Cumulative readings of distributive conjunctions: Evidence from Czech and German[1]

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Abstract. We present new data showing that cross-linguistically a class of conjunction strategies usually considered purely distributive exhibit cumulative readings in object position. This is similar to the pattern found for *every*-DPs (Kratzer 2003; Champollion 2010 a.o.) and German *jed*-DPs (Haslinger and Schmitt, 2018), suggesting all these elements form a natural class. Our evidence stems from experiments on Czech *A i B* and German *sowohl A als auch B* ('A as well as B') using a Semantic Choice Task (Lohiniva and Panizza 2016). In the crucial items, participants saw pictures of a cumulative scenario and a scenario making both the cumulative and the distributive reading false, and had the option of selecting one scenario or rejecting both. In both languages, cumulative scenarios were accepted more often with the conjunction in object position than with the conjunction in subject position. Further, as surface subjects of passive sentences patterned with objects of active sentences and topicalized objects with non-topicalized objects, passivization and topicalization do not seem to affect cumulative readings.

Keywords: distributive conjunction, cumulativity, distributivity, cumulativity asymmetries

1. Introduction

Distributive universals ('DUs') like English *every*-DPs and their correlates in some other languages have a surprising property: In many contexts they are purely distributive, but sometimes they allow for cumulative construals, a hallmark of semantic plurality (see Schein 1993, Kratzer 2003, Ferreira 2005, Champollion 2010, Chatain to appear a.o. for English, Haslinger and Schmitt 2018, 2022 for German, Flor 2017 for Italian). Thus, while (2a) can only be true in the distributive scenario in (1a), (2b) can also be true in the cumulative scenario in (1b).

(1) OVERALL SCENARIO: Two girls, Ada and Bea. Two cats, Ivo and Joe ...
   a. DISTRIBUTIVE SCENARIO: Ada fed Ivo and Joe. Bea fed Ivo and Joe.
   b. CUMULATIVE SCENARIO: Ada fed Ivo. Bea fed Joe.

(2) a. *Every girl in this town fed the two cats.* **true in (1a), false in (1b)**
   b. *(The) two girls fed every cat in this town.* **true in (1a), (1b)**

As the contrast in (2) shows, this plural-like behavior of DUs is restricted to certain syntactic

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contexts. While the DU in subject position in (2a) lacks a cumulative construal relative to the plural object, such a construal is available for the DU in object position relative to the plural subject. Several authors take this asymmetry to reflect a more general hierarchical constraint, namely, that a cumulative construal of a DU relative to another plural DP α is only available if α c-commands the DU (see Champollion 2010; Haslinger and Schmitt 2018, 2022).[2]

The question underlying this paper is whether another class of seemingly purely distributive elements – so-called **distributive conjunctions** – behaves analogously; that is, whether distributive conjunctions also display hallmarks of plurality and permit cumulative construals.

Previous cross-linguistic work on conjunction strategies yields a binary typology (see Mitrović and Sauerland 2014, 2016; Szabolcsi 2015; Flor et al. 2017b, a): We find conjunction forms that roughly behave like plurals (here called '**C-conjunctions**') and conjunction forms that seem to require a purely distributive interpretation ('**D-conjunctions**'). For example, German has a C-conjunction strategy marked with *und*, which behaves like a plural DP (e.g. *the two girls* in (3b)) in that both cumulative and distributive construals are available (3a), but also a D-conjunction strategy marked with *sowohl . . . als auch*, which disallows cumulativity (3c).

(3) a. ***Ada und Bea*** *haben genau zwei Katzen gefüttert.*
Ada COORD Bea have exactly two cats fed
'Ada and Bea fed exactly two cats.' **true in (1a), (1b)**

b. *The two girls fed exactly two cats.* **true in (1a), (1b)**

c. ***Sowohl Ada als auch Bea*** *haben genau zwei Katzen gefüttert.*
PRT Ada PRT also Bea have exactly two cats fed
'Ada and Bea each fed exactly two cats.' **true in (1a), false in (1b)**

Standardly, D-conjunctions are analyzed as having distributive generalized quantifier denotations akin to the classical semantics for *every*-DPs (Barwise and Cooper 1981 a.o.).[3] The recent proposals in Mitrović and Sauerland (2014, 2016); Szabolcsi (2015) follow distinct compositional paths to these denotations, but agree on the basic assumption that a D-conjunction as a whole does not denote a plurality or quantify over pluralities. This picture is challenged by Haslinger et al. (2019), which presents anecdotal evidence that D-conjunctions may be cumulative in object position. This raises three empirical questions we will investigate in this paper and which, to our knowledge, have not been addressed in the literature yet.

The first question is if the phenomenon extends beyond the anecdotal observations in Haslinger et al. (2019): **Do D-conjunction strategies systematically permit cumulative readings? [Q1]**. A positive answer to **Q1** would mean that the standard generalized-quantifier analysis of D-conjunctions cannot be correct and provide support for 'plural-based' conjunction theories.

The second question is motivated by the fact that cumulative construals of DUs are restricted to certain syntactic configurations of the DU and the other plural expression: **Are there syntactic restrictions on cumulative construals of D-conjunctions and if so, which ones? [Q2]**. An-

[2]Kratzer (2003), Ferreira (2005) and Chatain (to appear) tie the availability of cumulative construals for DUs to thematic role asymmetries, but correlate a difference in thematic roles with a difference in hierarchical position.

[3]Specifically, an *every*-DP is taken to quantify universally over the atomic individuals contributed by the NP-denotation (ia), while a D-conjunction quantifies universally over the denotations of its conjuncts (ib).

(i) a. $[\![\textit{every}\ \text{NP}]\!] = \lambda P_{\langle e,t\rangle}.\forall x_e[[\![\text{NP}]\!](x) \wedge x \text{ is an atomic individual} \rightarrow P(x)]$

b. $[\![\textit{sowohl}\ \text{A}\ \textit{als auch}\ \text{B}]\!] = \lambda P_{\langle e,t\rangle}.\forall x_e[x \in \{[\![\text{A}]\!], [\![\text{B}]\!]\} \rightarrow P(x)]$

swering **Q2** will determine whether the same mechanism underlies the cumulative construals of DUs and those of D-conjunctions, but also help us narrow down the class of plausible analyses.

