Linking scope, exhaustivity and ignorance

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Abstract. This paper accounts for a link between scope and epistemic effects of $-$*hari* marked disjunctions/indefinites in Sinhala (Indo Aryan, Sri Lanka) with respect to DPs carrying universal quantificational force. It proposes to derive the wide/narrow scope and related epistemic effects as implicatures by way of exhaustification with respect to alternatives associated with a disjunction/indefinite. A doxastic and an exhaustivity operator placed in the syntactic structure of a $-$*hari* disjunction/indefinite construction serve in deriving the implicatures, following the grammatical approach to derivation of implicatures (cf. Fox, 2007; Chierchia et al., 2012; Meyer, 2013; Nicolae, 2017, a.m.o.).

Keywords: disjunction, indefinites, scope, exhaustivity, ignorance.

1. Introduction

A Sinhala (Indo-Aryan, Sri Lanka) disjunction/indefinte formed with the particle *-hari* can receive a wide or narrow scope (WS/NS) interpretation with respect to a universal quantifier of a DP as seen in (1). Crucially, different types of epistemic implicatures/inferences (EIs) are also generated relative to the differences in the scope configurations as shown in (1).[2]

(1) a. hæmə lamə-ek-mə Giita-hari Maala-hari hamuuna.
every student-INDF-EMP Giita-hari Maala-hari met
" Every student met Giita or Maala."

b. hæmə lamə-ek-mə kaawə-hari hamuuna.
every student-INDF-EMP wh-hari met
" Every student met somebody."

WS READING: Every student met either Giita or Maala/somebody (-hari/somebody $>$ $\forall$).
EI: The speaker does not know who.

NS READING: Every student met at least one of Giita or Maala/somebody ($\forall$ $>$ -hari/somebody).
EI: The speaker may know who met who.

Thus, when the *-hari* disjunction/indefinite is interpreted with a wide scope effect with respect to the universal quantifier, it gives rise to ignorance implicatures. These ignorance implicatures can disappear when the disjunction/indefinite is interpreted with a narrow scope effect. Observations somewhat similar to those in (1) are found in Fox (2007) for English *or* disjunction, Alonso-Ovalle and Shimoyama (2014) for Japanese *wh-ka* indefinites, Nicolae (2017) for French *ou* disjunction and Alonso-Ovalle and Menéndez-Benito (2017) for Spanish *algún* indefinites. However, as discussed in Section 3, the previous accounts on independent grounds do not establish a clear link between wide/narrow scope effects of disjunction or indefinites and generation/obviation of ignorance inferences.

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[2]I use the terms implicatures and inferences interchangeably in this paper to mean the same.

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This paper, drawing insights from previous accounts, claims that the relation between the scope and ignorance inferences can be accounted for based on the differences in the scope of an exhaustivity operator with respect to a doxastic operator assumed to take scope over a disjunction/indefinite sentence. This characterization, however, runs into a complication as a Fox defined exhaustivity operator (*Exh*: cf. Fox, 2007) on a Sauerland defined set of alternatives (cf. Sauerland, 2004) falls short of deriving the exhaustivity implicatures akin to wide scope effects. It shows that a Fox defined *Exh* operating on a set including a subset of alternatives closed under conjunction can derive a strong exlusivity implicature akin to the wide scope effects (inspired by Spector, 2016). The paper is organized in the following manner. Section 2 offers descriptive facts pertaining to the formation of disjunctions and indefinites with the particle *-hari*. Section 3 discusses a sample of previous accounts and their implications for the proposal in this paper. Section 4 presents the proposal. Section 5 provides a summary and conclusion.

2. Disjunctions and indefinites with *-hari* in Sinhala

The particle *-hari* is used to form both disjunctions and indefinites in Sinhala. Following are some relevant descriptive facts of the formation of disjunctions/indefinites with the particle *-hari*.

