoting three groups of waiting events. This is because groups possess the property of stable atomicity and can be precisely counted (Landman 1989a, b; Snyder and Shapiro 2022; a.o.).

As for VV, namely, V-(one$_{\text{UF}}$)-V, its pluractionality (**Puzzle III**) also hinges on the stable atomicity of events. In brief, with Activities I, V-(one$_{\text{UF}}$)-V denotes a set of events composed of stable atoms, and competes with the singular alternative V-one$_{\text{F}}$-V, resulting in pluractionality. With Activities II, V-(one$_{\text{UF}}$)-V denotes a set of events composed of unstable atoms that cannot be counted, and thus simply indicates the existence of events.[17] Consequently, VV formed with Activities II lacks singular alternatives like V-one$_{\text{F}}$-V for competition and does not exhibit pluractionality. The specifics of pragmatic competition will be further explored in Section 5.

(40) Illustration of *qiao yi*$_{\text{UF}}$ *qiao* 'knock one CL$_{\text{KNOCK}}$'

a. $[\![\text{Div}]\!]([\![\sqrt{qiao}]\!]) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots\}$

b. $[\![\text{Quan}_1]\!]([\![\text{Div}]\!]([\![\sqrt{qiao}]\!])) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots\}$

c. $([\![yi_{\text{UF}}]\!])([\![\text{Quan}_1([\![\text{Div}]\!]([\![\sqrt{qiao}]\!]))) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots\}$

d. $([\![qiao]\!])(([\![yi_{\text{UF}}]\!])([\![\text{Quan}_1([\![\text{Div}]\!]([\![\sqrt{qiao}]\!])))) = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots\}$

(41) Illustration of *deng yi*$_{\text{UF}}$ *deng* 'wait one CL$_{\text{WAIT}}$'

a. $[\![\text{Div}]\!]([\![\sqrt{deng}]\!]) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

b. $[\![\text{Quan}_2]\!]([\![\text{Div}]\!]([\![\sqrt{deng}]\!])) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

c. $([\![yi_{\text{UF}}]\!])([\![\text{Quan}_2([\![\text{Div}]\!]([\![\sqrt{deng}]\!]))) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

d. $([\![deng]\!])(([\![yi_{\text{UF}}]\!])([\![\text{Quan}_2([\![\text{Div}]\!]([\![\sqrt{deng}]\!])))) = \{e_{wait1}, e_{wait2}, e_{wait1} \oplus e_{wait2}, \ldots\}$

4.2.3. Denotation of V-NUM-CL

Eventually, in our analysis, V-NUM-CL$_{evt}$ denotes a certain number of events, where the counting unit is CL and the counting result is NUM. The verbal classifier can be either a general classifier that encodes the natural unit, or a cognate classifier taking the event itself as the unit.

(42) a. $[\![knock\ one\ xia]\!] = \lambda e\,.\,knock(e) \wedge \#e \geq 1$
There are at least one knock, the counting unit of which is the **natural unit**.

b. $[\![knock\ one\ knock]\!] = \lambda e\,.\,knock(e) \wedge \#e \geq 1$
There are at least one knock, the counting unit of which is the **knock** itself.

[17] Such an existential interpretation may give rise to a durative reading, as in (4); see also Donazzan (2013).

Numerals are assumed to have an *at least* semantics, from which the *exactly* reading can be derived as a Gricean scalar implicature (Horn 1972; Gazdar 1979; Levinson 1983; a.o.). For instance, when *yi* 'one' is not focused, it has the *at least* reading '≥ 1'. When focused, it triggers stronger alternatives such as '≥ 2' and '≥ 3' and negates them, yielding the *exactly* reading '$= 1$'. In the case of V-NUM-CL$_{evt}$, as discussed in Section 4.2.2, only the ones formed with Activities I (*qiao* 'knock') can have different numerals as alternatives to derive the scalar implicature. That is, only V-NUM-CL$_{evt}$ formed with Activities I can have the *exactly* reading. With Activities II (*deng* 'wait'), the numeral in V-NUM-CL$_{evt}$ is limited to the unfocused *yi* 'one' without numeral alternatives, and hence can only receive the *at least* reading.

(43) a. $[\![knock\ one_{\mathrm{UF}}\ xia]\!] = \lambda e\,.\,knock(e) \wedge \#e \geq 1$ — Activities I

$[\![knock\ one_{\mathrm{F}}\ xia]\!] = \lambda e\,.\,knock(e) \wedge \#e = 1$

b. $[\![wait\ one_{\mathrm{UF}}\ xia]\!] = \lambda e\,.\,wait(e) \wedge \#e \geq 1$ — Activities II

$^{*}[\![wait\ one_{\mathrm{F}}\ xia]\!] = \lambda e\,.\,wait(e) \wedge \#e = 1$

One special case of V-one$_{\mathrm{UF}}$-CL$_{evt}$ is VV. As demonstrated in Section 3.1, VV is in fact V-one$_{\mathrm{UF}}$-CL$_{evt}$ with an omitted *yi* 'one'. Thereby, VV denotes an unspecified quantity of events.

(44) a. $[\![knock\ (one_{\mathrm{UF}})\ knock]\!] = \lambda e\,.\,knock(e) \wedge \#e \geq 1$

b. $[\![wait\ (one_{\mathrm{UF}})\ wait]\!] = \lambda e\,.\,wait(e) \wedge \#e \geq 1$

5. Pluractionality via competition

Based on the semantics of V-NUM-CL$_{evt}$, we propose the following pragmatic mechanism for deriving the pluractionality of VV formed with Activities I (**Puzzle IV**).

(45) **Competition between VV and V-one$_{\mathrm{F}}$-V**

a. VV formed with Activities I denotes an unspecified quantity of events.
For example, $[\![knock\ knock]\!] = \lambda e\,.\,knock(e) \wedge \#e \geq 1$

b. V-one$_{\mathrm{F}}$-V formed with Activities I denotes exactly one event.
For example, $[\![knock\ one_{\mathrm{F}}\ knock]\!] = \lambda e\,.\,knock(e) \wedge \#e = 1$

c. With Activities I, V-one$_{\mathrm{F}}$-V is a stronger alternative of VV.

d. Using VV implicates that V-one$_{\mathrm{F}}$-V does not hold, i.e., VV denotes non-singular events.
For example, $[\![knock\ knock]\!]^{+} = \lambda e\,.\,knock(e) \wedge \#e > 1$

As mentioned in Section 3.1, V-NUM-V formed with Activities I is prevalent in late Medieval and early Modern Chinese (1200s – 1500s A.D.). For example, in (46) and (47), the numerals in V-NUM-V are focused and have the *exactly* reading.

(46) qu menxian-shang **qiao yi$_{\mathrm{F}}$ qiao**, zhuo zhougongjia si yi kou.
go threshold-LOC knock one CL$_{\mathrm{KNOCK}}$ make Mr. Zhou's die one CL
'If you give one knock on the threshold, one person in Mr. Zhou's family will die.'

Q: **qiao liang$_{\mathrm{F}}$ qiao** ne?
knock two CL$_{\mathrm{KNOCK}}$ Q
'How about giving two knocks?'

A: zhuo zhougongjia si liang kou.
make Mr. Zhou's die two CL
'Two people in Mr. Zhou's family will die.'

(*Taohuanv po fa jia Zhougong*, Drama, 1200s A.D.)

(47) wangming na-chu baobei lai, **qiao**-le **san$_F$ qiao**.
Wangming take-out precious.weapon come knock-PERF three CL$_{KNOCK}$
'Wangming took out the precious weapon and gave it three knocks.'
(*Sanbao taijian xiyang ji*, Novel, 1500s A.D.)

The pragmatic competition between VV and V-one$_F$-V is observed in early Modern Chinese (1500s A.D.), as shown by (48) and (49). V-one$_F$-V in (48) has the *exactly* reading, as the master delivers one knock to each servant. Meanwhile, VV in (49)[18] is pluractional, indicating Wangming's intention to perform multiple knocks. This is evidenced by the fact that he eventually gave two or three knocks. In Mandarin, the pluractionality of VV formed with Activities I is inherited from cases like (49), although V-NUM-V diminishes and V-one$_F$-V disappears.

(48) que you **qiao**-le **yi$_F$ qiao**, qiahao shi dier-ge changban jiao-qilai.
but again knock-PERF one CL$_{KNOCK}$ just is second-CL servant scream-up
'But (he) again gave one knock, and the second servant just screamed.'

jizhi zai **qiao**-le **yi$_F$ qiao**, disan-ge changban you jiaojiang-qilai.
until again knock-PERF one CL$_{KNOCK}$ third-CL servant also scream-up
'Until (he) gave another knock, the third servant also screamed.'
(*Sanbao taijian xiyang ji*, Novel, 1500s A.D.)

(49) 'bumian **qiao** ta **qiao**, kan shi zenme.' qiao-le liang san qiao.
have.to knock it CL$_{KNOCK}$ see is how knock-PERF two three CL$_{KNOCK}$
'(Wangming thought,) "it is necessary to give some knocks on the door to see what is happening inside." Then he gave two or three knocks.'
(*Sanbao taijian xiyang ji*, Novel, 1500s A.D.)

In contrast, with Activities II (*deng* 'wait'), VV lacks alternatives such as V-one$_F$-V, since the numeral inside V-NUM-V is limited to the unfocused *yi* 'one', as discussed in Section 4.2.2. Therefore, VV formed with Activities II does not enter the pragmatic competition in (45) and hence is not pluractional.

6. Motivation for cognate classifiers

We have advanced in Section 3 that the underlying structure of VV consists of a verb and its cognate verbal classifier, where the cognate classifier is base generated within the adjunct of the verb. In our analysis, the connection between the verb and the cognate classifier is not attributed to syntactic movement or copying. Instead, we propose that cognate classifiers are motivated by a semantic requirement.

Intuitively, the way of counting depends on the object being counted, which can be explicitly formulated in terms of the subset requirement in (50). For V-NUM-CL$_{evt}$, the choice of verbal classifiers is determined by the verbs, that is, the denotation of the verb is required to be a subset of the denotation of the verbal classifier. In principle, there are two possibilities: (i) The denotation of the verb is a proper subset of that of the classifier, as is the case with the general classifier *xia*. (ii) The denotation of the verb equals to that of the classifier, as is the case with a cognate classifier.

[18] Object insertion in such cases further demonstrates that the second V of VV is a verbal classifier (Fan 1964).

(50) **Subset requirement of dependency**
Let A and B be two sets. If A depends on B, then $B \subseteq A$.
In the case of V-NUM-CL$_{evt}$, $[\![\mathrm{v}]\!] \subseteq [\![\mathrm{Div}^{min/max}]\!]$.
(i) If $[\![\mathrm{v}^{min}]\!] \subset [\![\mathrm{Div}^{min/max}]\!]$, then $\mathrm{Div}^{min/max}$ is realised as the general classifier *xia*.
(ii) If $[\![\mathrm{v}^{min}]\!] = [\![\mathrm{Div}^{min/max}]\!]$, then $\mathrm{Div}^{min/max}$ is realised as a cognate classifier.

Overall, given the subset requirement, there are two strategies for specifying the counting unit: a general classifier representing the union set of all objects that can be counted, or a cognate classifier that is identical to the object being counted. This provides the semantic motivation for the existence of cognate classifiers in Mandarin.

The subset requirement is supported by the selectional restriction of classifiers. The general classifier *xia* is compatible with various verbs, as shown by (51a). By contrast, a cognate classifier, due to the absence of subset relations among different verbal roots, is only compatible with the verb that shares the same lexical form, as shown by (51b).

(51) a. {**da / qiao**} yi xia
hit knock one CL$_{evt}$
'to give a hit' / 'to give a knock'

b. {**da** / ***qiao**} yi da
hit knock one CL$_{\mathrm{HIT}}$
'to give a hit' / Int.: 'to give a knock'

Note that cases like (52) are ungrammatical in Mandarin, despite certain entailment relations between verbs and classifiers.[19] This suggests a distinction between the entailment relations and the subset relations defined in (50). The entailment relations between events are captured by conjunction, as originated in Davidson (1967). For instance, to capture the fact that *qiao* 'knock' entails *dong* 'act', we can analyse a knocking event as a modified acting event, as (53) illustrates. However, the subset relations pertain to event sets, and therefore are not guaranteed by the entailment relations between events. For instance, there is no subset relation between (53a) and (53b), that is, the denotation of *qiao* 'knock' is not a subset of the denotation of *dong* 'act'. This explains why *dong* 'act' cannot serve as a classifier for the verb *qiao* 'knock'.