Our third question targets the distinct morphosyntactic makeup of D-conjunctions in different languages. They often contain morphemes that also occur with other functions in the language. For example, German D-conjunctions contain morphemes resembling equative markers and additive particles; Czech D-conjunctions (but not C-conjunctions) contain a morpheme that looks like a scalar particle (4). This raises the option that different classes of morphemes in D-conjunctions (say, equative vs. scalar items) could have distinct semantic effects: **Do differences in the morphological makeup of D-conjunctions correlate with the restrictions on cumulative construals? [Q3]** Answering **Q3** will bear on the internal semantics of D-conjunctions: If they behave the same regardless of the other uses of the D-conjunction morphemes, the relation between these morphemes and cumulativity/distributivity must be indirect. In contrast, any semantic difference might suggest that the meanings these morphemes have in other contexts 'carry over' to D-conjunctions and directly affect their range of interpretations.

(4) C-conjunction: *A a B* D-conjunction: *A i B*

We targeted **Q1**–**Q3** by experimentally investigating D-conjunctions in German and Czech. Our main findings have direct consequences for the semantics of distributive elements, but also raise interesting questions for future research. They might also provide some insights into the strengths and weaknesses of the experimental task we used: We chose a **Semantic Choice Task ('SCT')** (Lohiniva and Panizza 2016) rather than the more standard Truth Value Judgment Task ('TVJT'; Crain and Thornton 1998). In Section 4, we will discuss potential (dis)advantages of this task and comment on why a comparison with a TVJT experiment could be instructive.

The paper is structured as follows: Section 2 gives some background on C- and D-conjunctions and motivates **Q1**–**Q3** in more detail. Section 3 describes the design of the experiments and presents the results. Section 4 lays out the consequences of these results for **Q1**–**Q3**, identifies two new puzzles raised by the data and sketches how those could be tackled in future research.

2. Motivating our questions

2.1. Background

Plural DPs are standardly assumed to denote pluralities of individuals, i.e. individuals with a non-trivial part structure (e.g. Link 1983). Thus, the denotation of *the two girls* involves an operation $\oplus$ that forms such pluralities (or 'sums') from individuals, as in (5).[4]

(5) $[\![\textit{the two girls}]\!] = \textbf{Ada} \oplus \textbf{Bea}$ (assuming that Ada and Bea are the only girls)

Sentences with two or more plural expressions are systematically ambiguous. (6a) (= (3b)) has a DISTRIBUTIVE construal: The property of feeding exactly two cats must hold of every atom

[4]We use basic notions of plural semantics: We assume a set $A \subseteq D_e$ of atomic individuals, a binary operation $\oplus$ on D_e and a function $f : (\mathscr{P}(A) \setminus \{\emptyset\}) \to D_e$ such that 1) $f(\{x\}) = x$ for any $x \in A$ and 2) f is an isomorphism between the structures $(\mathscr{P}(A) \setminus \{\emptyset\}, \cup)$ and $(D_e, \oplus)$. We also use the following notation:
(i) $x \leq y$ ('x is a part of y') iff $x \oplus y = y$. (ii) $x \leq_a y$ ('x is an atomic part of y') iff $x \leq y$ and $x \in A$.

of the girl-plurality in (5). On this construal, it is true in scenario (6b) (and (1a)), but not in (6c) (= (1b)). (6a) also has a CUMULATIVE construal, on which we intuitively 'add up' properties of the parts of the plurality. On this construal, the sentence is true in (6c), but not in (6b).

(6) a. *The two girls fed exactly two cats.*
b. DISTRIBUTIVE SCENARIO: Ada fed cats Ivo and Joe. Bea fed cats Moe and Nick.
c. DUMULATIVE SCENARIO: Ada fed Ivo. Bea fed Joe.

Simplifying, the cumulative construal of (6a) involves attributing the property ⟦*fed exactly two cats*⟧ to the plurality in (5) directly.[5] The distributive reading requires an additional step of universal quantification over atomic parts, e.g. via a distributivity operator attached to the VP, as in (7).

(7) $[\![\text{DIST}]\!] = \lambda P_{\langle e,t\rangle}.\lambda x_e.\forall y \leq_a x.P(y)$

2.2. Two types of conjunction strategies: The basic problem

Conjunctions of individual-denoting expressions like *Ada and Bea* seem to behave like plural DPs: (8) has a distributive construal (true in scenario (6b)), and a cumulative one (true in (6c)).

(8) *Ada and Bea fed exactly two cats.*

But cross-linguistically, many languages have two types of conjunction strategies (see Szabolcsi 2015, Mitrović and Sauerland 2014, 2016, Flor et al. 2017b, a): The first type, which we call 'C-conjunctions', is exemplified by English *A and B*, German *A und B* (3a), Czech *A a B* (9a), and Hungarian *A és B* (10a). C-conjunctions exhibit a plural-like behavior, permitting both distributive and cumulative construals. The second type, henceforth 'D-conjunctions', is exemplified by German *sowohl A als auch B* (3c), Czech *A i B* (9b) and Hungarian *A is és B is* (10b). For our purposes, the defining feature of D-conjunctions is that when they occur in subject position, they seem to be solely distributive: The sentences in (3c), (9b) and (10b) are true in the distributive scenarios, but not in the cumulative ones.[6]

(9) a. *Kluk a dívka rozbili dvě okna.*
boy COORD girl broke two windows
'A boy and a girl broke two windows.'
b. *Kluk i dívka rozbili dvě okna.*
boy I girl broke two windows
'A boy and a girl each broke two windows.'

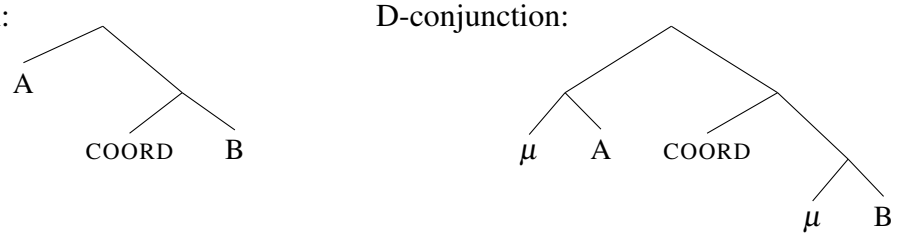
(10) a. *A és B 100 kilót nyomott*
A COORD B 100 kg weighed
'A and B weighed 100 kg.'
b. *A is (és) B is 100 kilót nyomott*
A too COORD B too 100 kg weighed
'A and B each weighed 100 kg.' adapted from Szabolcsi (2015)

[5]This is overly simple as the cumulative construal of (6a) is often taken to be derived from a basic meaning of the predicate *fed* applying only to atomic individuals (Krifka 1986; Beck and Sauerland 2000 a.m.o.).
[6]A language may have more than one strategy of each type; e.g., in addition to the *is* strategy, Hungarian has the D-conjunction pattern *mind A mind B*. See Szabolcsi (2018) for more discussion of this type of syntactic variation.