2.1. Disjunctions with *-hari*

Disjunctions with *-hari* are formed with the particle *-hari* combining disjuncts (or individual alternatives) as shown in the example in (2).[3]

(2) John Giita-hari Maala-hari hamu-un-a.
John Giita-hari Maala-hari meet-PAST-A
"John met Giita or Maala."

Thus, the particle *-hari* attached to alternatives forms disjunctions in Sinhala.

2.2. Indefinites with and without *-hari*

Indefinites in Sinhala are formed as plain indefinites, wh-indefinites and complex indefinites as discussed in the following sections.

2.2.1. Plain indefinites (i.e. indefinites without *-hari*)

Plain indefinites in Sinhala are formed by adding the particle *-ek/ak* to a noun root as seen in the example in (3).

(3) John guruwəriy-ak bænda.
John teacher-INDF married
"John married a teacher."

Plain indefinites are different from *-hari* indefinites as shown next.

[3]Combining alternatives with the particle *-hari* is only one way to form disjunctions in colloquial Sinhala. Sinhala also makes use of the particle *-də* to form disjunctions in a similar fashion in colloquial Sinhala. Formal Sinhala makes use of the item *ho* to form disjunctions. See Weerasooriya (2019) for more details. This paper only focuses on the disjunctions formed with the particle *-hari* and a discussion of other disjunctions under the scope of a universal quantifier is left for future research.

2.2.2. Indefinites with *-hari*

Indefinites similar to indefinite pronouns can be formed by adding the particle *-hari* to a wh-word (or indeterminate pronouns (IDPs): cf. Kuroda,1965; Kratzer and Shimoyama, 2002) as shown in (4).[4]

(4) John monəwa-hari kanəw-a.
John what-hari eat-A
"John is eating something."

Thus, indefinite pronouns make use of the particle *-hari* attached to wh-words (IDPs).

2.2.3. Complex indefinites with *-hari*

The particles *-hari* attached to wh-words can also be used with plain indefinites like *kell-ek* 'a girl' to form complex indefinites like *kaawə-hari kell-ek* 'some girl'.

(5) John kaaw-hari kell-ek hamu-una.
John who-hari girl-INDF meet-PAST
"John met some girl."

Thus, the particle *-hari* attached to IDPs can be combined with plain indefinites to form complex indefinites.

The particle *-hari* is also a positive polarity item (PPI). This is discussed next.

2.3. The particle *-hari* as a PPI

Disjunctions or indefinites formed with the particle *-hari* can not be interpreted under clause-mate (immediate scope of) negation as illustrated in (6).

(6) a. John Gita-hari Mala-hari dækk-e næ.
John Gita-hari Mala-hari saw-E not
"John did not see Gita or he did not see Mala. or > not
(This would be true in a context where John saw exactly one of Gita or Mala, but he is not sure which one he did not see. Thus, not>or (i.e. *John did not see any of them*) is ruled out.)

b. John kaawə-hari dækk-e næ.
John who-hari saw-E not
"John did not see somebody." somebody > not
(This would be true in a context where John did see someone, but he did not see some particular one. Thus, not>someone (i.e. *John did not see anyone*) is ruled out.)

c. John kaawə-hari kelle-ek dækk-e næ.
John who-hari a-girl saw-E not
"John did not see some girl." some girl > not
(This would be true in a context where John did see some girl, but he did not see

[4]This paper focuses only on the indefinites marked with the particle *-hari*. Indefinites are also formed with the particle *-də* in the same manner. See Weerasooriya (2019) for more details. An analysis of indefinites formed with the particle *-də* is beyond the scope of this page and is left for future research.

some particular girl. Thus, not>some girl (i.e. *John did not see any girl*) is ruled out.)

Thus, *-hari* is a PPI. (This analysis was mainly motivated by the analysis of French *soit – soit* as a PPI in Spector, 2014).[5]

The PP behavior of *-hari* is crucial in accounting for the wide scope effects and ignorance inferences as well as the differences with respect to the scope and ignorance effects as discussed in Section 4.