(52) a. *qiao yi dong
knock one CL$_{\mathrm{ACT}}$
Int.: 'to give a knock'

b. *da yi dong
hit one CL$_{\mathrm{ACT}}$
Int.: 'to give a hit'

(53) a. $[\![\sqrt{qiao}]\!] = \{e_{knock1}, e_{knock2}, e_{knock1} \oplus e_{knock2}, \ldots\}$
$= \{(e_{act} \wedge e_{w/hand})_1, (e_{act} \wedge e_{w/hand})_2, (e_{act} \wedge e_{w/hand})_1 \oplus (e_{act} \wedge e_{w/hand})_2, \ldots\}$
b. $[\![\sqrt{dong}]\!] = \{e_{act1}, e_{act2}, e_{act1} \oplus e_{act2}, \ldots\}$

The subset requirement in (50) sheds light on nominal classifiers as well. Archaic Chinese features cognate classifiers that share the same lexical form as the noun, as in (54), whilst Old Chinese makes use of general classifiers that are compatible with various nouns, like *tou* in (55). These two strategies can also be viewed as motivated by the subset requirement.

(54) fu **niu** san bai wu shi wu **niu**, **yang** nian ba **yang**.
capture ox three hundred five ten five CL$_{\mathrm{OX}}$ sheep twenty eight CL$_{\mathrm{SHEEP}}$
'(The king) captured three hundred and fifty-five oxen and twenty eight sheep.'
(Bronze inscriptions on *Xiao Yu Ding*, 900s B.C.)

[19] Thanks to a reviewer for bringing this to our attention.

(55) huo **niu ma yang** shi wan yu **tou**.
obtain ox horse sheep ten ten.thousand more CL
'(The army) obtained over a hundred thousand oxen, horses, and sheep.'
(*Qian han ji*, 100s A.D.)

7. Conclusion

In this paper, we demonstrate that VV is an instantiation of V-(NUM)-CL_{evt}, and analyse NUM-CL_{evt} in V-NUM-CL_{evt} as an adjunct and an intersective modifier. Our syntax and semantics successfully resolve the four puzzles about VV introduced in Section 1.

For **Puzzle I**, VV allows for the insertion of numerals and aspectual markers, as it is V-CL_{evt} rather than verbal reduplication. For **Puzzle II**, given the cumulativity presupposition, only activity roots can form verbal classifiers and subsequently constitute VV. As for **Puzzle III** and **IV**, the observed pluractionality of VV is a result of its competition with V-one_F-V. Activities I (*qiao* 'knock') and Activities II (*deng* 'wait') differ in stable atomicity. VV formed with Activities I denotes a set of countable events, and competes with the singular alternative V-one_F-V. In contrast, VV formed with Activities II denotes a set of uncountable events, lacking singular alternatives like V-one_F-V for competition, and therefore does not display pluractionality.

Our analysis of VV in Mandarin offers not only a pragmatic mechanism for deriving pluractionality (cf. Lasersohn 1995; Newman 2012; Henderson 2017; Mattiola 2019; Lund 2021; Pasquereau 2021; a.o.), but also a semantic motivation for cognate classifiers in general. Yet, additional syntactic evidence is needed to argue that cognate classifiers are base generated. We leave this issue for further research.

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Updating unexpected moves[1]

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Abstract. This paper investigates the behaviours of the particle *ne* in the sentence-final position along with its interactions with different clause types in Mandarin. I present novel data showing that *ne* marks an *unexpected move* in both declaratives and interrogatives. In declaratives the speaker believes that the content of the prejacent of *ne* is not among what the addressee has expected in future discourse. In questions *ne* marks that the current move is not in the standard flow of a conversation. I propose that *ne* signals that the speaker believes that the current discourse move she makes is not *optimal*[2] for the addressee: the speaker chooses to use *ne* when the discourse agents have conflicting beliefs, or the speaker wants to redirect/reset the conversational goals. The current account provides broader coverage of empirical data, and sheds light on the discourse dynamics on non-canonical/uncooperative conversations.

Keywords: discourse particles, clause types, pragmatics, Mandarin.

1. Introduction

Utterances of natural language are analogous to making a move in a game (Wittgenstein 1953). On this view, utterances that interlocutors in a conversation make can be understood as actions/moves they decide to take at some certain point in the conversation. Discourse particles, crosslinguistically, have been shown to help the interlocutors to understand each other's utterance choices: they can be anaphoric to discourse structures (Rojas-Esponda 2014, 2015); they can guide interlocutors actions in the next step (Davis 2009, 2011); they may be used to convey interlocutors' epistemic states (Zimmermann 2009; Hara 2018; Theiler 2021); and so on. This paper focuses on the discourse particle *ne* in Mandarin, a language which has a very rich inventory of discourse particles. To foreshadow a bit, I will show that the particle signals that a questioning/asserting move is unexpected in a uniform way.

Like many other particles in the language, *ne* can occur both sentence-internally as a topic marker, and sentence-finally as a discourse marker (Chao 1968; Chu 2009; Constant 2014 among many others), as shown in (1) and (2). The current paper only concerns with its sentence-final uses. When *ne* is used sentence-finally, it interacts with both interrogatives (as in (2)) and declaratives (as in (3)), as we will see in details in the following sections.

(1) zhe-jian shi **ne**, meiyou name jiandan.
this-CL thing NE NEG that simple
'This thing is not that simple.'

(2) ni xiang he shenme **ne**?
you want drink what NE
'What do you want to drink?'

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[2] Given that I use notions such as 'flow of conversation' and 'optimality' of a discourse move, which I make more precise, the paper seeks to contribute conceptually to the literature too.

(3) wo tingshuo yuehan hui lai **ne**.
I hear John will come NE
'I heard that John will come.'

It is worth noting that *ne* is an optional marker: it can only appear when the discourse itself is coherent, but cannot be used as repair[3]. For example, in (4), before A said that John broke his leg, A and B were talking about plums. A then talked about something irrelevant. To repair the incoherent discourse, one can say 'I like plums', but not with *ne*. This shows that the unexpectedness of the content of the containing clause of *ne* is not to be defined just with respect to the last move in the discourse.

(4) [A and B were talking about plums. A told B that John broke his leg, B says:]

wo xihuan meizi #***ne***
I like plum NE

'I like plums.'

In the rest of the paper, I will show that *ne* marks that the current discourse move is 'unexpected' both in declaratives and interrogatives: in interrogatives, *ne* signals that the current move is not in the standard flow of the conversation; in declaratives, the particle suggests that neither the semantic content nor the asserting act itself is among what the addressee 'expects'. I thereby propose that *ne* is typically used to acknowledge that the speaker knows the current move is not *optimal* for the addressee[4].

The paper is structured as follows: §2 discusses instances of *ne* in questions. §3 lays out the main proposal that *ne* marks the current move as not optimal for the addressee. §4 shows that the proposal correctly predicts the distribution of *ne* in declaratives. §5 compares the current proposal with the Contrastive Topic (CT) approach by Constant (2014). I will show that the claim that *ne* is a CT marker is a bit too strong and we might want to take one step back and carefully examine the functions of *ne*.

2. *ne* in interrogatives

In Mandarin, sentence-final ne occurs predominantly in questions. Most literature claims its discourse function to be that of marking a *wh*-question. For example, Cheng (1997) argues that *ne* is clause-typing particle, indicating that the host clause it attaches to is a *wh*-question. However, it is not the case that *ne* is always acceptable in questions. For instance, *ne* is not felicitous in out-of-the-blue contexts as shown in (5) (see also Wu 2006; Li 2006).

[3]I thank an anonymous reviewer for the point and the example.
[4]In abstracting away from notions such as *standard flow* and *expectedness*, I use the notion of *optimality*. Working at this level of generality helps in unifying my account for both declaratives and interrogatives. The notions will be defined in the rest of the paper.

(5) **Truly out-of-the-blue**
[A approaches a stranger on the street.]

A: qingwen, xianzai jidian le ??**ne**?
excuse.me now how.many-o'clock PERF NE

'Excuse me, what time is it?' (Constant 2014: 368, slightly changed)

To get a better sense of the particle, let us first look at the felicitous uses of *ne*. As suggested in the introduction, *ne* can appear in questions when the current questioning act is, to some extent, abnormal. For example, in the **Reaffirming the QUD** scenario below, the *ne* question is used when the speaker wants to step back to double-check if the current Question Under Discussion (QUD) *What do you want to drink?* is indeed answerable, given several unsuccessful attempts to resolve the QUD in the prior conversation (see also Rojas-Esponda 2014).

(6) **Reaffirming the QUD**
A: Would you like some wine? B: No, thanks.
A: Would beer attract you? B: Actually no.

A: ni xiang he shenme **ne**?
you want drink what NE

'What do you want to drink?'

In the **Elaborative questions** scenario, the *ne*-question is 'unexpected': when an interlocutor asks a question, an expected move should be to answer the question. However, the speaker in (7) raises the question '*What do you want to order*' without answering the addressee's question first. *ne* is used to mark this abnormality. It signals that the speaker is aware of the fact that the move she is making is not in the normal course of a conversation, and therefore the addressee can infer the reason of this deviation: the speaker is reluctant to give an answer to the addressee's question unless she gets an answer from the current question (i.e. the answer of the previous question depends on the current one), or the speaker does not believe there is anything good to order from Ubereats (for more on elaborative questions see Bledin and Rawlins 2019).

(7) **Elaborative questions**
A: Can we order Ubereats today?

B: ni xiang dian shenme **ne**?
you wang order what NE

'What do you want to order?'

Conjectural questions are questions that do not request an answer, or to which the speaker does not even expect an answer. They have been discussed in connection with German particle *wohl* (Eckardt 2018 a.o.), and with the behaviors of inferential evidentials in questions (Bhadra 2020 a.o.). *ne* is also attested in conjectural questions, as shown in (8), where speaker A knows very well that the speaker B is not capable to answer the question before she makes the move.

(8) **Conjectural questions**
[A and B have been discussing a math problem for a while, but neither of them knows how to solve it.]

A: zhe ti daodi zenme zuo ne?
this question at.all how do NE

'How on earth can we do this **ne**?'

Finally, *ne* often occurs in what I call **Challenging uses** scenarios. For example in (9), the *ne*-question is used to challenge, or indirectly reject speaker A's offer.

(9) **Challenging uses**
A: Ask me anything about the homework!

B: wo weishenme yinggai wen ni **ne**? ni dou mei qushangke!
I why should ask you NE you even NEG go.to.class

'Why should I ask you? You didn't even go to the lecture!'

To sum up, from the four cases presented above we have seen that *ne* overall marks that the current questioning act is not indicated as a preferred action: it can be used to double-check if the QUD is answerable; to raise a new issue without addressing the previous one first; to ask a question which the addressee does not seem to be competent to answer; and to resist to carry out the addressee's instructions. Thus, we would predict that *ne* should be infelicitous when the questioning act is actually desired. This is borne out, as we can see in the **Oral exam** scenario. As shown in (10), speaker B accepts A's request first and then asks a relevant question which should be expected by speaker A. Using *ne* in speaker B's question results in infelicity.

(10) **Oral exam**
A: I am ready. Ask me anything.

B: hao, lambda shi shenme yisi #**ne**?
okay lambda be what meaning NE

'Okay, what does lambda mean?'

3. Proposal

This section characterizes the contribution of *ne* as a discourse particle. Firstly, we assume that interlocutors share a belief in **optimal action choices**, i.e. interlocutors are expected to only make optimal utterances to each other (Lauer 2013; Portner 2004, 2007). Here, optimal actions are assumed to be canonical discourse moves, or utterance choices which obey the general Gricean principles. For example, if the addressee utters an *assertion*, a cooperative speaker who takes the content of the assertion to be true will accept it; if the addressee utters a *question*, a cooperative speaker will accept and answer it truthfully due to the Quality maxim in Grice; if the addressee utters an *imperative*, a cooperative speaker will perform the addressee's preferred action (see Theiler 2021 for a similar treatment of the notion of Proceeding in Discourse).