C-conjunctions are often formally unmarked relative to the D-conjunction strategies in the same language, as illustrated by the Hungarian case in (10): The D-conjunction is obtained by adding the particle *is* to a C-conjunction. While this containment pattern is not universal (e.g., in Czech (9) neither structure is formally marked relative to the other) Flor et al. (2017a, b) point to an implicational generalization strongly suggesting that D-conjunctions universally have a more complex underlying morphosyntactic structure. Simplifying, they observe that whenever one of the two readings is blocked by adding morphology within the coordinate structure, it is the cumulative one, so extra morphology is correlated with the absence of a cumulative construal.

Following Szabolcsi (2015), they derive this from a syntactic containment relation between C-conjunctions and D-conjunctions, as sketched in (11). In Hungarian, the COORD marker present in both structures and the additional D-conjunction markers μ are transparently spelled out (as *és* and *is*, respectively); languages like Czech, where the containment pattern is not transparent, could be accommodated by using the tools of realizational morphology to spell out complex subtrees that contain both μ and COORD (see Flor et al. 2017b; Haslinger et al. 2019).

(11) C-conjunction: D-conjunction:



Flor et al. (2017a, b) argue that this containment relation constrains our choice of semantic analysis: Broadly, there are two approaches to the lexical meaning of COORD in (11). On approach 1, the C-conjunction denotes a classical quantifier (Winter 2001 a.m.o.): Each conjunct is shifted to a generalized quantifier (encoded by ↑ in (12b)) and the meaning of COORD, (12a), applies each of these quantifiers to the predicate the conjunction combines with ([[*fed exactly two cats*]] in (8)). Approach 1 thus takes the distributive construal to reflect the basic meaning. The cumulative construal requires additional operators applying to (12b) (see Winter 2001).

(12) a. $[\![\text{and}]\!] = \lambda\mathscr{P}_{\langle\langle e,t\rangle,t\rangle}.\lambda\mathscr{Q}_{\langle\langle e,t\rangle,t\rangle}.\lambda P_{\langle e,t\rangle}.\mathscr{P}(P) \wedge \mathscr{Q}(P)$

b. $[\![[[\uparrow \text{A}]\ [\text{and}\ [\uparrow \text{B}]]]]\!] = \lambda P_{\langle e,t\rangle}.P(\mathbf{A}) \wedge P(\mathbf{B})$

Approach 2 (13) takes the lexical meaning of COORD to directly encode the plurality-forming operation $\oplus$ (see Link (1983) a.o.). Thus the cumulative construal of (8) would be basic, while the distributive construal would require additional operations like DIST in (7).

(13) a. $[\![\text{and}]\!] = \lambda x_e.\lambda y_e.x \oplus y$

b. $[\![\text{A and B}]\!] = \mathbf{A} \oplus \mathbf{B}$

Flor et al. (2017a, b) take the markedness pattern to support approach 2: COORD cross-linguistically denotes plurality formation. Taking the generalized-quantifier meaning in (12b) to be primitive would wrongly predict that if one of the two readings is systematically associated with more marking, it should be the cumulative one. But their argument faces a problem: If COORD is simply a plurality-forming operator, this leaves the lack of a cumulative reading for D-conjunctions unaccounted for. Most approaches to D-conjunctions appeal to a generalized-quantifier analysis along the lines of (14) (Mitrović and Sauerland 2014, 2016, Szabolcsi 2015[7]).

[7]We gloss over the differences between these proposals.

(14) $[\![\text{sowohl A als auch B}]\!] = \lambda P_{\langle e,t\rangle}.P(\mathbf{A}) \wedge P(\mathbf{B})$

This standard analysis in (14) does not make reference to the plurality $\mathbf{A} \oplus \mathbf{B}$; neither does it involve pluralities of quantifiers. It is thus hard to reconcile with the assumption that COORD expresses plurality formation in both of the structures in (11): If this is the case, why are the plural characteristics of structures with COORD completely lost in D-conjunctions? Put differently: Shouldn't there be a plural 'core' to D-conjunctions as well?[8]

2.3. Q1: Availability of cumulative readings?

Based on anecdotal evidence from German, Hungarian and Polish, Haslinger et al. (2019) argue that we do in fact find reflections of plurality in D-conjunctions and that they are similar to DUs like *every*-DPs: They permit cumulative construals, but only in a restricted set of environments. In German, for example, a cumulative construal for the D-conjunction *sowohl A als auch B* relative to the plural object is blocked in (3c). But in (15b) the same D-conjunction, occurring in object position, permits a cumulative construal relative to the plural subject.

(15) a. CUMULATIVE SCENARIO: Two skiing races took place today. Ada and Bea were the only German participants. Ada competed in the downhill and won. Bea competed in the slalom and won.

b. *Heute haben die zwei Deutschen* ***sowohl die Abfahrt als auch den Slalom***
today have the two Germans PRT the downhill PRT also the slalom
gewonnen!
won
'Today, the two Germans won both the downhill and the slalom.' **true** in (15a)

If such cases exemplified a consistent pattern of cumulative construals for D-conjunctions, this would support the idea that the semantics of COORD in (11) is plural-based (which does not mean that COORD literally denotes the operation $\oplus$; see Haslinger et al. 2019). It would further provide an argument against analyses of D-conjunctions as distributive generalized quantifiers ((14); cf. Mitrović and Sauerland 2014, 2016; Szabolcsi 2015), which do not derive a cumulative construal in any syntactic position. Finally, it would raise a general question: DUs and D-conjunctions are the standard examples of natural-language expressions supposedly denoting non-plural generalized quantifiers. Yet, we already know that DUs exhibit symptoms of plurality. If the same holds for D-conjunctions, one might wonder whether purely distributive DP-quantification exists at all.[9] This motivates our first empirical question, **Q1**:

Q1: Are cumulative readings a stable feature of D-conjunctions?

2.4. Q2: When are cumulative readings available?

A positive answer to **Q1** would raise the question of whether there are deeper analogies between DUs and D-conjunctions (Haslinger et al., 2019). Section 1 showed that DUs only exhibit

[8] See Haslinger et al. (2019) for arguments against the assumption that COORD is ambiguous.
[9] Thomas and Sudo (2016) show English DPs with the determiner *each* also permit cumulative readings.