3. Implications from previous accounts

Scalar/scope and epistemic effects of disjunction/indefinites with respect to DPs with universal quantificational force have received much attention in the recent literature (Fox, 2007; Alonso-Ovalle and Shimoyama, 2014; Nicolae, 2017; Alonso-Ovalle and Menéndez-Benito, 2017). In the following, I review this sample of accounts to draw insights from some of the general implications associated with disjunction/indefinite scope cross-linguistically.

3.1. Fox 2007

Fox (2007) shows that the disjunction *or* under a universal quantifier in English gives rise to scalar inferences as in (7).

(7) Every friend of mine has a boyfriend or a girlfriend.
Implicatures:
a. It is not true that every friend of mine has a boyfriend.
b. It is not true that every friend of mine has a girlfriend.

Fox accounts for such scalar and related ignorance inferences in (7) based on a Sauerland-defined set of alternatives and procedure (as conversational implicatures). For instance, Sauerland (2004) argues that the set of alternatives of a disjunction is formed of individual disjuncts as well as the conjunction, which can be represented as in (8).

(8) $Alt\ (p \vee q) = \{\ p \vee q, p, q, p \wedge q\}$

Sauerland (2004) in his Neo-Gricean approach to implicature calculation employs a knowledge or belief operator which he dubs as κ to derive ignorance as well as scalar implicatures in terms of primary and secondary implicatures. Following Sauerland, Fox derives the scalar and related ignorance inferences as primary and secondary implicatures with a belief operator as in (9).

(9) $\forall$x (P(x)) $\vee$ Q(x))
PRIMARY IMPLICATURES: $\neg B_s$ ($\forall$x P(x)), $\neg B_s$ ($\forall$x Q(x)) ($\neg B_s$ $\forall$x (P(x)) $\wedge$ Q(x)), follows)
SECONDARY IMPLICATURES: B_s ($\neg$ $\forall$x P(x)), B_s ($\neg$ $\forall$x Q(x)) (B_s $\neg$ $\forall$x (P(x)) $\wedge$ Q(x)), follows)

However, Fox does not discuss the relationship between scope effects and ignorance inferences.

[5] A reviewer asks whether there is a particular prosody/focus associated with *-hari* sentences in these negative contexts as English *or* serves to disambiguate scope when it is stressed. This does not hold for *-hari*. The PP character is a lexical property of *-hari*.

Neither does Fox discuss the implications associated with obviation of ignorance inferences. Fox's (2007) primary interest is in deriving the free-choice implicatures of a disjunction in the scope of a possibility modal such as *may* as in the example in (10).

(10) You may eat the cake or the ice-cream.

Fox proposes to derive the free-choice effects of a construction as in (10) by recursive application of an exhaustivity operator (*Exh*) with the notion of innocent exclusion (IE) incorporated into the definition of *Exh* as in (11).

(11) $[[\text{Exh}]]\ (A_{<st,t>})\ (p_{st})\ (w) \Leftrightarrow p\ (w) \wedge \forall\ q \in \text{I.E}\ (p,A) \rightarrow \neg q\ (w)$ (Fox 2007)

This amounts to the meaning that the proposition expressed by the sentence under its scope is true and all its innocently excludable competitors (alternatives) are false. Rather than claiming that a proposition *p* is true as opposed to all other alternatives, Fox (2007) proposes to identify the propositions that can be safely excluded which are referred to as "innocently excludable" propositions. As in Fox (2007), the definition of the set of innocently excludable competitors to a certain proposition *p* in a set of propositions A is represented in (12).

(12) $\text{I.E}\ (p,A) = \cap\ \{A' \subseteq A\text{: A' is a maximal set A' s.t. } A'^{\neg} \cup \{p\} \text{ is consistent }\}$
$A^{\neg} = \{\neg p\text{: } p \in A\}$

This amounts to the meaning that given a proposition p and a set of alternatives A, innocent exclusion I.E (p,A) excludes any maximal set of propositions in A such that its exclusion is consistent with the prejacent.