To model the 'unexpectedness' of *ne*, we need both the notion of QUD and the notion of *decision problems*. The spirit behind doing so is that although *ne* marks that the speaker's move is not in the normal course of action, the *ne*-marked move is still on the track of resolving a mutual conversational goal. We model this intuition using the notion of QUD, which specifies the shared conversational goal which steers the flow of the conversation (Roberts 1996; Farkas and Bruce 2010). Aside from the mutual discourse goal of resolving the current QUD, each interlocutor often has separate *domain goals* (Roberts 2012). We assume that an interlocutor always faces a decision problem of whether to accept the proposal when an assertion is made, or whether to figure out a practical answer/follow the instruction when a question or a command is made (Bledin and Rawlins 2019; Roberts 2018). Canonical moves are desired, but interlocutors can always choose not to obey the general communicative principles for achieving their own domain goals. For example, in the **Arrange a party** scenario below, imagine that John is an alcoholic, then it is perfectly acceptable to use a *ne* question to resist/challenge speaker A's claim. Here the QUD is supposed to be '*whether we have had enough alcohol*', but speaker B redirects the QUD using the *ne*-question due to their own *practical interests* (Stanley 2005), for instance, successfully arranging a party. We thus suggest that *ne* functions as part of the strategies for achieving speaker's domain goals: although *ne*-marked utterances are not optimal for the addressee, they help the speaker decide what to do in the real world.

(11) **Arrange-a-party**
A: I think we have enough alcohol.

B: yaoshi yuehan lai-le **ne**?
if John come-PERF NE

'(What if) John comes?'

Following Gunlogson (2004), Farkas and Bruce (2010) and Davis (2009), we implement our analysis in the following discourse model. We assume that a context *c* consists of three core components: discourse commitment sets for each participant *x*, Farkas and Bruce's *table* stack, and a salient *Action Set*.

(12) A context *c* consists of:

a. $\mathscr{C}_x^c$ is Gunlogson (2004)'s **Discourse Commitment** sets for each participant *x*, and thus the context set for each participant *x*, $cs_x^c = \bigcap \mathscr{C}_x^c$;

b. $\mathscr{T}_c$ is Farkas and Bruce (2010)'s **Table Stack**, which represents the current issue under discussion, tracking the proposals made by interlocutors;

c. a salient **Action Set** $\mathscr{A}_x^c = \{a_1, ..., a_n\}$, the set of possible actions for each participant *x*, representing the current *decision problem* that each participant *x* faces. (Davis 2011)

To model the decision-making procedure, we adopt a minimal approach, following Portner (2007) and Davis (2011) (for other applications of decision theory, see Van Rooy 2003; Kaufmann 2012; Kaufmann and Kaufmann 2012; Bledin and Rawlins 2019 a.o.). We assume Portner (2007)'s metric on the notion of 'rationality': interlocutors mutually agree to deem each other's actions optimal (see Portner 2007: 358). The notion **optimality** is represented by each participant *x*'s *Optimal Set*, which imposes an ordering on the worlds compatible with each interlocutor's public beliefs, as shown in (13). A Portner-style ordering $<^c_x$ is defined in (14), where we substitute Porner's To-Do List with Kratzer's contextual ordering source. Hence, the set of propositions introduced by the ordering source imposes a partial order on the context set (i.e. joint public beliefs) for each participant.

(13) The **Optimal Set** $\mathscr{O}^c_x$ of participant x is defined as:
$\mathscr{O}^c_x = \{w_i \in cs^c_x | \neg\exists w_j \in cs^c_x : w_j <^c_x w_i\}$ (Davis 2011: 94)

(14) **Partial Ordering of Worlds**
For any worlds w_i, $w_j \in cs^c_x$, $w_i <^c_x w_j$ iff for some $p \in \texttt{ordering-source}(c)$, $p(w_i) = 1$ and $p(w_j) = 0$, and for all $q \in \texttt{ordering-source}(c)$, if $q(w_j) = 1$ then $q(w_i) = 1$.

We are now ready to state the felicity condition for *ne*. Recall that *ne* cannot appear in out-of-the-blue contexts; and *ne* signals that the speaker does not act in line with the **addressee's preferred actions**; *ne*-utterances are relevant.[5] A successful model should be able to capture all of these properties of *ne*.

We propose the condition in (15). Specifically, the condition says that (i) *ne* marks the discourse move the speaker makes as not desired for the addressee; (ii) the Table stack must not be empty, and (iii) a *ne*-utterance is relevant. Here we pursue a weaker version of Relevance, in that if an assertion or a question shifts the probability of at least one of the answers to the QUD (Büring 2003), or they bring new live options to the other speaker's attention (Franke and de Jager 2011), they are also relevant to the QUD. We will see that *ne*'s behavior exactly follows this weaker version of relevance also in assertions in the next section.

(15) **Felicity Condition for sentence-final *ne***:
Sentence-final *ne* can be felicitously used by a speaker s in c only if (i) s_c performs an action a such that the addressee's optimal set $\mathscr{O}^c_{a_c} \notin a(s_c)$, (ii)$\mathscr{T}_c \neq \langle\rangle$, and the *ne*-utterance is relevant.

[5] *ne*-utterances are not optimal in the sense that they are not expected answers to the QUD/strategies to resolve the QUD, but rather strategies to achieve speaker's domain goals. Bledin and Rawlins (2019) address this tension between QUD and decision problems by positing the notion of *Subservience*:

(1) **Subservience**: If the speakers in c face a decision problem $top(\mathscr{G}_{DP_c})$ that is not yet resolved in c (i.e. DP_c is unresolved) and a speech act is performed that results in a new question Q being pushed onto the goal stack, then this speech act is appropriate only if completely answering Q helps to resolve DP_c. (Bledin and Rawlins 2019: 39)

The notion of *Subservience* gives us a baseline of when to reject a QUD, namely when there is a conflict between speaker's domain goal and the question proposed by the addressee. But it does not seem to capture the nature that in a conversation interlocutors' domain goals are usually somehow connected to the QUD, and that an interlocutor may reject a question even if all discourse participants share similar practical interests. For instance, in the **Arrange a party** scenario, both interlocutors share the goal of arranging a successful party, and the QUD 'is alcohol enough' helps to resolve the goal. However, the speaker can still resist addressee's proposal due to their private knowledge (i.e. the speaker knows that John might come but it is not in addressee's epistemic state).

4. Predictions: *ne* in declaratives

With the felicity condition proposed in (15), we will spell out the predictions the current account make for *ne*-declaratives. To recap, *ne* marks the move itself is non-optimal in questions. For assertions, on the other hand, the condition proposed in (15) predicts that neither the informative content nor the asserting act itself should be preferred by the addressee. This gives as two following predictions.

Prediction 1: *ne* is infelicitous in an expected answer.

Prediction 1 operates on the level of content. This prediction is borne out as shown in the **Whisky at party** scenario, where the two possible answers, beer or whisky, are already given in an alternative question. Therefore, B's answer is expected. We see that *ne* is unacceptable in this scenario.

(16) **Whisky-at-party**
A: What did you drink at the party today? Beer or whisky?

B: wo jintian he-le weishiji #**ne**.
I today drink-PERF whisky NE

'I drank whisky today.'

In contrast, *ne* is acceptable when the speaker believes the information the utterance carries is surprising to the addressee. For example, in the (17) scenario, *ne* is being used because the speaker believes that drinking whisky at breakfast is not normal. Hence, B uses *ne* to suggest that she is aware of the fact that her preference might not be practical for A to prepare. Here, *ne* functions as a marker for bringing new live options to the addressee's attention.

(17) **Whisky-at-breakfast**
[A is preparing for tomorrow's breakfast. B is a guest.]
A: What do you usually drink for breakfast?

B: wo zaocan jingchang yao he weishiji **ne**.
I breakfast often will drink whisky

'I often drink whisky for breakfast.'

Prediction 2: *ne* is infelicitous in accepting moves.

Prediction 2 operates on the level of discourse moves. In other words, in response to assertions, *ne* cannot appear in the canonical responses. That is, *ne*-declaratives cannot be used to accept an assertion (as shown in 18), or to carry out an instruction (as shown in 19). If in (19), instead A challenges B's command with a question such as '*What if it rains?*', *ne* becomes acceptable in the scenario.

(18) **Accepting assertions**
B: There will be water suspension tomorrow.

A: zhidao-le #**ne**.
know-PERF NE

'(Okay, now) I know.'

(19) **Carrying out instructions**
B: Open the window!

A: hao, wo mashang kai #**ne**
okay I soon open NE

'Okay, I will open it soon.'

In contrast, *ne* is acceptable in rejections, refutations, and resistance moves (see also Bledin and Rawlins 2020). For example, a *ne*-assertion can be used to directly reject another interlocutor's proposal as in (20), or to indirectly reject the proposal by providing a piece of additional evidence against the proposal as in (21).

(20) **Refutation**
A: I know Bill's apartment is pretty small.

B: meiyou, ta jia ke da **ne**
no he home very big NE

'No, his home is quite big.'

(21) **Resistance move**
A: Becky is coming to the party.

B: keshi wo tingshuo yuehan yao lai **ne**
but I hear John will come NE

'But I heard John will come.'

5. A note on the CT account of *ne*

We have argued that discourse marker *ne* signals a non-optimal discourse move. In this section, we discuss some previous accounts on *ne*. Previous literature have suggested that *ne* can be used to *respond to expectations* (Li and Thompson 1989), *look back for contrast* (Chu 2009), or *mark a question* (Cheng 1997). More recently, Constant (2014) gives a very comprehensive introduction to *ne*, and makes the claim that *ne* always marks the existence of a Contrastive Topic (CT) in discourse[6], as shown in (22). More specifically, for sentence-final cases, the claim is that for declaratives, *ne* can only appear in partial answers, or sentences that carry an uncertainty/incompleteness flavor; for interrogatives, *ne* marks a sub-question or a follow-up

[6]Constant (2014) also mentioned about the durative use of *ne*, and he treats it as a different type. Following his insights, in this paper we only consider the cases where *ne* is supposed to appear as a CT marker.

question. Although Constant's account correctly captures the intuition that *ne* can change the current goal of discourse, we suggest that at least sentence-final *ne* is more than that: we have seen above that *ne* can appear in a direct answer to a question as in (17), or in a higher-level QUD as in (6). In the following discussion, we will provide novel data and challenge the view that *ne* is a genuine CT marker.

(22) (Well in that case, there are only two roads to take.)

Yi tiao **ne**, shi cou qian mai-shang che, yi tiao **ne**, shi zanqie lin che la-zhe.
one CL CT be gather money buy-RES cart, one CL CT, be for.now rent cart pull-DUR

'One road, is to save up the money to buy a rickshaw. The other road, is to rent a rickshaw to pull for the time being.'

(Constant 2014: 309)

5.1. Does *ne* resist non-contrasting topics/maximal elements?

Constant (2014) §6.3.4 argues that *ne*-marked topics are necessarily interpreted contrastively. However, *ne* is widely accepted by native speakers as a pure aboutness topic marker, as shown in (23).

(23) A: What fruit does Sue like?

B: shuiguo **ne**, su xihuan boluo.
fruit NE Sue like pineapple

'(As for) fruits, Sue likes pineapples.'

A similar "aboutness" topic interpretation is also received in (24), where the topicalized phrase is actually a maximal element *suoyoudeshiqing* "all of these things". Here, the particle *ne* makes the topic anaphoric to the previous discourse.

(24) A: Today all the kids in the first group should perform.

B: danshi yizu suoyou-de xiaopengyou **ne** dou shengbing mei lai.
but group.one all-POSS kid NE DOU sick NEG come

'But all of the kids in the group are absent because they are sick.'

Moreover, *ne* is perfect when it marks *meigeren* 'everyone'.

(25) A: What fruit will the kids get for lunch today?

B: meigeren **ne** dou hui dedao yige pingguo.
everyone NE DOU will get one apple

'Everyone will get an apple.'