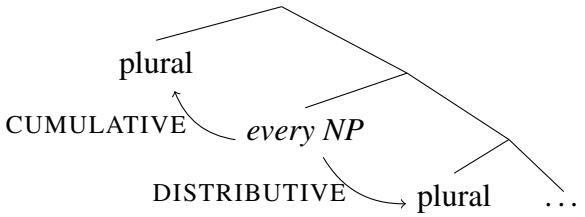


Figure 1: Cumulativity asymmetries

cumulative construals in a restricted set of environments. Most analyses explicitly or implicitly tie the distribution of cumulative construals to the hierarchical relation between the DU and the other plural (Kratzer 2003; Ferreira 2005; Champollion 2010; Haslinger and Schmitt 2018; Chatain to appear), the simplest generalization being that DUs may be cumulative relative to plurals that c-command them at LF, but not relative to plurals they themselves c-command.

Descriptively, this accounts for the asymmetry in (2). The existing compositional semantic analyses derive this asymmetry in different ways, but draw on two shared assumptions. First, predicate expressions containing a plurality-denoting expression, like *fed the two cats*, do not denote simple predicates of (possibly plural) individuals, but rather predicates of pluralities of 'complex' objects[10]: In event-based accounts (Kratzer 2003; Ferreira 2005; Chatain to appear), we obtain predicates of plural events, (16a); on the 'plural projection' approach (Haslinger and Schmitt, 2018), predicates of pluralities of higher-type objects, like properties in (16b) (with Ivo and Joe the only salient cats). Cumulativity arises if such a predicate of pluralities of complex objects combines with another plurality, e.g., the sum individual denoted by *the two girls*.[11]

(16) a. $[\![\textit{fed the two cats}]\!] \approx \{e_1 \oplus e_2 \mid \mathbf{feed}(\mathbf{Ivo})(e_1) \wedge \mathbf{feed}(\mathbf{Joe})(e_2)\}$
b. $[\![\textit{fed the two cats}]\!] \approx \{\lambda w_s.\lambda x_e.\mathbf{feed}_w(\mathbf{Ivo}) \oplus \lambda w_s.\lambda x_e.\mathbf{feed}_w(\mathbf{Joe})\}$

The second assumption is that DUs denote functions taking such predicates of complex pluralities as their arguments. They match each of the atomic individuals in their restrictor with one of the complex pluralities (of events or properties), so that *every* will always be distributive relative to its nuclear scope. The crucial difference from the generalized-quantifier account is that the result of composing a DU denotation with its scope is again a predicate of pluralities (of events or properties/propositions). It is thus of the right type to be able to cumulate with hierarchically higher plurals. The schematized LF in Figure 1 illustrates these predictions.

Now, if D-conjunctions are like DUs in that they combine with a predicate of pluralities of complex objects (events or properties), they should exhibit the same structural asymmetry: They should require a distributive construal relative to hierarchically lower plurals, but permit a cumulative construal relative to higher plurals. This predicts, for example, that the D-conjunction in subject position in (17a) should only have a distributive construal. In contrast, with the D-conjunction in object position as in (17b), a cumulative construal should be available (cf. (2)).

[10]We use 'complex' in a pre-theoretical, non-technical way here; in particular, we do not want to suggest that predicates of plural events have a more complex type than predicates of plural individuals.
[11]While the two types of proposals (events vs. plural projection) differ on the compositional details needed to derive this result, these differences are irrelevant for our present purposes. See the papers cited above for discussion.

(17) a. *Am Wochenende haben* ***sowohl der Sohn als auch der Vater*** *die zwei Bäume gefällt.*
on.the weekend have.PL as.well the.NOM son as also the.NOM father the two trees felled
'Last weekend, both the son and the father cut down the two trees.'

b. *Am Wochenende haben die zwei Nachbarn* ***sowohl die Eiche als auch die Fichte*** *gefällt.*
on.the weekend have.PL the two neighbors as.well the oak as also the spruce felled
'Last weekend, the two neighbors cut down both the oak and the spruce.'

A further prediction is that a cumulative construal for a D-conjunction relative to another plural should be blocked by movement of the D-conjunction across the other plural. For instance, (18a) is a passivized version of (17) in which the D-conjunction ends up in subject position, c-commanding the definite. If the surface c-command relation in (18a) reflects the LF configuration, the cumulative reading should be unavailable. The same holds for (18b), where the D-conjunction in object position has been topicalized and therefore c-commands the subject.[12]

(18) a. *Am Wochenende sind* ***sowohl die Eiche als auch die Fichte*** *von den zwei Nachbarn gefällt worden.*
on.the weekend AUX.PL as.well the oak as also the spruce by the two neighbors felled been
'Last weekend, both the oak and the spruce were cut down by the two neighbors.'

b. ***Sowohl die Eiche als auch die Fichte*** *haben die zwei Nachbarn am Wochenende gefällt.*
as.well the oak as also the spruce have.PL the two men on.the weekend felled
'Both the oak and the spruce, the two neighbors cut down last weekend.'

Our empirical question **Q2** targets these predictions. An answer to **Q2** will have direct consequences for the hierarchical view of cumulativity asymmetries, but also bear on the question to what extent the elements usually assumed to denote distributive generalized quantifiers – DUs and D-conjunctions – form a natural class once their plural-like behavior is taken into account.

Q2: Which syntactic configurations permit cumulative construals of D-conjunctions?

2.5. Q3: Effect of morphological make-up?

As indicated in Section 2.2, D-conjunctions tend to be syntactically more complex than C-conjunctions crosslinguistically. Regardless of whether they transparently contain the C-conjunction marker (as in Hungarian, (10)) or not (as in German, (3a)/(3c)), D-conjunctions often exhibit morphosyntactic parts that are also found, with other semantic functions, in contexts other than conjunctions (see e.g. Mitrović and Sauerland 2014, Szabolcsi 2015, 2018 for dis-

[12] It is unclear if movement ever has an effect in the other direction, i.e. if moving a plural across a D-conjunction can make a cumulative reading available. Chatain (to appear) argues that this does not hold for *every*-DPs: Otherwise a cumulative reading for an English *every*-DP in subject position should be derivable via covert QR.

cussion). Take Czech: The marker *i* found in D-conjunctions (but not in C-conjunctions, see (9a) vs. (9b)) also has another use, illustrated in (19), as a focus-sensitive particle with scalar inferences (Dočekal and Šafratová 2019). In contrast, German D-conjunctions, *sowohl A als auch B* (see (3c)) contain the marker *auch*, which also occurs as an additive particle, (20a). Further, the element ***so**-wohl* (lit. '**as**-well') contains a particle used in equative marking, (20b).