The free-choice effects of (10) are derived by recursive application of *exh* operating on a Sauerland defined set of alternatives as in (13), where $\diamondsuit$ represent epistemic possibility.

(13) $\text{Exc(C')(Exh(C)} (\diamondsuit\ (p \vee q))) = \diamondsuit\ (p \vee q) \wedge \neg\ \diamondsuit\ (p \wedge q)$ and
$\neg\ (\diamondsuit\ p \wedge \neg\ \diamondsuit\ q)$ and
$\neg\ (\diamondsuit\ q \wedge \neg\ \diamondsuit\ p)$
$= \diamondsuit\ p \wedge \diamondsuit\ q$ and
$\neg\ \diamondsuit\ (p \wedge q)$

The Fox defined *Exh* as in (11) with the notion of innocent exclusion rightly captures the free-choice effects of a construction as in (10). However, as discussed in Section 3.5, we run into complications when we try to derive the strong exclusivity inferences akin to wide scope effects by application of the *Exh* with the notion of innocent exclusion (cf also. Fox, 2007 and Spector, 2016). In Section 4, I propose that we can derive the desired effects if we include a set of alternatives closed under conjunction in a Sauerland defined set still in keeping with consistency.

A more recent account on indefinite scope and ignorance effects is found in Alonso-Ovalle and Shimoyama (2014). Implications of this account are discussed next.

3.2. Alonso-Ovalle and Shimoyama (2014)

Alonso-Ovalle and Shimoyama (2014) note that the Japanese *wh-ka* indefinites under a universal quantifier as in (14) gives rise to ignorance inferences when interpreted over the universal quantifier. They also show that when the indefinite is interpreted within the scope of the quantifier, the ignorance effects disappear.

(14) Dono kyooju-mo dare-ka gakusee-to odotteru.
which professor-MO who-KA student-with is.dancing
"Every professor is dancing with some student."

They account for the generation and obviation of such ignorance inferences as primary and secondary implicatures as in (15b) and (15c).[6]

(15) a. $\Box$ [Every professor is dancing with s1 or s2 or s3]
b. $\neg\,\Box$ [Every professor is dancing with s1], $\neg\,\Box$ [Every professor is dancing with s2], $\neg\,\Box$ [Every professor is dancing with s3]
c. $\Box\,\neg$ [Every professor is dancing with s1], $\Box\,\neg$ [Every professor is dancing with s2], $\Box\,\neg$ [Every professor is dancing with s3]

However, the derivation in (15b) is equivalent to the following.

(16) $\Diamond \neg [\forall x\ s1(x)] \wedge \Diamond \neg [\forall x\ s2(x)] \wedge \Diamond \neg [\forall x\ s3(x)]$

The LF in (16) amounts to the meaning that in some worlds epistemically accessible to the speaker it is false that every professor is dancing with s1 and in some worlds epistemically accessible to the speaker it is false that every professor is dancing with s2 and in some worlds epistemically accessible to the speaker it is false that every professor is dancing with s3. This rightly derives the predicted ignorance effects. However, it also gives rise to a distributivity/ narrow scope effect. Thus, Alonso-Ovalle and Shimoyama (2014) do not establish a clear link between wide scope effects and ignorance inferences.

Nicolae (2017) has more recently proposed to derive ignorance inferences of a disjunction in a matrix context by way of a doxastic operator (cf. Alonso-Ovalle and Menéndez-Benito, 2010 and Alonso-Ovalle and Shimoyama, 2014) combined with an exhaustivity operator (cf. Fox, 2007). This is discussed next.

3.3. Nicolae (2017)

Nicolae (2017) derives ignorance inferences of the French disjunction *ou* as in (17) by way of exhaustification with respect to domain alternatives as shown in (18).[7]

(17) Marie a parlé à Jean ou Paul.
Mary talked with John or Paul.