To sum up, the above three example suggest that *ne* does not necessarily mark a topic as contrastive; it can function as an aboutness topic marker without any contrastive meaning. When *ne* attaches to maximal elements, it is automatically interpreted as an aboutness topic.

5.2. Is *ne* always compatible with partial answers?

Constant (2014) argues that sentence-final *ne* in declaratives can mark a lone CT or a sentential CT by giving the example shown in (26), where *ne* marks its prejacent as a *partial answer* to the question.

(26) A: Is Zhangsan going to the conference?

B: ta gen wo shuo yao qu **ne**... (danshi ta hai mei mai jipiao.)
he with me say will go NE but he still have.not buy plane-ticket

'He *told* me he's going...(but he still hasn't bought a ticket.)'

However, the uses of *ne* in partial answers are actually very restricted. For instance, in (27), if we change the piece of evidence that speaker B uses (i.e. from hearsay evidence to another indirect type), *ne* is no longer felicitous in a partial answer.

(27) A: Is Zhangsan going to study in the UK?

B: ta ban-le qianzheng #**ne**...
he do-PERF visa NE

'He applied for visa...'

In (28) I provide another piece of evidence supporting the claim that *ne* is not compatible with partial answers in general. (28) is a standard scenario for CT contour in English, but it turns out to be a terrible context for Mandarin *ne* to exist.

(28) A: Is his car some crazy color?

B: ta-de che shi juhongse-de #**ne**...
he-POSS car be orange-POSS NE

'His car is [**orange**]$_{CT}$......(but I don't know if it's crazy.)'

In another example Constant gives for the lone CT use of *ne*, shown in (29), *ne* is felicitous. But in (29) the phrase *santouniu* 'three cows' must be stressed, which again casts doubt on whether the lone CT meaning is brought by *ne* or by prosody.

(29) A: His family is poor, so you'd do better not to interact with him.

B: ta jia you [san tou niu]$_{CT}$ **ne**
his family have three CL cow NE

'His family has three cows...(!)'
(Isn't that proof that they're not poor?) (Constant 2014: 67)

ne is also not felicitous in typical sentential CT scenarios, as shown in (30). Note that in A's reply in (30), *ne* cannot appear to mark the antecedent as a topic, but it can appear at the end of a question.

(30) A: Will we have picnic tomorrow?

B: mingtian yao xiayu #**ne**
tomorrow will rain NE

B: it will rain tomorrow...

5.3. The standard CT+F construction

Lastly, when it comes to the CT+F type of examples, *ne* can never appear to mark the CT. But if we manipulate the intonation of *Fred* in (31) (i.e. stressing *Fred*), then the whole sentence becomes acceptable without *ne*.

(31) A: What about Bill? What did he eat?

B: #en... Fred **ne** chi-le douzi.
well Fred NE eat-PERF beans

'Well...[Fred]$_{CT}$ ate [beans]$_F$'

To sum up, I have shown that *ne*-marked topics do not always receive a contrastive interpretation, *ne* is not acceptable in many partial answers, and *ne* is infelicitous in the typical Büring-style CT constructions. Based on the empirical evidence, I suggest we take one step back and carefully examine the functions of *ne* in various contexts first. No matter what *ne* actually is, it seems to be more than just a pure CT marker.

6. Conclusion

This paper developed a unified analysis for the uses of the sentence-final *ne* in declaratives and interrogatives. I have showed that *ne* signals unexpectedness both in the content and in the discourse move itself. I propose that by using *ne*, the speaker acknowledges current utterance as not optimal for the addressee. I suggest that the 'unexpectedness' expressed by *ne* is related to the domain goals of the speaker, which signals the tension between interlocutors' practical interests and the conversational goal shared by all interlocutors (the QUD).

For future research, since *ne* may co-occur with other discourse particles in Mandarin (e.g the question marker *ma*), it would be interesting to explore the interactions between them. Moreover, more needs to be done on the comparison between *ne* and other non-canonical question particles such as *ba* (see more in Yuan 2020; Yang 2020).

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The scope of supplements[1]

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Abstract. This paper defends the bidimensional approach (Potts 2005) to the semantics of supplements against criticisms based on non-projecting supplements. We discuss the empirical and theoretical aspects of two opposing representatives, Martin (2017) and Schlenker (2023), and propose a bidimensional semantics where supplements take scope when needed. The proposals resolves the issues arising from non-projecting supplements while retaining the explanatory advantages of bidimensionalism.

Keywords: non-restrictive relative clauses, supplements, projection, bidimensionalism, scope, monad

1. Introduction

Supplemental contents, or supplements, such as those introduced by **non-restrictive relative clauses (NRRCs)** (as highlighted in italics below), present a fascinating puzzle to semantic theory, particularly with two of their well-known features. First, they usually escape the effect of scope-taking operators, i.e. they **project**, as shown in (1). Second, they usually cannot be used to address the prominent Question Under Discussion (QUD), i.e. they are **not at-issue**, as shown in (2).

(1) a. Alex **didn't** invite Nate, *who is a musician*.
$\rightsquigarrow$ Nate is a musician.

b. Alex **might** invite Nate, *who is a musician*.
$\rightsquigarrow$ Nate is a musician.

c. **If** Alex invites Nate, *who is a musician*, then Mark will be happy.
$\rightsquigarrow$ Nate is a musician.

(2) a. Who had prostate cancer?

b. ??Tammy's husband, *who had prostate cancer*, was being treated at the Dominican Hospital. (AnderBois et al. 2015: ex.43)

How can a semantic characterization deliver these two features and, preferably, be implemented in a compositional fragment? Potts (2005) pioneered the now-prominent idea of a *bidimensional* semantics, according to which supplements live on a semantic dimension separate from the main, **at-issue**, content. The idea provides an account for both features in one fell swoop – the supplement-residing dimension is designated to be non-at-issue, and since it is separate from the at-issue content, no scopal interactions are possible during the semantic computation.

Such formulation of the bidimensional idea makes some strong predictions, one of which being that supplements should *always* project. It has been a frequent target of criticism, and counterexamples often contain allegedly non-projecting (thus narrow-scope) supplements. Martin

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(2017), in part following Amaral et al. (2007), pointed out that quantifiers such as *every* in the matrix clause can bind into the **anchor**, i.e. the nominal argument (immediately) precedding the NRRC on which it predicates, as in (3), or directly into the NRRC (4). Such quantificational binding, according to Martin, forces a narrow-scope reading of the supplement under the quantifier.

(3) [Every professional man I polled]^i said that while his$_i$ wife, *who had earned a bachelor's degree*, nevertheless had no work experience, he$_i$ thought she could use it to get a good job if she needed one. (Amaral et al. 2007: ex. 35)

(4) a. [Every cyclist]^i met Lance, *who gave him$_i$ a Tour de France souvenir*. (Martin 2017: ex. 13b)

b. [Every famous boxer I know]^i has a devoted brother, *who he$_i$ completely relied on back when he$_i$ was just an amateur*. (Martin 2017: ex. 16)

Schlenker (2023), following McCawley (1981); Del Gobbo (2003) and others, found arguments against bidimensionalism within cases where NRRCs are generated and *interpreted* inside the scope of conditional antecedents (5) or attitude verbs like *wonder* (6).

(5) If tomorrow I called the Chair, *who in turn called the Dean*, then we would be in big trouble.

(6) I will be wondering next Wednesday whether DSK, *who met with the judge the day before*, agreed to a settlement.

For Schlenker, sentences like (5) and (6) present both syntactic and semantic evidence for non-projecting supplements. Both of them contain future-referring past tenses, which is only possible in the syntactic scope of the subjunctive *if*, or the matrix future tense of *will*. In addition, neither (5) nor (6) entails the supplemental proposition, contrasting cases with projecting supplements as in (1).

Since bidimensionalism leads inevitably to projection (at least at this point), data such as (3) – (6) led both Martin (2017) and Schlenker (2023) to develop versions of what we will call *unidimensional* semantics. In their theories, the differences in semantic representation between at-issue and supplemental content are eliminated – the latter is now simply conjoined to the former at its attachment site, and projection and/or non-at-issueness are accounted for with additional structural (syntactic or LF) operations and pragmatic principles.

This paper defends bidimensionalism against these challenges from non-projecting supplements. We will show that not all counterarguments mentioned above are valid – in particular, Martin's examples (3) – (4) *do not* necessarily contain narrow-scope supplements. Schlenker's examples (5) – (6) do so more convincingly, but even so, the drastic turn to a unidimensional semantics may be at too high (and perhaps unnecessary) a cost of an otherwise simple explanation for both projection and non-at-issueness. Instead, we emphasize that the existence of non-projecting supplements do not necessarily mean a divorce from bidimensionalism, or, in other words, bidimensionalism is not 'cursed' by pervasive scopelessness. To show this, we develop a bidimensional semantics that retains its original perks while resolving the newly emerged problems. The new theory, largely inspired by Grove's (2019b) treatment of intensionality, encodes supplements as being composed separately from the at-issue content, but can *take scope* if needed.

The rest of the paper is organized as follows. In §2, we present and discuss the two unidimensional analyses on supplements, highlighting the difficulties they experience trying to explain projection and non-at-issueness. §3 lays out the basic architecture of the proposal, and §4 shows its application to capture different scope possibilities. Finally §5 concludes. This paper will focus on NRRCs without diving too much into other types of supplements such as nominal appositives and parentheticals (for detailed discussions, see Nouwen 2010; Sæbø 2011; Koev 2013; Schlenker 2023 and many others). However, we believe the proposal is general enough to at least have the potential of extending to the relevant cases.

2. Against unidimensionalism

2.1. Martin (2017)

Martin (2017) argued against bidimensionalism based on the assumption that quantificational binding into the NRRC (4) or its anchor (3) forces a narrow scope reading of the supplement. Since narrow-scope readings clash with the projection guaranteed by a bidimensional characterization, Martin proposed a unidimensional analysis that takes supplements to contribute incrementally to the main content via (dynamic) conjunction.[2] The analysis is illustrated below:

(7) $\underbrace{\text{Some cyclist}}_{\text{Q}}, \underbrace{\text{who is a doper}}_{\text{D}}, \underbrace{\text{won the Tour de France}}_{E}$.

(Martin 2017: ex.1, modified)

a. COMMA := λ_{QDE}. (QD) AND (THE D E)

b. (Some cyclist^i is a doper) AND (The doper$_i$ won the Tour de France).

That is, a kind of QP modification is packaged into the denotation of the comma intonation COMMA, where first the anchor Q (i.e. *some cyclist*) quantifies over the NRRC D (i.e. *who is a doper*), generating the supplement proposition that is conjoined to the matrix proposition, obtained by applying the predicate E (i.e. won the Tour de France) to the most salient discourse referent (THE D) that satisfies the supplemental property.

2.1.1. The empirical issue

The first and foremost problem with Martin (2017) is that the motivating examples (3) – (4) are not necessarily cases with narrow-scope supplements. The key observation comes from cases where a quantificational binding into the NRRC happens within a classic *scope island* such as an *if*-clause (8) or the tensed complement of *claim* (9). True quantifiers such as *every* does not scope out of these environments:

(8) If every cyclist has met Lance, Alex will given me a call.
For every cyclist x, if x met Lance, Alex will give me a call. (# $\forall >$ if)
3 (only) if every cyclist has met Lance, Alex will give me a call. (if $> \forall$)

[2] The dynamicity is not the key concern for our purpose.

(9) Someone claimed that every cyclist had met Lance.
For every cyclist x, there is some individual y (possibly different individuals for different x) that claimed that x had met Lance. (# $\forall > \exists$)
3 Some individual y claimed that for all cyclist x, x had met Lance. ($\exists > \forall$)

Now insert NRRCs. In some cases it does seem that the supplement scopes under the *if*-clause as well, as it fails to be entailed by the whole sentence:

(10) If [every cyclist]^i has met Lance, *who (then) has given him$_i$ a souvenir*, then Alex will give me a call.
$\approx$ If every cyclist has met Lance *and* received a souvenir from him, then Alex wil give me a call.
$\not\rightsquigarrow$ Lance has given every cyclist a souvenir.

However, examples where *every* binds the NRRC while the supplemental content projects out of the scope island (or at least prefers to) can be constructed. (11) shows cases with quantificational binding into the NRRC, and (12) into the anchor.