(19) *Rýže v ledničce vydrží i tři dny.*
rice.NOM.SG in fridge.LOC.SG last.PRS.3SG even three day.ACC.PL
'Rice even lasts three days in the fridge.' (Dočekal and Šafratová, 2019: 260, (14-a))

(20) a. *Ada ist müde. Bea ist **auch** müde.*
Ada is tired. Bea is also tired
b. *Ada ist **so** müde wie Bea.*
Ada is as tired like Bea
'Ada is as tired as Bea.'

Given the possibility that D-conjunctions sometimes allow for cumulative construals, this variation raises a new question: Morphemes with different functions in other contexts (e.g., Czech *i* vs. German *so*) could have a different semantic impact on the D-conjunctions they occur in. Do these potential differences affect the availability of cumulative readings and the contexts where they occur? For example, do D-conjunctions using equative morphology (as in German) permit cumulative construals more easily than D-conjunctions using scalar particles (as in Czech)?

It is not obvious that we should expect such differences: On some proposals (including the otherwise very different analyses in Mitrović and Sauerland 2016 and Haslinger et al. 2019), the main function of the additional morphemes in D-conjunctions is to shift the conjunct denotations to a t-based type.[13] This higher type is needed to derive their obligatorily distributive interpretation relative to lower plurals. Such accounts thus lead us to expect that the feature qualifying a particle for occurring in a D-conjunction might be something as abstract as its type; other semantic contributions of the particle might affect the meaning of the construction as a whole, but not the availability of cumulative or distributive construals. To our knowledge, the predictions of this idea have not been studied, which motivates our empirical question **Q3**.

Q3: Do differences in the morphological makeup of D-conjunctions correlate with the availability of / restrictions on cumulative construals?

While a negative answer to **Q3** would be compatible with the type-shifting proposals just discussed, a positive one would indicate that further research on the correlation between the kinds of particles occurring in D-conjunctions and the availability of cumulative construals is needed.

3. Experiment

This section summarizes the results of two experiments, one conducted with Czech speakers, the other with German speakers. While the experiments were designed to address **Q1** and **Q2**, we expected that comparing the results for the two languages could be informative for **Q3**.

[13] Haslinger et al. (2019) take the items labeled μ in (11) to denote the operation symbolized by $\uparrow$ in (9b) (=the function $\lambda x_e.\lambda P_{\langle e,t\rangle}.P(x)$), while Mitrović and Sauerland (2016) basically divide the workload of this operation between two morphemes, one of which would correspond to the overt additional material we find in D-conjunctions.

3.1. Methods and predictions

The experiments were completed by 38 Czech-speaking participants (university students in Brno) and 48 German-speaking participants (university students in Vienna). All the participants were self-identified native speakers of Czech and German, respectively, and received course credit for their participation. Both experiments were run online on IBEX Farm.

The experiments involved four conditions, `subj`, `obj`, `pass` and `topic`, illustrated in (21) for Czech and (17)/(18) for German. Conditions `subj` and `obj` target the subject/object cumulativity asymmetry attested for DUs; `pass` and `topic` target the question of whether moving a D-conjunction across another plural α blocks a cumulative reading wrt. α. We included A-movement (`pass`) and A′-movement (`topic`) to check if movement types with potentially different reconstruction options interact differently with cumulativity.

(21) a. *Karel i Jakub vyfotili dvě herečky.*
Karel.NOM I Jakub.NOM photographed two.ACC actresses.ACC
'Karel and Jakub photographed two actresses.' `subj`

b. *Dva novináři vyfotili Simonu i Kamilu.*
two.NOM journalists.NOM photographed Simona.ACC I Kamila.ACC
'Two journalists photographed Simona and Kamila.' `obj`

c. *Na večírku byly Simona i Kamila vyfoceny dvěma novináři.*
at party were.3PL Simona.NOM I Kamila.NOM photograph.PASS two.INSTR journalists.INSTR
'At the party Simona and Kamila were photographed by two journalists.' `pass`

d. *Simonu i Kamilu dva novináři vyfotili až po půlnoci.*
Simona.ACC I Kamila.ACC two.NOM journalists.NOM photographed only after midnight
'Simona and Kamila, two journalists photographed only after midnight.' `topic`

The experiment used a version of the SCT. In each item, participants were presented with two pictures. They were then shown a sentence of the kind illustrated in (21), preceded by a context, and had to decide which, if any, of the pictures was described by the sentence. Three possible answers for the question 'Which of the images fits the sentence?' (in Czech and German) were provided: 'left', 'right', 'neither'. Participants were thus not forced to select one of the pictures. We chose this task as our aim was to test which construals are available at all in a given syntactic configurations, abstracting away from potential preferences for the cumulative over the distributive construal or *vice versa*.

(22) provides an example sentence with an actual context from the Czech part. It was presented with the pictures in Figure 2. Half of the items involved a 'cumulative picture', with a scenario making the sentence true under the cumulative construal (but false under the distributive construal), and an 'inadequate picture' with a scenario making it false under both a distributive and a cumulative construal. This is shown for the context and target sentence in (22), from the `obj` condition: The inadequate picture is on the left in Figure 2, the cumulative one on the right.

(22) CONTEXT: Last weekend the two neighbors, father and son, went to the garden behind the house to cut down the old trees and plant new trees in their place. One oak and one spruce were especially old and were supposed to be cut down.
SENTENCE: *Dva muži pokáceli dub i smrk.*
two men cut-down.3PL oak.ACC I spruce.ACC
'Two men cut down an oak and a spruce.'

Figure 2: Sample item: cumulative construal, `obj` condition

Since we were also interested in testing whether participants accessed the distributive reading, the other half of the items involved a 'distributive picture' with a scenario making the sentence true on a distributive construal (left in Figure 3) and an 'inadequate picture' (right in Figure 3).

Figure 3: Sample item: distributive construal, `pass` condition

(23) CONTEXT: Last weekend, a DIY fair took place at the exhibition center, at which competitions were held. At one competition, the task was to produce a wooden product in 6 hours. A jury evaluated the most beautiful products. Competitors could submit any number of products to the jury, but products that were not completed within the given time limit were not considered by the jury. Teams and individuals could take part in the competition.
SENTENCE: *Na veletrhu byly židle i ptačí budka vyrobeny*
at fair were.3PL chair.NOM I bird house.NOM made.PASS
dvěma soutěžícími.
two.INSTR competitors.INSTR
'At the fair the chair and the birdhouse were made by two competitors.'