(18) a. $\Box$ [p $\vee$ q]
b. Alt_D ($\Box$ [p $\vee$ q]) = $\{\Box p, \Box q\}$

[6]Alonso-Ovalle and Shimoyama (2014) employ an epistemic necessity modal represented with $\Box$ in the sense of belief/knowledge operator as in Sauerland (2004) or Fox (2007) to derive the implicatures. Also see (24) for a definition of $\Box$.

[7]Nicolae (2017) marks a difference between scalar alternatives (i.e. conjunctive alternatives) and domain alternatives (i.e. individual alternatives) when deriving ignorance inferences. I follow the same approach in the derivations in this paper. I mark domain alternatives as Alt_D and scalar alternatives as Alt_S. For instance, see the derivation in (22).

c. $\text{Exh}_D[\Box\ [p \vee q]] = \Box\ [p \vee q] \wedge \neg \Box p \wedge \neg \Box q$

Nicolae utilizes a doxastic operator as defined in Alonso-Ovalle and Menéndez-Benito (2010) and a slightly modified version of a Fox defined exhaustivity operator as in (19) to derive the implicatures.[8]

(19) $\text{Exh}(p) = p \wedge \forall q \in \text{IE}\ (p, Alt(p))\colon \neg q$
where: $\text{IE (p, Alt (p))} = \lambda q \in Alt(p).\ \neg \exists\, r \in \text{Alt (p)}\colon (p \wedge \neg\, q\,) \longrightarrow r.$
This amounts to the meaning that *p* is true and any alternative *q* not entailed by *p* is false, as long as negating *q* is consistent with negating any other non-weaker alternatives. (cf. Nicolae, 2017)

Nicolae (2017) does not discuss the ignorance inferences associated with disjunction in the nuclear scope position of a universal quantifier.[9] However, the way the *Exh* operator is used to derive ignorance inferences in Nicolae (2017) is relevant for the derivations and discussion here.

More recently, Alonso-Ovalle and Menéndez-Benito (2017) propose to derive the ignorance inferences of Spanish *algún* indefinites with respect to a universal quantifier as a quantity implicature by means of pragmatic competitors. This is discussed next.

3.4. Alonso-Ovalle and Menéndez-Benito (2017)

Alonso-Ovalle and Menéndez-Benito (2017) note that when *algún* in the example in (20) is interpreted with scope over the universal quantifier (i.e. in a context where every professor is dancing with the same student), it gives rise to an ignorance effect. They claim that when *algún* is interpreted in the scope of the universal quantifier, (i.e. in a context where different professors are dancing with different students), the speaker can utter the sentence even if s/he knew well which professors were dancing with which students. Thus, the ignorance effect is shown to disappear when *algún* is interpreted in the scope of the universal quantifier.

(20) Todos los profesores están bailando con algún estudiante.
All the professors are dancing with algún student
"Every professor is dancing with some student."

Alonso-Ovalle and Menéndez-Benito (2017) refer to the above as co-variation contexts and argue that the presence and absence of ignorance inferences is a result of a quantity implicature. They claim that when the domain of students for *algún* include the set { Juan, Lola, Sara}, the pragmatic competitors will be as those in (21).

(21) Every professor is dancing with a student in {Juan, Lola, Sara}
a. Every professor is dancing with a student in {Juan}
b. Every professor is dancing with a student in {Lola}
c. Every professor is dancing with a student in {Sara}

They argue that the pragmatic competitors in (21) rule out a situation where the speaker can

[8] Nicolae uses a slightly reformulated version of the Fox (2007) *Exh* still keeping to the spirit of the original version of *Exh* in Fox (2007) as in (11)
[9] Nicolae (2017), however, discusses the implications associated with disjunction in the restrictor of a universal quantifier, which has no direct relevance to our discussion here.

commit to any of them. Then the ignorance effect is derived. They also argue that (21) is compatible with a context where different professors are dancing with different students and the speaker knows who is dancing with who, which is compatible with the narrow scope reading of disjunction with respect to the universal quantifier.