(11) a. **If** [every student]^i has bid farewell to Nate, *who had given [them]$_i$ some great advice during their individual meetings*, then we can officially close off the session.
$\rightsquigarrow$ Nate had given every student some great (and likely different) advice during their meetings.
b. Just now, the organizer **claimed** that [every boxer]^i had met Max, *who has nevertheless only been seen talking to [their]$_i$ coach about [their]$_i$ weaknesses.*
$\rightsquigarrow$ Max has only been seen talking to each boxer's coach about their (different) weaknesses (and the organizer may be making a false claim).

(12) a. **If** [every boxer]^i had brought [their]$_i$ brother, *who [they]$_i$ relied on very much as a child*, the gathering would have been heartwarming.
$\rightsquigarrow$ Every boxer relied on their brother very much as a child.
b. Just now, Cruella **claimed** that [every missing dalmatian]^i has been returned to [their]$_i$ owner, *who was just thinking that they might never see their dog again.*
$\rightsquigarrow$ Every owner of the missing dalmatians was just thinking that they might never see their dog again (and Cruela didn't claim this).

Therefore despite being universally quantified, the supplements are (or at least can be) entailed by the full clauses, and therefore have projected out of the semantic scope of the conditional antecedent (11a, 12a), and the attitude verb (11b, 12b). Quantificational binding is not sufficient to trap supplemental content inside a scope island.[3]

Furthermore, just for argument's sake, nothing really hinges on whether the scope operator creates an island – as long as the operator c-commands a universal quantifier that binds into the NRRC or the anchor, and the reading is available where a wide-scope (relative to the scope operator), supplemental universal and a narrow-scope, at-issue universal coexist, the argument would persist. This releases us from the concern of whether the scope operators we choose to

[3]Schlenker's example (5), on the other hand, shows that they are not necessary either.

make the argument are *really* scope islands (see e.g. Barker 2021). To make the point more explicit, note that *every* has been shown to occasionally scope over an embedding *make sure*, as in (13a):

(13) A student **made sure** that every invited speaker had a ride. (Farkas and Giannakidou 1996: ex.6)

a. ✓For every invited speaker *x*, a (possibly) different student made sure that *x* had a ride. ($\forall > \exists >$ make sure)

b. ✓A single student made sure that every invited speaker had a ride. ($\exists >$ make sure $> \forall$)

But even with the (at least equally possible) reading as in (13b) where *every* is interpreted under the scope of *make sure* (and therefore the indefinite subject), an NRRC that is universally quantified over by the narrow-scope *every* can still project:

(14) Someone needs to **make sure** that [every missing dalmatian]^i is returned to [their owner]$_i$, *who was just thinking that they might never see their dog again.*
⇝ For every missing dalmatian, their owner was just thinking that they might never see their dog again.
⇝ A (specific) individual needs to make sure that every dalmatian is returned (but not that what the owner was thinking).
($\forall_{\text{NRRC}} > \exists >$ made sure $> \forall$)

In short, a narrow-scope interpretation of a quantifier does not guarantee the narrow scope (or non-projection) of a NRRC within its quantificational scope. In fact, it seems that the semantic scope of a quantifier is hardly (if at all) predictive of that of its binding NRRC, therefore arguments for unidimensionalism based on quantificational configurations are likely to be inconclusive without further controls.

2.1.2. The theoretical issues

Now turn to the specifics of Martin's proposal. For him, projection is an 'epiphenomenon' of supplements *piggybacking* onto their anchors that take wide scope. Given the unidimensional analysis, the negative sentence (15) has in principle two possible LFs, (15a) and (15b). The negation scopes over the supplement in (15a), but not in (15b). But clearly (15b) is a much more preferred (if not the only) reading. To explain the contrast, Martin proposed that the anchor *Lance*, being a proper name, *prefers* to scope high, and the supplement *prefers* to be interpreted as close to its anchor as possible.

(15) **It's not the case** that Lance, *who is a doper*, won the Tour de France.

a. NOT (COMMA LANCE (A DOPER) WIN-TDF) ⇝ $\neg(\mathsf{doper}(\mathsf{l}) \wedge \mathsf{win}(\mathsf{l}))$

b. (COMMA LANCE (A DOPER))$_n$. NOT (WIN-TDF n) ⇝ $(\mathsf{doper}(\mathsf{l}) \wedge \neg\mathsf{win}(\mathsf{l}))$

This explanation faces several conceptual and empirical challenges. First, it is at least controversial whether proper names take scope at all (instead of being *scopeless*). Generally it makes no difference in interpretation whether a proper name takes wide scope or remains *in situ*, so forcing it to take wide scope at LF seems to incur a violation of scope economy (Fox 1995). Second, attributing projection solely to the scope of the anchor does not readily explain the contrast as in (16).[4] That is, if the proper name *Bill* prefers to take wide scope and there is no quantificational binding whatsoever that forces the NRRC to be interpreted *in situ*, it is hard to explain why the supplement projects in (16b) but not in (16a).

(16) a. If tomorrow I call Bill, *who in turn calls the Dean*, then we will be in big trouble.
$\not\rightsquigarrow$ The Chair will call the Dean tomorrow.

b. If tomorrow I call Bill, *who is a total jerk*, then we will be in big trouble.
$\rightsquigarrow$ The Chair is a total jerk.

Furthermore, supplement projection is clearly not restricted to only definite anchors. For example in (17), the NRRC predicates on the indefinite *a book*. Since indefinites have no problem scoping low, the LFs in (17a) and (17b) should be equally possible. Yet again only the wide-scope interpretation (17b) is possible.[5]

(17) John didn't read a book, *which Mary had recommended to him*. (AnderBois et al. 2015: ex. 72)

a. $\text{J{\scriptsize OHN}}_m$ $\text{M{\scriptsize ARY}}_n$. NOT(COMMA (A BOOK) ($\lambda_x$. READ mx) (λ_y. RECOMMEND ny))
$\rightsquigarrow \neg(\exists x.(\mathsf{book}(x) \wedge \mathsf{read}(j,x) \wedge \mathsf{recommend}(m,x)))$

b. $\text{J{\scriptsize OHN}}_m$ $\text{M{\scriptsize ARY}}_n$ (A BOOK)$_l$. NOT(COMMA l (λ_x. READ mx) (λ_y. RECOMMEND ny))
$\rightsquigarrow \exists x.\mathsf{book}(x) \wedge \neg(\mathsf{read}(j,x) \wedge \mathsf{recommend}(m,x))$

These facts suggest that at the end of the day, projection is most likely due to the innate properties of supplements, and it's not enough to just tweak the scope of their anchors. This shadows a more general problem for unidimensionalism. For bidimensionalists, the innate property that drives projection is usually just non-at-issueness, it receives a *semantic* encoding in the non-at-issue dimension and leads automatically to projection. In contrast, bidimenional approaches integrate supplements into the at-issue content, which forces them to seek extraneous reasons for projection and non-at-issueness. The task is, across the board, not trivial, as we will also see from Schlenker's attempt momentarily.

2.2. Schlenker (2023)

We take Schlenker's examples to contain genuinely narrow-scope supplements:

(5) If tomorrow I called the Chair, *who in turn called the Dean*, then we would be in big trouble.

[4]Note that (16a) is adapted from the Schlenker example (5) by taking out the 'fake' past marking, which can be taken as a grammatical factor that forces a narrow scope reading, just like quantificational binding as per Martin.

[5]Martin argued that the narrow-scope reading is blocked by the alternative containing a restrictive relative clause:

(1) John didn't read a book which Mary had recommended to him.

We acknowledge that this is a way out, but it also feeds the point that there is some inherent feature of supplements that are forcing their projection, not just the scope of their anchors.

(6) I will be wondering next Wednesday whether DSK, *who met with the judge the day before*, agreed to a settlement.

As mentioned above, the NRRCs in (5) and (6) both contain past tense that signals future times, suggesting that they must be *syntactically* embedded. Meanwhile, neither (5) nor (6) necessarily entails the supplements, suggesting that they do not project *semantically* either (see also Poschmann 2018 for experimental evidence in German). On top of that, Schlenker showed that the scope taking of NRRCs can be quite flexible, as both the *matrix*-scope reading (18), where the supplemental content projects, and the *intermediate*-scope reading (19), where it is interpreted as part of the conditional antecedent but outside the c-commanding quantifier, can be easily obtained.

(18) If tomorrow I call Bill, *who is a total jerk*, then we will be in big trouble. (same as 16b)

(19) If each of the faculty had mentioned the fact that they didn't like John, *who had gotten fired as a result*, we would now feel terrible.
(if$>$ NRRC $>$ $\forall$, Schlenker 2023: ex. 32)

Schlenker (2023) proposed a unidimensional semantics where, like in Martin (2017), supplemental content is simply conjoined to the main at-issue content. To deal with the various scope possibilities, he proposed that NRRCs can in principle be attached to any propositional node that dominates their anchor, and the conjunction happens at the attachment site. In (5), the NRRC is syntactically attached (and conjoined) to the clause *I called the Chair* inside the conditional antecedent, in (18) it is attached to the whole conditional, and in (19) it is attached to *each of the faculty had mentioned the fact that they didn't like John*.

This resort to syntax is again motivated by the morphological tense marking as in (5)–(6), which, importantly, cannot be explained at LF. But it immediately raises suspicions as (pre-Spell Out) syntactic structures, unlike LF, usually map homomorphically to surface structures; yet regardless of the projection status of the supplements, their corresponding NRRCs are always pronounced right next to their anchors in a superficially embedded position. Furthermore, if supplements can take flexible syntactic scope, one needs to explain why they (usually) don't do so in cases such as (18) and, along the same vain, why forcing a narrow-scope supplement using 'fake' past marking is not always viable, as in (20).

(20) #/?? If tomorrow I called Bill, *who was a total jerk (by the way)*, then we will be in big trouble.

Schlenker did claim that syntax does not bear the whole burden of explaining projection, and supplements carry a distinct *pragmatic* property that distinguish them from at-issue content. The property is coined **Translucency**, stated as follows:

(21) TRANSLUCENCY
   a. A supplement must make a non-trivial contribution in its local context relative to the global context C of the conversation.

b. It should be 'easy' to accommodate assumptions that make a supplement locally trivial, i.e. to add assumptions to C to obtain a strengthened context C+ relative to which the supplement is locally trivial.

The first condition (21a) speaks to Potts' (2005) original observation that supplements should carry novel information, which is not relevant here. The second condition (21b) predicts, as Schlenker intended, a presupposition projection-like behavior of supplements. For instance given the non-projecting example (5), the local context of the supplement is one where the antecedent to its left, namely *tomorrow I call the Chair*, supposedly holds; as the supplement should be easily accommodated in this local context, it suggests at least a positive correlation between 'me' calling the Chair and the Chair calling the Dean. This prediction is more or less attested (see Schlenker 2023 and Poschmann 2018 for experimental results).

Unfortunately, even with Translucency, it is far from certain that a satisfactory explanation for the obligatory projection as in (20) would arise. There is no clear path to the general non-at-issueness either. Schlenker entertained a preliminary solution in his Appendix III. The basic idea is that, since supplements are easy to accommodate at local context due to Translucency, it should be easy for interlocutors to infer them from the current context, thus less likely for them to address QUDs. Even if this eventually leads to a full-fledged account, it has been noted that Translucency itself, especially the condition (21b) that Schlenker relied on to explain both projection and non-at-issueness, may be problematic in certain respects. Marty (2021) argued that the 'easy-to-accommodate' is neither necessary nor sufficient to characterize supplements. He introduced the following minimal pair:

(22) a. #Bill, *who has thirteen fingers*, speaks faster than anybody else.
b. Bill, *who has thirteen fingers*, plays arpeggios very fast.

Two things to notice. First, the supplemental content, that Bill has thirteen fingers, is quite surprising for someone who first hears about it (or at least as surprising as, say, Bill plays arpeggios very fast). Yet (22b) sounds perfectly fine. This suggests that (21b) is probably unnecessary. Second, given the same (null) context, (21a) and (21b) have the exact same supplement situated in the exact same local context, yet their acceptability differ sharply. This suggests that (21b) is insufficient, and the licensing of supplements needs to look beyond local context – possibly an evaluation of the relevance/coherence between the supplement and at-issue content. Therefore, even though an explanation for non-at-issueness might be retrieved from Translucency, Translucency itself seems to be problematic.