The distributive and the cumulative part each consisted of 8 items per condition. From these, 4 lists were created following a Latin-square design; each item was presented only in one condition per list. Each participant saw two distributive and two cumulative items per condition. As the predicates used in the distributive and the cumulative items were different, the acceptance

rates for the distributive and cumulative items in the same condition cannot be directly compared and we cannot exclude a potential effect of the different predicates on the results for the two parts. We will thus report separate analyses for the distributive and the cumulative part.

Given the hypothesis (see Section 2) that D-conjunctions display a subject/object asymmetry wrt. the availability of a cumulative reading, we expected a higher acceptance rate for the cumulative picture in the `obj` condition, compared to the reference level `subj` condition. Regarding the `pass` and `topic` condition (see Section 2), we expected that if a D-conjunction outscopes another plural, the availability of the cumulative reading should decrease relative to the `obj` condition. For the distributive pictures we expected high acceptance rates in all conditions.

In addition to the 16 real items per list, we created fillers which used Czech/German correlates of binominal *each* and the determiner *every*, in the same task. Half of the fillers were designed to get participants to select one of the pictures, the other half to evoke the 'neither' answer. Each participant saw 16 real items and 16 fillers. The order of the items and fillers was randomized; in total, each participant rated 32 stimuli. 4 Czech-speaking and 1 German-speaking participant were excluded due to poor scores ($<$ 75% correct) on the fillers. We thus used the data from 34 Czech speakers and from 47 German speakers in the subsequent analysis.

3.2. Results

The descriptive statistics are shown in Figure 4 for Czech and in Figure 5 for German. Graph A represents the results for the distributive part of the experiment, graph B the results for the cumulative part. We coded the individual answers as 1 if the participant selected the 'distributive picture' (in graph A) or 'cumulative picture' (in graph B), reflecting the availability of the reading in question, and as 0 if they selected the 'inadequate picture' or chose the 'neither' option. The dependent variable represented on the *y*-axis is the proportion of responses coded as 1, i.e. the acceptance rate for the sentences in the distributive/cumulative scenarios.

It is obvious that the results for both languages are very similar, and that the expected subject-object asymmetry in the cumulative items is confirmed: The acceptance rate was much higher for `obj` than for `subj`. Strikingly, the distributive items showed the reverse asymmetry, rather than consistently high acceptance rates.

We analyzed the data via mixed-effects logistic models with subject and item random effects. The analysis was carried out in R (R Core Team, 2020) using the package LME4 (Bates et al., 2015). We constructed separate models for the cumulative and distributive parts, using `subj` as the reference level condition in both models. The dependent variable was always the participants' response (coded as 1 or 0 as described above). The independent (explanatory) variable was the factor `condition` with four levels.