As we can see here, Alonso-Ovalle and Menéndez-Benito (2017) derive the ignorance inferences via a pragmatic competition between a proposition and alternative stronger propositions to that proposition. However, this proposal also does not account for a link between scope and epistemic effects.

It is clear that the previous analyses on independent grounds have not accounted for a link between scope and epistemic effects. In the next section, I show that when we attempt to derive the exclusivity inferences akin to wide scope effects with the existing accounts without further assumptions, we are faced with complications.

3.5. Complications for deriving wide scope effects

The meaning that a *-hari* disjunction, when interpreted over a universal quantifier, gives rise to is that in all the world epistemically accessible to the speaker either all the students met Giita or they met Maala, thus a meaning akin to a wide scope effect. However, a Fox defined *Exh* (cf. Fox, 2007) operating on a Sauerland-defined set of alternatives (cf. Sauerland, 2004) in Nicolae's (2017) procedure gives rise to a distributivity effect as explained in the following with repect to the derivation in (22). This poses a problem for deriving the exclusivity implicature akin to a wide scope effect.

(22) a. $\Box$ [hæmə laməy-ek-mə Giita-hari Maala-hari hambə-un-a.
" Every student met Giita or Maala."

b. Assertion: $\Box[\ \forall x\ (G(x) \vee M(x))]$

c. Domain Implicatures: $Alt_D(\Box\ [\forall x\ (G(x) \vee M(x))]) = \{\Box\ \forall x G(x), \Box\ \forall x M(x)\}$
$Exh_D\ [\Box\ [\forall x\ (G(x) \vee M(x))]] = \Box\ [\forall x\ (G(x) \vee M(x))] \wedge \neg\ \Box\ [\forall x\ G(x)] \wedge \neg\ \Box\ [\forall x\ M(x)]$

d. Scalar Implicature: $Alt_S\ (\ \forall x\ (G(x) \vee M(x))) = \{\forall x\ (G(x) \wedge M(x))\}$
$Exh_S\ (\forall x\ (G(x) \vee M(x))) = \forall x\ (G(x) \vee M(x)) \wedge \neg\ (\forall x\ (G(x) \wedge M(x)))$

e. Total meaning: $\Box\ [\forall x\ [G(x) \vee M(x)]] \wedge \neg\ \Box\ [\forall x\ G(x)] \wedge \neg\ \Box\ [\forall x\ M(x)] \wedge \Box\ \neg\ [\forall x\ (G(x) \wedge M(x))]$

In (22a), we have the *-hari* disjunction sentence with the universal quantifier and the covert doxastic operator is adjoined at the matrix level at LF. Assertion of (22a) is represented in (22b) (i.e. that the speaker believes/knows that all the students met Giita or Maala). The domain implicatures drawn by exhaustification with respect to epistemic domain alternatives result in the uncertainty implicatures as represented in (22c). This serves to generate the ignorance component of meaning as uncertainty implicatures, that the speaker does not believe/know that all the students met Giita and the speaker does not believe/know that all the students met Maala. The scalar implicature is derived by exhaustification with respect to the scalar alternative as seen in (22d). This adds to the meaning that the speaker believes/knows that it is false that all the students met Giita and Maala.[10] In (22e),we have the total meaning derived by the union of the domain and scalar implicatures.

The derivation in (22e) is equivalent to the following, which shows that it can give rise to a distributivity effect.[11]

(23) $\Box$ [$\forall$x (G(x) $\vee$ M(x))] $\wedge$ $\Diamond$ $\neg$ [$\forall$x G(x)] $\wedge$ $\Diamond$ $\neg$ [$\forall$x M(x)] $\wedge$ $\Box$ $\neg$ [$\forall$x (G(x) $\wedge$ M(x))]

This in other words means that in all of the speaker's epistemically accessible worlds every student met Giita or Maala and in some of the speaker's epistemically accessible worlds it is false that every student met Giita and in some of the speaker's epistemically accessible worlds it is false that every student met Maala and in all of the speaker's epistemically accessible worlds it is false that every student met Giita and Maala.