3. The semantics of supplements

What's suggested by the previous section is that although a 'radical' bidimensional semantics like Potts' faces difficulties accounting for non-projecting supplements, a 'radical' unidimensional view would have its own demon, especially when trying to explain projection and non-at-issueness. We propose to reconcile the two views by developing a bidimensional semantics where the supplemental content is generated at a separate dimension, it can be 'discharged' into the at-issue content *if needed*.

In recent years, an increasing body of literature has shown that **monads** (Moggi 1989; Wadler 1992) are extremely useful in integrating linguistic *side effects* (e.g. Shan 2005) into a compositional fragment that involves scope-taking (see for instance Barker 2002; Barker and Shan 2014; Giorgolo and Asudeh 2012; Charlow 2014, 2015, 2020; Grove 2019b). If one think of supplements as a kind of 'side effect', an appropriately deviced monad structure may hopefully capture their interpretive characters, while modulating its scope-taking behaviors.

A monad can be defined as a quadruple $\langle \mathsf{M}, (\cdot)^{\overset{\uparrow}{\mathsf{M}}}, (\cdot)^{\overset{\mathsf{M}}{\downarrow}}, \mu_{\mathsf{M}} \rangle$ of a type constructor M and three operations – the 'unit' operator $(\cdot)^{\overset{\uparrow}{\mathsf{M}}}$, the 'apply' operator $(\cdot)^{\overset{\mathsf{M}}{\downarrow}}$ and the 'join' operator μ_{M}. M, as a type constructor, takes a 'boring' type α and returns a 'fancy' type $\mathsf{M}\alpha$. $(\cdot)^{\overset{\uparrow}{\mathsf{M}}}$ is a polymorphic function of type $\alpha \to \mathsf{M}\alpha$ that trivially lifts values into the 'fancy' type space. $(\cdot)^{\overset{\mathsf{M}}{\downarrow}}$ is a function that enables composition in the 'fancy' type space, through which two 'fancy' types $\mathsf{M}\alpha$ and $\mathsf{M}(\alpha \to \beta)$ can be composed by applying functional application to their 'boring' cores independently of the side effects. Finally, μ_{M} (called 'join') is an operator that can collapse multiple layers of side effects into a single layer. As we will see, this operator will play an important role in determining the scope of supplements. The type signatures of the unit, apply and join operators are summarized as follows[6]:

$$
\begin{aligned}
(\cdot)^{\overset{\uparrow}{\mathsf{M}}} &:: \alpha \to \mathsf{M}\alpha \\
(\cdot)^{\overset{\mathsf{M}}{\downarrow}} &:: \mathsf{M}(\alpha \to \beta) \to \mathsf{M}\alpha \to \mathsf{M}\beta \\
\mu_{\mathsf{M}} &:: \mathsf{M}(\mathsf{M}\alpha) \to \mathsf{M}\alpha
\end{aligned}
$$

The set of monadic operations have to satisfy a series of naturality conditions (often called *'monad laws'*) that in turn ensure modular extension, i.e. monadic effects can be stacked on other (layers of) monadic effects 'for free'. We refer to Appendix A for the formulation and proof of the relevant monad laws.

We propose to model supplements using a `Reader.Set` monad, which is what Grove (2019a) used to encode intensionality. Importantly, any non-trivial supplemental content introduced by NRRCs will enter the semantic composition with (at least) two layers of monadic effects. It is due to this feature that the join operator can apply to collapse the supplemental content into the at-issue content.[7]

3.1. First layer: intensional propositions

The current analysis for supplements is built on Grove (2019b), who encoded *intensional* propositions as sets of pairs of possible worlds and truth values. For instance, the sentence *Nate left* has the following denotation:

$$\{\langle w, \mathsf{left}\, \mathbf{n}\, w\rangle \mid w \in \mathscr{W}\} \tag{a}$$

[6]The operations $(\cdot)^{\overset{\uparrow}{\mathsf{M}}}$ and $(\cdot)^{\overset{\mathsf{M}}{\downarrow}}$ comprise an *applicative functor* (McBride and Paterson 2008), a more general structure than monad.

[7]Earlier works, including Giorgolo and Asudeh (2012) and Charlow (2015), suggested using the `Writer` monad to model supplements, which basically enriches ordinary semantic values with an independently paired (supplemental) proposition. They were honest and intuitive depictions of Potts' bidimensional semantics, but also inherit the problem that the information flow is at most one-way (from the main content to the supplemental content), thus failing at capturing the various scope possibilities.

where $\mathscr{W}$ is the set of possible worlds. In other words, $\langle w, \top \rangle$ is in the set above as long as Nate left at world w, and $\langle w, \bot \rangle$ is in the set as long as Nate didn't. Conversely, the truth condition of a proposition φ, i.e. the set of worlds in which it is true, can be reconstructed from the new denotation:

(23) φ is true in w iff $\langle w, \top \rangle \in \varphi$

The compositional schema that derives such propositional meanings is powered by the monad `Reader.Set`. The representation with a *set of world-value pairs* correspond to a de-sugared form of an object of type $\mathtt{s} \to \alpha \to \mathtt{t}$, which is obtained after the `Set` component lifts the value of type α into a charateristic function of type $\alpha \to \mathtt{t}$, and the Reader component makes the new value world-sensitive. The corresponding type constructor N and *unit* are defined as follows.

$$\mathsf{N}\alpha :: \mathtt{s} \to \alpha \to \mathtt{t}$$

$$(\cdot)^{\overset{\uparrow}{\mathsf{N}}} :: \alpha \to \mathsf{N}\alpha$$

$$a^{\overset{\uparrow}{\mathsf{N}}} := \{\langle w, a \rangle \mid w \in \mathscr{W}\}$$

Then *Nate*, with an ordinary denotation $\mathbf{n}$, can be lifted by unit into $\mathbf{n}^{\overset{\uparrow}{\mathsf{N}}}$, as follows:

$$\{\langle w, \mathbf{n} \rangle \mid w \in \mathscr{W}\} \tag{b}$$

An intensional one-place property *left* has the following denotation:

$$\{\langle w, \lambda x.\, \mathsf{left}\, x\, w \rangle \mid w \in \mathscr{W} \rangle\} \tag{c}$$

Finally, note that for each pair in the denotation of *Nate left* (a), the second component can be obtained from applying simple functional application to the second components of a couple of pairs picked from (b) and (c). This is precisely what apply does when combining 'fancy'-type expressions. If we define apply $(\cdot)^{\overset{\mathsf{N}}{\downarrow}}$ as follows:

$$(\cdot)^{\overset{\mathsf{N}}{\downarrow}} :: \mathsf{N}(\alpha \to \beta) \to \mathsf{N}\alpha \to \mathsf{N}\beta$$

$$m^{\overset{\mathsf{N}}{\downarrow}} n := \{\langle w, f x \rangle \mid \langle w, f \rangle \in m \;\&\; \langle w, x \rangle \in n\}$$

Then (a) is simply the result of applying (c) to (b), as we would like it to be.

3.2. Second layer: supplements

Let's add supplements. As hinted above, we would like to make use of the join operator to model the scope-taking of supplements. The argument to which join is applied to should have a type signature of the form $\mathsf{M}(\mathsf{M}\alpha)$, corresponding to a set of {pairs of possible worlds and sets of {pairs of possible worlds and expressions of type α}}. What supplements do, essentially, is adding to the comprehension condition of the matrix set by restricting the set of worlds that can be used as the world component in the pairs. For instance, given a phrase such as *Nate, who is a musician*, we would like it to have the following denoation:

$$\{\langle w, \{\langle w', \mathbf{n} \rangle \mid w' \in \mathscr{W}\} \rangle \mid \mathsf{musician}\, \mathbf{n}\, w\} \tag{d}$$

To derive it compositionally, I propose the following semantics for the COMMA intonation:

(24) **COMMA** :: $\mathsf{N}(\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathsf{N}(\mathsf{N}\mathtt{e})$

$$:= \lambda m \lambda x. \{\langle w, \{\langle w', x\rangle \mid w' \in \mathscr{W}\}\rangle \mid \langle w, \top\rangle \in m \overset{\mathsf{N}}{\downarrow} (x^{\overset{\uparrow}{\mathsf{N}}})\}$$

That is, **COMMA** combines directly with a monadic property of type $\mathsf{N}(\mathtt{e} \to \mathtt{t})$ and an $\mathtt{e}$-type individual and returns a (doubly-lifted) $\mathsf{N}(\mathsf{N}\mathtt{e})$-type expression. Now consider the simple sentence containing an NRRC (25):

(25) Alex invited Nate, *who is a musician*.

Based on the discussion in the last section, we can expect the following semantics for *invite*:

$$\{\langle w, \lambda xy. \mathsf{invite}\, x\, y\, w\rangle \mid w \in \mathscr{W}\} \tag{e}$$

There is yet no way to compose (e) and (d), but we can use the same trick as in the last subsection. First, applying unit to lift (e) to an $\mathsf{N}(\mathsf{N}(\mathtt{e} \to \mathtt{e} \to \mathtt{t}))$-type expression:

$$(\mathrm{e})^{\overset{\uparrow}{\mathsf{N}}} = \{\langle w, \{\langle w', \lambda xy. \mathsf{invite}\, x\, y\, w'\rangle \mid w' \in \mathscr{W}\}\rangle \mid w \in \mathscr{W}\} \tag{f}$$

Then we can implement a fancier apply, which I will call apply^2 $(\cdot)\overset{\mathsf{N}^2}{\downarrow}$, to combine (f) and (d). Essentially, apply^2 uses apply $(\cdot)\overset{\mathsf{N}}{\downarrow}$ to combine the second components of selected couple of pairs from (d) and (f), while reserving the membership restrictions provided by the NRRC.[8]

$$(\cdot)\overset{\mathsf{N}^2}{\downarrow} :: \mathsf{N}(\mathsf{N}(\alpha \to \beta)) \to \mathsf{N}(\mathsf{N}\alpha) \to \mathsf{N}(\mathsf{N}\beta)$$
$$\mathbf{m} \overset{\mathsf{N}^2}{\downarrow} \mathbf{n} := \{\langle w, m \overset{\mathsf{N}}{\downarrow} n\rangle \mid \langle w, m\rangle \in \mathbf{m} \;\&\; \langle w, n\rangle \in \mathbf{n}\}$$

Then apply^2 (f) to (d), we get the denotation for *invite Nate, who is a musician*:

$$\{\langle w, \{\langle w', \lambda y. \mathsf{invite}\, \mathbf{n}\, y\, w'\rangle \mid w' \in \mathscr{W}\}\rangle \mid \mathsf{musician}\, \mathbf{n}\, w\} \tag{g}$$

Finally, feed to (h) the doubly lifted denotation for *Alex*:

$$\mathbf{a}^{\overset{\uparrow}{\mathsf{N}^2}} = \{\langle w, \{\langle w', \mathbf{a}\rangle \mid w' \in \mathscr{W}\}\rangle \mid w \in \mathscr{W}\} \tag{h}$$

We get the following denotation for (25):

$$\{\langle w, \{\langle w', \mathsf{invite}\, \mathbf{n}\, \mathbf{a}\, w'\rangle \mid w' \in \mathscr{W}\}\rangle \mid \mathsf{musician}\, \mathbf{n}\, w\} \tag{i}$$

Up to this point, the supplemental content (namely *Nate is a musician*) is processed completely independent of the main at-issue content (namely *Alex invited Nate*). The truth condition of (25) can be quite easily extracted from (i) – first, apply 'join' μ_{N}, as defined below:

$$\mu_{\mathsf{N}} :: \mathsf{N}(\mathsf{N}\alpha) \to \mathsf{N}\alpha$$
$$\mu_{\mathsf{N}}(\mathbf{m}) := \{\langle w, a\rangle \mid \exists m. \langle w, m\rangle \in \mathbf{m} \;\&\; \langle w, a\rangle \in m\}$$

[8]In fact, $(\cdot)\overset{\mathsf{N}^2}{\downarrow}$ can be derived from $(\cdot)\overset{\mathsf{N}}{\downarrow}$ based on general rules of monad transformation. See Appendix A for the proof.