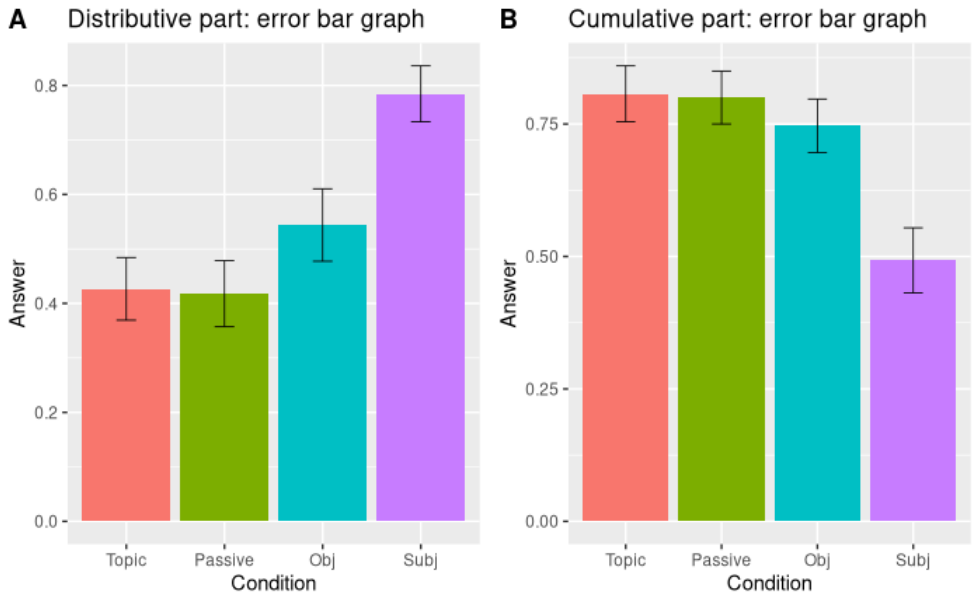


Figure 4: Acceptance rates from the Czech experiment

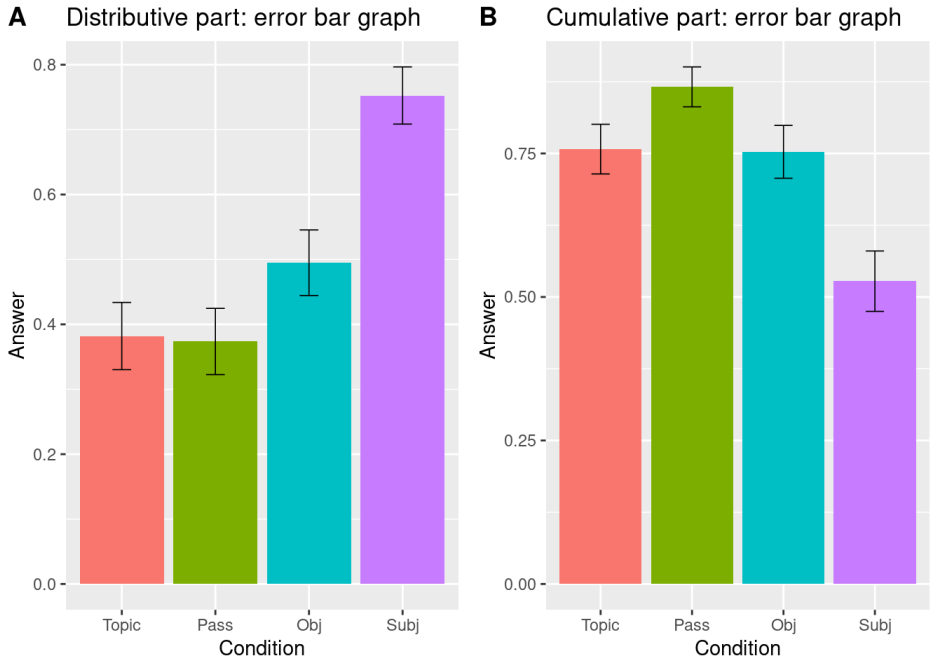


Figure 5: Acceptance rates from the German experiment

We first summarize the results of the distributive part. As Figures 4 and 5 show, the distributive picture gave rise to high acceptance rates when the D-conjunction appeared in the subject position (`subj`); in all other conditions, the acceptability decreased. The effects against the reference level `subj` condition are robust in both languages: with a distributive picture, the target sentences were accepted less often (i) in the `obj` condition (Czech: $\beta = -1.54, z = -2.89, p < 0.01$, German: $\beta = -1.68, z = -4.26, p < 0.001$), (ii) in the `pass` condition (Czech: $\beta = -2.51, z = -4.47, p < 0.001$, German: $\beta = -2.55, z = -5.67, p < 0.001$) and (iii) in the `topic` condition (Czech: $\beta = -2.57, z = -4.80, p < 0.001$, German: $\beta = -2.30, z = -5.39, p < 0.001$). The results are confirmed by Tukey's pairwise comparison of conditions (using the R package EMMEANS; Lenth 2021). In both languages, `subj` significantly differed from all three other conditions ($p = 0.02$ and below) but no pair of `obj,pass,topic` differed significantly in either language. In sum, `subj` clearly contrasts with the other three conditions concerning the acceptability of the distributive construal of D-conjunctions.

In the cumulative part of the experiment, we also found a strong effect, in the other direction, between the reference level `subj` and all other conditions. These effects were again consistent across both languages, as is visible from the standard error bar graphs B in Figures 4 and 5. The pattern from the distributive part of the experiment was reversed. Given a cumulative picture, the target sentences in the `subj` condition with the D-conjunction in subject position were accepted less often compared to: (i) `obj`, with the D-conjunction *in situ* in object position (Czech: $\beta = 1.12, z = 2.86, p < 0.01$, German: $\beta = 1.30, z = 3.51, p < 0.001$); (ii) `pass` with the D-conjunction in the subject position of a passive sentence (Czech: $\beta = 1.44, z = 3.29, p < 0.01$, German $\beta = 2.14, z = 5.18, p < 0.001$); and (iii) `topic` with the D-conjunctions in topicalized position (Czech: $\beta = 1.65, z = 3.58, p < 0.001$, German $\beta = 1.33, z = 3.65, p < 0.001$). The effects of the model are confirmed by Tukey's pairwise comparison of conditions: again, only the reference level, `subj`, differs significantly from the three other conditions. The three conditions `obj, pass` and `topic` don't differ significantly from each other in either language.

4. Discussion

While the experimental results provide clear answers to some of our research questions, some of the results are puzzling for all accounts of cumulativity asymmetries. We will now first relate the results to our questions **Q1**–**Q3** and then address two new puzzles raised by the findings.

4.1. Relating the results to our research questions

Both experiments support a positive answer to **Q1: Are cumulative readings a stable feature of D-conjunctions?** In both languages, we found high acceptance rates with the cumulative picture (around 75% or higher) and decreased acceptance rates with the distributive picture in the conditions `obj, pass` and `topic`. Only the reference condition `subj` showed a higher acceptance rate for the distributive picture, and a decreased acceptance rate for the cumulative one, compared to the other three conditions. While the data on D-conjunctions in subject position are compatible with the standard assumption that distributivity is among the meaning components of D-conjunctions, the high acceptance rates for a cumulative construal in the other three con-

ditions are problematic for analyses of D-conjunctions as distributive generalized quantifiers, which do not generate a cumulative construal in any syntactic position. Further, the results are compatible with our speculation in Section 2.3 that the generalized-quantifier semantics might be inadequate for DPs with universal quantificational force in general.

But one data point is surprising for all accounts of D-conjunctions: The acceptance rate for a cumulative construal in the `subj` condition, was around 50%, much higher than it should be if cumulative readings for D-conjunctions in subject position were categorically blocked. This is **Puzzle 1**: Why was the acceptance rate for cumulative scenarios so high in the `subj`-condition?

This high acceptance rate might suggest that D-conjunctions have simple plural denotations like C-conjunctions. But this would not explain the clear subject-object asymmetry found in both languages.[14] This contrast between `subj` and the other conditions leads us to **Q2: Which syntactic configurations permit cumulative construals of D-conjunctions?**

The cumulative part of the experiments confirms that the subject-object asymmetry found for cumulative readings of DUs extends to D-conjunctions, as claimed by Haslinger et al. (2019). Yet, the other predictions of the compositional analysis in Haslinger et al. (2019) were not confirmed: The acceptability boost in the `obj` condition relative to the `subj` condition extended to the conditions `pass` and `topic`, where the object was moved to a position c-commanding the subject. At first sight, this suggests that movement of a D-conjunction across another plural does not block a cumulative interpretation, thus contradicting the generalization that the interpretation of a D-conjunction relative to another plural is determined by the LF c-command relation between them (Haslinger et al. 2019, but also potential extensions of accounts of *every*-DPs). So our **Puzzle 2** is: Why didn't movement affect the availability of cumulative readings?

Finally, our results do not support a positive answer to **Q3: Do differences in the morphological makeup of D-conjunctions correlate with the availability of restrictions on cumulative construals?** Czech and German D-conjunctions are morphologically very different, but the results of the two experiments are nearly uniform: We see a strong tendency for participants in both experiments to accept a cumulative interpretation in conditions `obj`, `pass` and `topic`, while its acceptability was lower (and that of a distributive interpretation higher) in the reference level condition, `subj`. Data from more languages are needed but our results are compatible with the accounts addressed in Section 2.5 which connect distributivity to the semantic type, and not the exact denotation, of the additional particles in D-conjunctions.

4.2. Two puzzles and potential task-based explanations

We conclude by sketching potential explanations for Puzzles 1 and 2 and ways of testing them.

Puzzle 1 concerned the fact that even the `subj` condition was not consistently rejected in cumulative scenarios. Two potential explanations are compatible with a cumulativity asymmetry for D-conjunctions, along the lines of Haslinger et al. (2019) and most previous work on DUs. First, we could attribute the high acceptability to independent semantic properties of some of

[14] Unless we appeal to general disambiguation strategies rather than compositional semantics of D-conjunctions. Above, we take the asymmetry to be semantic. This makes a prediction we have yet to test: An experiment with C-conjunctions (German *A und B*, Czech *A a B*) using the same task should not yield a comparable asymmetry.

the experimental sentences. One relevant such property, at least in German, are non-maximal construals of plural definites. In the German experiment, we intentionally combined the D-conjunction with a definite plural in half of the items and an indefinite plural in the other half. Thus, half of the target sentences for the `subj` condition were of the following form:

(24) *Gestern haben sowohl der Karl als auch der Jakob* ***die zwei*** ***Schauspieler*** *fotografiert.*
yesterday AUX.PL as.well the.NOM Karl as also the.NOM Jakob the two actors photographed
'Yesterday, both Karl and Jakob photographed the two actors.'