That is, μ_{N} conjoins the comprehension conditions of the matrix set the set denoted by the second component of the pairs who are members in the matrix set. Applied to (i), it returns:

$$\{\langle w, \mathsf{invite}\,\mathbf{n}\,\mathbf{a}\,w\rangle \mid \mathsf{musician}\,\mathbf{n}\,w\} \tag{j}$$

Now the set contains only $\langle w, \top\rangle$ or $\langle w, \bot\rangle$, for some $w \in \mathscr{W}$. $\langle w, \top\rangle$ is in the set if and only if Nate is a musician at w (only these worlds are included), and Alex invited Nate at w (so that the second component is $\top$). Then by (23), the sentence (25) is true iff Alex invited Nate and Nate is a musician, corresponding to the logical conjunction of the at-issue and supplemental content, as desired.

To conclude this section, the derivation of (25) is presented in the following tree:

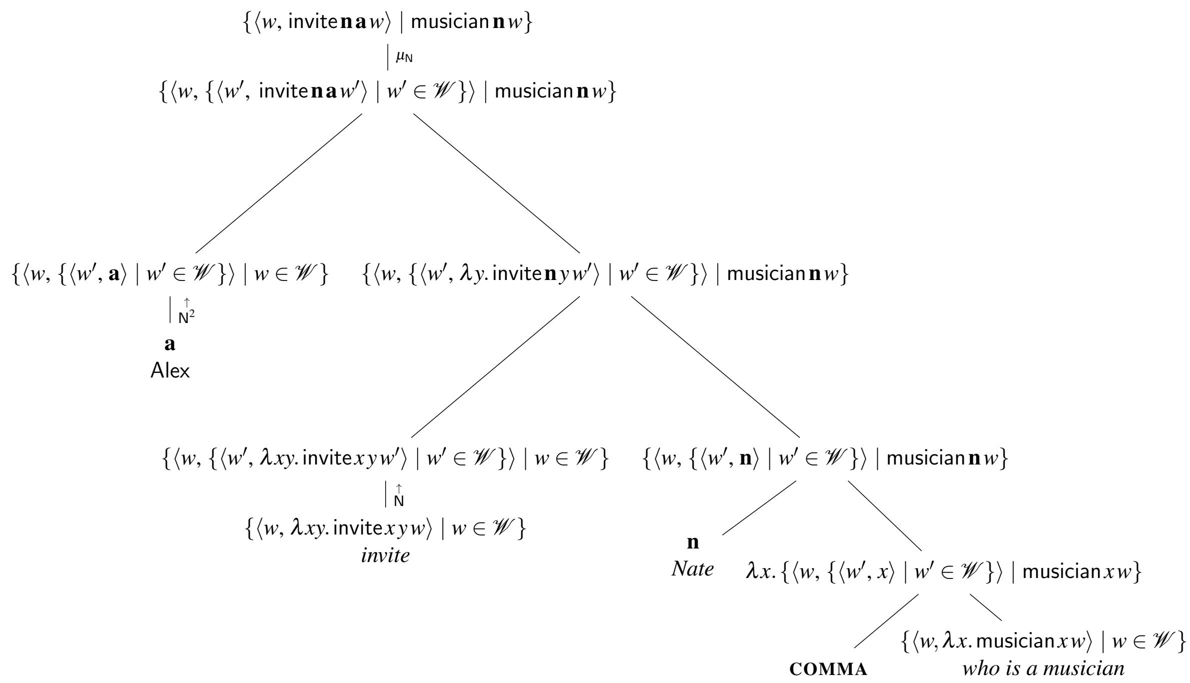

Figure 1: Alex invited Nate, who is a musician.

4. The scopes of supplements

4.1. Projection, or 'wide-scope' supplements

It is perhaps clear by now that the projection of supplement follows directly from the (default) non-interaction of at-issue and supplemental content during semantic computation. We hereby illustrate with the case where the supplement projects through the matrix-level negation negation (26), but similar derivations apply to other scope operators.

(26) Alex **didn't** invite Nate, *who is a musician*.
$\rightsquigarrow$ Nate is a musician.

Assuming the following semantics for the negation and *might*, both propositional operators:

(27) $\mathsf{not} := \lambda p.\{\langle w,\top\rangle \mid \langle w,\top\rangle \notin p\}$ $(\mathtt{Nt} \to \mathtt{Nt})$

For simplicity, it takes and returns only $\mathtt{Nt}$-type arguments. In order to combine with sentences with non-trivial supplements such as *Alex invite Nate, who is a musician* denoting (i), they need to be lifted by unit $(\cdot)^{\overset{\uparrow}{\mathsf{N}}}$ before applying $(\cdot)^{\overset{\mathsf{N}}{\downarrow}}$ to (i). The derivation is shown in Figure 2.

$$\{\langle w,\top\rangle \mid \mathsf{musician}\,\mathbf{n}\,w \;\&\; \neg\mathsf{invite}\,\mathbf{n}\,\mathbf{a}\,w\}$$
$$\Big|\;\mu_{\mathsf{N}}$$
$$\{\langle w, \{\langle w',\top\rangle \mid \neg\mathsf{invite}\,\mathbf{n}\,\mathbf{a}\,w'\}\rangle \mid \mathsf{musician}\,\mathbf{n}\,w\}$$
$$\Big|\;=$$
$$\{\langle w, \lambda p.\{\langle w',\top\rangle \mid \langle w',\top\rangle \notin p\}\rangle \mid w \in \mathscr{W}\}^{\overset{\mathsf{N}}{\downarrow}}\{\langle w, \{\langle w', \mathsf{invite}\,\mathbf{n}\,\mathbf{a}\,w'\rangle \mid w' \in \mathscr{W}\}\rangle \mid \mathsf{musician}\,\mathbf{n}\,w\}$$

$$\{\langle w, \lambda p.\{\langle w',\top\rangle \mid \langle w',\top\rangle \notin p\}\rangle \mid w \in \mathscr{W}\} \qquad \{\langle w, \{\langle w', \mathsf{invite}\,\mathbf{n}\,\mathbf{a}\,w'\rangle \mid w' \in \mathscr{W}\}\rangle \mid \mathsf{musician}\,\mathbf{n}\,w\}$$

Alex invited Nate, who is a musician

$$\Big|\;\overset{\uparrow}{\mathsf{N}}$$
$$\lambda p.\{\langle w,\top\rangle \mid \langle w,\top\rangle \notin p\}$$

not

Figure 2: Alex didn't invite Nate, who is a musician.

Note that since the supplement *Nate is a musician* is logged as the comprehension condition of the matrix set, it never interacts with the negation, which is only applied to the 'inner' set, as evidenced by the final truth condition (i.e. the comprehension condition of the set on top).

4.2. Non-proejction, or 'narrow-scope' supplements

So far the join operator μ_{N} is only applied at the end of the derivation for the purpose of retrieving truth conditions. But as we suggested before, it can be applied at a sub-sentential level to 'discharge' supplements into the at-issue content. For Schlenker's example (5):

(5) If tomorrow I called the Chair, *who in turn called the Dean*, then we would be in big trouble.

μ_{N} is applied after the conditional antecedent *tomorrow I call the Chair, who in turn call the Dean* is computed, and before it is combined with *if*. Assuming the following simplified semantics for *if* (equivalent to a material conditional):

(28) $\mathsf{if} := \lambda p \lambda q.\, \mathsf{not}(p \cap \mathsf{not}\, q)$ $(\mathtt{Nt} \to \mathtt{Nt} \to \mathtt{Nt})$

The derivation of (5) proceeds as in Figure. 3. μ_{N} is applied to integrate the supplemental content, i.e. the comprehension condition of the matrix set, to that of its 'inner' set, returning an $\mathtt{Nt}$-type expression which is then fed to if. Consequently, both the at-issue and (originally) supplemental components are affected by the logical operations introduced by if. In the final result, $\langle w,\top\rangle$ is a member of the resulting set iff 'I' don't call the Chair at w, or the Chair doesn't call the Dean at *w*, or we are in trouble at *w*. The truth condition is thus approximately the same as the conditional with a conjunctive antecedent as in (29), reflecting the non-projection of the supplemental content.

$$\{\langle w, \top\rangle \mid \neg\mathsf{call}\,\mathbf{c}\,s\,w \text{ or } \neg\mathsf{call}\,\mathbf{d}\,\mathbf{c}\,w \text{ or } \mathsf{trouble}\,\mathbf{us}\,w\}$$

$$\lambda q.\,\mathsf{not}\,(\{\langle w, \mathsf{call}\,\mathbf{c}\,s\,w\rangle \mid \mathsf{call}\,\mathbf{d}\,\mathbf{c}\,w\} \cap \mathsf{not}\,q) \qquad \{\langle w, \mathsf{trouble}\,\mathbf{us}\,w\rangle \mid w \in \mathscr{W}\}$$

We would be in big trouble.

$$\lambda p \lambda q.\,\mathsf{not}(p \cap \mathsf{not}\,q) \qquad \{\langle w, \mathsf{call}\,\mathbf{c}\,s\,w\rangle \mid \mathsf{call}\,\mathbf{d}\,\mathbf{c}\,w\}$$

if

$$\mid \mu_{\mathsf{N}}$$

$$\{\langle w, \{\langle w', \mathsf{call}\,\mathbf{c}\,s\,w'\rangle \mid w' \in \mathscr{W}\}\rangle \mid \mathsf{call}\,\mathbf{d}\,\mathbf{c}\,w\}$$

I call the Chair, who in turn called the Dean

Figure 3: If tomorrow I called the Chair, who in turn called the Dean, then we would be in big trouble.

(29) If tomorrow I called the Chair and he called the Dean, then we would be in big trouble.

Finally, since the application site of μ_{N} alone determines the semantic scope of supplements, the intermediate-scope reading of supplements, as in (19), is obtained when μ_{N} is applied *after* the lower-scope quantification takes effect and *before* combining the antecedent with if. We leave it to the reader to verify the derivation.

4.3. Non-at-issueness

At this point we've accomplished what we set out do to – defending bidimensionalism against arguments based on non-projecting supplements. Supplements are registered differently than at-issue content, but can be integrated, thus take scope, when needed. The discourse effects of supplements have been mostly sidelined, to which we now turn briefly.

Recall that the hallmark of the bidimensional analysis is the coupling of non-at-issueness and projection. Since our analysis is bidimensional, with the supplemental dimension modeled as comprehension conditions of sets that asymmetrically nest sets denoted by at-issue content, the coupling is retained and the default non-at-issueness of supplements follows straightforwardly. Based on the discussions in §2, we take the simplicity of this explanation to be a good thing.

In fact, the current proposal delivers a more fine-grained account for the discourse status of supplements. Supplements do not *always* project, as they can be discharged into the computation of at-issue contents; analogously, supplements are not non-at-issue *a priori*, they may exhibit a diversity of discourse effects which are tied to their scope possibilities.

Here it is important to note that a supplement being non-projecting does not mean that the differences between its discourse effects and that of the at-issue content are eliminated. For instance, Schlenker (2023) showed that sentences with a narrow-scope supplement as in (5) carry a stronger conditional inference (in this case, that 'if tomorrow I called the Chair, he *would* call the Dean') than its minimal variation that uses explicit conjunction, as in (29). Such difference is expected due to their differences in semantic derivations, in particular that μ_{N} is applied in the derivation of (5) but not (29). The remaining question is then how exactly is the implementation of μ_{N} associated with the specific discourse effects. Leaving the detailed characterization to another occasion, it is relatively clear that narrow-scope supplements seem to be 'licensed' by some specific coherence relations. In (5) the supplement stands in a narrative/resultative, thus *coordinating* relation (Asher et al. 2003) with the adjacent at-issue content (as in 'I call the Chair and *then* he calls the Dean'), whereas for projecting supplements such as (18), the supplements tend to provide explanation or background information for the utterance (e.g. Bill being a jerk is the reason that we'll be in trouble if he knows), thus standing in a *subordinating* relation with the at-issue content. Jasinskaja and Poschmann (2021) proposed, alternatively, that narrow-scope supplements are 'licensed' when it is not speaker-oriented, while projecting ones usually are (e.g. for (18), the speaker thinks that Bill is a jerk). Regardless of what constitutes the most accurate characterization, the inferential patterns of sentences containing supplements may result from competitions between different derivations (i.e. those involve sub-sentential application of μ_{N} that those do not) in terms of maximizing discourse coherence.

5. Conclusion

In this paper, we defended the traditional bidimensional approach to supplements *à la* Potts (2005) by developing a version that allows supplements to take 'narrow scope' and enter the computation of at-issue content, thus resolving the problems pertaining to the existence of non-projecting supplements. The new semantics lays the foundation for a more fine-grained characterization of the discourse effects of supplements.

Note that the theoretical objective of the paper is simply reconciling bidimensionalism with one class of criticisms, i.e. non-projecting supplements. Other types of challenges remain. For instance, the semantic interactions between at-issue and supplemental components extend well beyond scoping towards empirical domains such as anaphora resolution, presupposition satisfaction and ellipsis (see e.g. Nouwen 2007; Amaral et al. 2007; AnderBois et al. 2015). Others challenge bidimensionalism by questioning the virtue of non-at-issueness directly (e.g. Koev 2013, 2015). It is beyond the scope of this paper to address these issues, but we believe that the current proposal is amenable enough to reach the ultimate goal. We've already shown in the previous section that bidimensionalism does not necessitates non-at-issueness (or projection) of supplements, which gives us the space of accommodating more empirical variations. For the semantic interactions, the common strategy (as used in AnderBois et al. 2015) is to deploy a dynamic framework, and it turns out that a monadic structure can be extended to a dynamic representation quite effortlessly (Charlow 2014). In general, therefore, we hope that this paper has provided an improved semantic basis for a more accurate depiction of supplements.

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A. Proof of Monad Laws

Monad laws can be formulated in several equivalent ways. In order to give a more transparent representation, we first define a new **sequencing operator** $\multimap$ from the general quadruple definition $\langle \mathsf{M}, (\cdot)^{\overset{\uparrow}{\mathsf{M}}}, (\cdot)^{\overset{\mathsf{M}}{\downarrow}}, \mu_{\mathsf{M}} \rangle$.

$$\begin{aligned} \multimap_{\mathsf{M}} &:: \mathsf{M}\alpha \to (\alpha \to \mathsf{M}\beta) \to \mathsf{M}\beta \\ &:= \lambda \mathbf{a}.\lambda \mathbf{f}.\, \mu_{\mathsf{M}}((\mathbf{f}^{\overset{\uparrow}{\mathsf{N}}})^{\overset{\mathsf{N}}{\downarrow}}\mathbf{a}) \end{aligned}$$

Monad laws. Monad laws as formulated in Charlow (2014):

$$\begin{aligned} a^{\overset{\uparrow}{\mathsf{N}}} \multimap k &= ka && \text{LeftID} \\ \mathbf{m} \multimap (\cdot)^{\overset{\uparrow}{\mathsf{N}}} &= \mathbf{m} && \text{RightID} \\ (\mathbf{m} \multimap k) \multimap c &= \mathbf{m} \multimap (\lambda a.ka \multimap c) && \text{Associativity} \end{aligned}$$

Now given the specific $\mathsf{Reader.Set}$ monad N, a type-$\mathsf{N}\alpha$ expression **a** should be in the form $\{\langle w, a_\alpha\rangle \mid \text{COND}_A\}$, and a type $\alpha \to \mathsf{M}\beta$ expression **f** in the form $\lambda x_\alpha.\{\langle w,(fx)_\beta\rangle \mid \text{COND}_B\}$. The sequencing operator $\multimap_{\mathsf{N}}$ is thus:

$$\begin{aligned} \multimap_{\mathsf{N}} :&= \lambda \mathbf{a}_{\mathsf{N}\alpha}.\lambda \mathbf{f}_{\alpha\to\mathsf{N}\beta}.\, \mu_{\mathsf{N}}((\mathbf{f}^{\overset{\uparrow}{\mathsf{N}}})^{\overset{\mathsf{N}}{\downarrow}}\mathbf{a}) \\ &= \lambda \mathbf{a}.\lambda \mathbf{f}.\, \mu_{\mathsf{N}}(\{\langle w, \lambda x_\alpha.\{\langle w',(fx)_\beta\rangle \mid \text{COND}_B[w']\}\rangle \mid w \in \mathscr{W}\}^{\overset{\mathsf{N}}{\downarrow}}\{\langle w,a_\alpha\rangle \mid \text{COND}_A[w]\}) \\ &= \lambda \mathbf{a}.\lambda \mathbf{f}.\, \mu_{\mathsf{N}}(\{\langle w, \{\langle w', fa\rangle \mid \text{COND}_B[w']\}\rangle\ \text{COND}_A[w]\}) \\ &= \lambda \mathbf{a}.\lambda \mathbf{f}.\, \{\langle w, fa\rangle \mid \text{COND}_A[w]\ \&\ \text{COND}_B[w]\} \end{aligned}$$

The unspecified COND_A and COND_B will cause representational inconvenience later. An equivalent presentation is as follows (read as 'm evaluates the variable v in program π', where m, v and π are of the type $\mathsf{N}\alpha$, α, $\mathsf{N}\beta$):

$$m_v \multimap \pi = \{\langle w, \pi_1[m_1/v]\rangle \mid \langle w, m_1\rangle \in m\ \&\ \langle w, \pi_1\rangle \in \pi\}$$

$\pi_1[m_1/v]$ means substituting all the occurrences of v in π_1 with m_1. Associativity can be rewritten accordingly:

$$(m_v \multimap k)_u \multimap c = m_v \multimap (k_u \multimap c)$$

Proof.

$$\overset{\uparrow}{a}^{\mathsf{N}} \multimap k = \{\langle w,a\rangle \mid w \in \mathscr{W}\} \multimap k$$
$$= \bigcup_{\langle w,a\rangle \in \{\langle w,a\rangle \mid w\in\mathscr{W}\}} ka \qquad \text{(Left ID)}$$
$$= ka \qquad (a \text{ does not covary with } w)$$

$$\mathbf{m} \multimap (\cdot)^{\overset{\uparrow}{\mathsf{N}}} = \bigcup_{\langle w,m\rangle \in \mathbf{m}} m^{\overset{\uparrow}{\mathsf{N}}}$$
$$= \bigcup_{\langle w,m\rangle \in \mathbf{m}} \{\langle w,m\rangle \mid w \in \mathscr{W}\} \qquad \text{(Right ID)}$$
$$= \mathbf{m} \qquad (w \in \mathscr{W} \text{ is a trivial membership condition})$$

$$\begin{aligned}(m_\nu \multimap k)_u \multimap c &= \{\langle w, k_1[m_1/\nu]\rangle \mid \langle w,k_1\rangle \in k \ \&\ \langle w,m_1\rangle \in m\}_u \multimap c\\ &= \{\langle w, c_1[k_1[m_1/\nu]/u]\rangle \mid \langle w,k_1\rangle \in k \ \&\ \langle w,m_1\rangle \in m \ \&\ \langle w,c_1\rangle \in c\}\end{aligned}$$

$$\begin{aligned}m_\nu \multimap (k_u \multimap c) &= m_\nu \multimap \{\langle w, c_1[k_1/u]\rangle \mid \langle w,k_1\rangle \in k\ \ \langle w,c_1\rangle \in c\} \qquad \text{(Associativity)}\\ &= \{\langle w, c_1[k_1/u][m_1/\nu]\rangle \mid \langle w,k_1\rangle \in k \ \&\ \langle w,m_1\rangle \in m \ \&\ \langle w,c_1\rangle \in c\}\\ &= \{\langle w, c_1[k_1[m_1/\nu]/u]\rangle \mid \langle w,k_1\rangle \in k \ \&\ \langle w,m_1\rangle \in m \ \&\ \langle w,c_1\rangle \in c\}\\ &= (m_\nu \multimap k)_u \multimap c \text{ (only } k_1 \text{ contains the variable } \nu \text{ after } \alpha\text{-conversion)}\end{aligned}$$

Monad Transformation. Now we show that the definition of $(\cdot)^{\overset{\mathsf{N}^2}{\downarrow}}$ can be derived by applying a *monad transformers* based on N back on N. Given an arbitrary monad $\langle \mathsf{M}_1, (\cdot)^{\overset{\uparrow}{\mathsf{M}_1}}, \multimap_1\rangle$, applying the monad transformation based on N gives rise to another monad $\langle \mathsf{M}_2, (\cdot)^{\overset{\uparrow}{\mathsf{M}_2}}, \multimap_2\rangle$:

$$\begin{aligned}\mathsf{M}_2\alpha &::= s \to \mathsf{M}_1\alpha \to t\\ a^{\overset{\uparrow}{\mathsf{M}_2}} &:= \{\langle w, a^{\overset{\uparrow}{\mathsf{M}_1}}\rangle \mid w \in \mathscr{W}\}\\ m_\nu \multimap_2 \pi &:= \{\langle w, m'_u \multimap_1 \pi_1[u/\nu]\rangle \mid \langle w,\pi_1\rangle \in \pi \ \&\ \langle w,m'\rangle \in m\}\end{aligned}$$

Now suppose $\mathsf{M}_1 = \mathsf{N}$, we get the following M_2:

$$\begin{aligned}\mathsf{M}_2\alpha &::= s \to (s \to \alpha \to t) \to t\\ a^{\overset{\uparrow}{\mathsf{M}_2}} &:= \{\langle w, \{\langle w',a\rangle \mid w' \in \mathscr{W}\}\rangle \mid w \in \mathscr{W}\}\\ m_\nu \multimap_2 \pi &:= \{\langle w, \{\langle w', \pi_2[m''/u]\rangle \mid \langle w',\pi_2\rangle \in \pi_1[u/\nu] \ \&\ \langle w',m''\rangle \in m'\}\rangle \mid \langle w,\pi_1\rangle \in \pi \ \&\ \langle w,m'\rangle \in m\}\\ &= \{\langle w, \{\langle w', \pi_2[m''/\nu]\rangle \mid \langle w',\pi_2\rangle \in \pi_1 \ \&\ \langle w',m''\rangle \in m'\}\rangle \mid \langle w,\pi_1\rangle \in \pi \ \&\ \langle w,m'\rangle \in m\}\end{aligned}$$

We can show that $(\cdot)^{\overset{\mathsf{N}^2}{\downarrow}}$ can be defined with $\multimap_2$ and $(\cdot)^{\overset{\uparrow}{\mathsf{M}_2}}$:

$$(\cdot)^{\overset{\mathsf{N}^2}{\downarrow}} = \lambda u_{\mathsf{M}_2\alpha}\lambda v_{\mathsf{M}_2(\alpha\to\beta)}.v_{f_{\alpha\to\beta}} \multimap_2 (u_{x_\alpha} \multimap_2 (fx)^{\overset{\uparrow}{\mathsf{M}_2}})$$

Proof.

$$
u \overset{\mathsf{N}^2}{\downarrow} v = \{\langle w', v_1 \overset{\mathsf{N}}{\downarrow} u_1\rangle \mid \langle w', u_1\rangle \in u \;\&\; \langle w', v_1\rangle \in v\}
$$

$$
= \{\langle w', \{\langle w, v_2\ u_2\rangle \mid \langle w, u_2\rangle \in u_1 \;\&\; \langle w, v_2\rangle \in v_1\}\rangle \mid \langle w', u_1\rangle \in u \;\&\; \langle w', v_1\rangle \in v\}
$$

$$
\begin{aligned}
v_f \multimap_2 (u_x \multimap_2 (fx)^{\overset{\uparrow}{\mathsf{M}_2}}) &= v_f \multimap_2 \{\langle w, \{\langle w', fu_2\rangle \mid \langle w', u_2\rangle \in u_1\}\rangle \mid \langle w, u_1\rangle \in u\} \\
&= \{\langle w, \{\langle w', v_2 u_2\rangle \mid \langle w', u_2\rangle \in u_1 \;\&\; \langle w', v_2\rangle \in v_1\}\rangle \mid \langle w, u_1\rangle \in u \;\&\; \langle w, v_1\rangle \in v\} \\
&= u \overset{\mathsf{N}^2}{\downarrow} v
\end{aligned}
$$