In some contexts, definite plurals permit **non-maximal** construals: A predicate can count as true of a plurality even if it does not hold of all of its atomic parts (Brisson 1998; Malamud 2012; Križ 2015, 2016 a.o.). If this option is available for the definite in (24), then in the right context, (24) could be accepted as true in a scenario in which Karl and Jakob *each* photographed *at least one* of the two actors. This weaker interpretation would be independent of cumulativity.

But this explanation faces two problems: First, the crucial sentences involved numerals, which have been claimed to block non-maximal construals (see e.g. Križ 2015). Second, the basic pattern for the `subj` condition was the same in German and Czech. Yet Czech lacks definite articles and it is a matter of debate if bare plurals in Slavic languages sometimes exhibit semantic traits of definites (see e.g. Šimík and Demian 2020 on Russian). In particular, it is not known whether Czech bare plurals exhibit the pragmatic effects associated with non-maximality. The uniformity of our findings across the two languages thus casts doubt on this explanation. However, it makes a testable prediction: In German, the acceptance rate for the `subj` condition in the cumulative scenario should decrease if only items with (numeral-modified) indefinites were used, as indefinites do not exhibit non-maximality effects. While our experiment did not control for this aspect, a cursory glance at the results is at least compatible with this prediction.

Yet the high acceptance rate in the `subj` condition could also reflect a bias inherent in the experimental design.[15] As discussed in Section 3.1, we did not use a forced-choice paradigm: participants were given the option of rejecting both of the scenarios presented. Yet, only half of the fillers were designed to evoke answers of this type, and most of the experimental sentences were expected to be acceptable in one of the scenarios given our hypotheses. This lack of balance between 'neither'-answers and the other two choices, together with the fact that the fillers were chosen to evoke a clear-cut unacceptability judgment, could have pushed participants to select the less odd of two unacceptable scenarios, rather than rejecting them both, when faced with a more subtle source of unacceptability. If this is on the right track, we would expect the acceptance rate for the `subj` condition in cumulative scenarios to decrease if the fillers and the instructions were modified to counteract a potential pressure to select one of the two pictures.

Such unintended consequences of using a SCT rather than a TVJT might also underlie **Puzzle 2**, i.e., that passivization and topicalization did not affect the availability of cumulative readings.

Taken at face value, this result suggests that the subject/object cumulativity asymmetry for D-conjunctions is driven by a thematic-role hierarchy, rather than c-command.[16] But this would

[15] We would like to thank the audience at SinFonIJA 14 for pointing this out to us.

[16] Much of the literature on *every*-DPs appeals to thematic-role asymmetries (e.g. Kratzer 2003; Chatain to appear).

be surprising in light of the data on DUs in German: A questionnaire study on German *jeder* in Haslinger and Schmitt (2022) found that a cumulative reading relative to a higher plural, as in (25a), becomes less acceptable if the *jeder*-DP is scrambled across the other plural (25b).

(25) a. *Gestern haben zwei Jäger jeden Hirsch in diesem Wald*
yesterday have two.NOM hunters.NOM every.ACC stag.ACC in this forest
erschossen.
shot
'Yesterday, two hunters shot every stag in this forest.'
b. *Gestern haben [jeden Hirsch in diesem Wald]$_i$ zwei Jäger t_i erschossen.*

Given that Haslinger and Schmitt (2022) studied German scrambling, which has been claimed to be less prone to scope reconstruction than topicalization (but see Frey 1993; Wurmbrand 2008 a.o.), the reason why we did not find effects of movement might not be the use of D-conjunctions instead of DUs, but rather the use of topicalization and passivization instead of scrambling. This would predict that if the German experiment were repeated with scrambling, sentences with the D-conjunction in object position scrambled across the subject should pattern with the `subj` rather than the `obj` condition. But while a contrast between movement types may well be part of the explanation, it does not solve the puzzle entirely: Given a distributive construal of the relevant quantifiers, neither movement to the passive subject position nor topicalization in German and Czech involves *obligatory* reconstruction. We would thus expect at least some participants to access an LF without reconstruction, which raises the question why there was not even a slight contrast between `obj` and `pass/topic` in the expected direction.

The absence of this contrast could again be due to our experimental task. D-conjunctions are usually described as purely distributive, suggesting their cumulative construals are dispreferred. We thus used the SCT, which is designed to reveal dispreferred readings (Lohiniva and Panizza, 2016). But by the same token, our task could have obscured potential effects of movement: Since topicalized phrases can in principle reconstruct, the German sentence in (26a) from the `topic` condition arguably has the alternative LF in (26b), with the plural c-commanding the D-conjunction as in the `obj` condition. Even if this LF is strongly dispreferred, the SCT should bring it out if it is the only interpretation under which the sentence matches one of the pictures.

(26) a. ***[Sowohl die Eiche als auch die Fichte]** haben die zwei Nachbarn am*
as.well the oak as also the spruce have.PL the two men on.the
Wochenende t_1 gefällt.
weekend felled
'Both the oak and the spruce, the two neighbors cut down last weekend.'
b. *die zwei Nachbarn am Wochenende [sowohl die Eiche als auch die Fichte] gefällt haben*

This alternative explanation would make our findings compatible with the c-command view of cumulativity asymmetries; further, it does not depend on grammatical differences between movement types, or between DUs and D-conjunctions. The effect of scrambling found by Haslinger and Schmitt (2022) might then be due to their use of graded truth-value judgments

But the compositional analyses of this type seem to assume a mapping of thematic roles to certain structural positions; further, once extended to movement, they predict that movement of an *every*-DP can block a cumulative reading (Chatain, to appear). They are thus not direct implementations of the generalization suggested above.

rather than a choice task. More generally, this explanation predicts a contrast between the `topic/pass` conditions and the `obj` condition to emerge once a different task is used, e.g., graded truth-value judgments relative to a cumulative scenario. If this is borne out, our findings might hold a general lesson for experimental work on the possible readings of plural constructions: The TVJT would let us detect subtle differences in acceptability between readings, but blur categorical distinctions between readings that are grammatically blocked and those that are merely dispreferred. The SCT would bring out dispreferred, weaker readings, but would obscure the conditions under which a certain preferred, stronger LF is available. Combining both tasks (with the same experimental sentences) might thus be the most informative approach.

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