Thus, a Fox-Sauerland inspired *Exh* falls short of deriving the wide scope effects of disjunction with respect to the universal quantifier.

In this background, I present a proposal based on the scope of the *Exh* operator with respect to the doxastic operator and characterization of the alternatives to account for the relationship between wide/narrow scope effects and generation/obviation of ignorance inferences.

4. The proposal

I argue that the wide scope effects and related ignorance inferences can be derived with the *Exh* operator taking scope over a doxastic operator with respect to domain alternatives and operating on a subset of alternatives closed under conjunction with respect to scalar alternatives. I show that the narrow scope and obviation of ignorance effects can be accounted for by way of the *Exh* operator scoping below the doxastic operator with respect to domain alternatives and operating on a regular Sauerland defined set of alternatives. In the following, I lay out the details and derivations of the proposal. I begin by introducing the theoretical background, tools and assumptions associated with the derivations and claims in the proposal.

4.1. Theoretical background, tools and assumptions

I assume that a covert assertoric/doxastic operator akin to an epistemic necessity modal adjoined at the matrix level at LF scopes above a disjunction/indefinite construction (cf. Alonso Ovalle and Menénde Benito, 2010; Meyer, 2013; Alonso Ovalle and Shimoyama, 2010 and Nicolae, 2017). I adopt a doxastic operator as defined in Alonso-Ovalle and Menéndez-Benito (2010) as in (24) and represent this with $\Box$ in the derivations.

(24) $[[\text{ASSERT}]]^c = \lambda p.\ \lambda w.\ \forall w'\text{: Epistemic}_{\text{Speaker of c}}\ (w)\ [\ p\ (w')\ ]$

This amounts to the meaning that the assertoric operator takes, as its arguments, a proposition

[10]Note that the scalar exhaustification happens below the doxastic operator to give rise to an exclusivity implicature.

[11]The LF in (23) can also be represented as $\Box$ [$\forall$x (G(x) $\vee$ M(x))] $\wedge$ $\Diamond$ $\exists x$ $\neg$ G(x) $\wedge$ $\Diamond$ $\exists x$ $\neg$ M(x) $\wedge$ $\Box$ $\exists x$ $\neg$ (G(x) $\wedge$ M(x)), which makes the distributivity effect more transparent.

p, a world w and asserts that this proposition is true in all worlds w′ epistemically accessible to the speaker in w. The assertoric operator serves in accounting for the scope effects as well as deriving ignorance inferences.

Inspired by Spector (2014), I assume that given its PP character, *-hari* associates with an implicit exhaustivity operator (O_{Exh}) placed in the syntactic structure of a disjunction/indefinite construction (cf also: Weerasooriya, 2018). I also assume that exhaustification is partially determined by the semantics of the particle *-hari* carrying an uninterpretable exhaustivity [*un*Exh] feature to be matched with the interpretable exhaustivity [*in*Exh] feature of the O_{Exh}.[12] Thus, I follow a hybrid system of lexical (cf. Levinson, 2000; Chierchia, 2004, a.m.o.) and grammatical (cf. Fox, 2007 and Chierchia et al., 2012) approaches in the derivation of implicatures. I adopt the Fox defined *Exh* as presented in (11) in the derivations. This serves in generating the exhaustivity implicatures of the alternatives associated with a disjunction/indefinite.

Inspired by Spector (2016), I assume that a set of alternatives can include a subset of alternatives to derive the strongest meaning. Comparing exhaustivity operators, Spector (2016) claims that an *Exh* incorporating innocent exclusion (i.e. Fox defined *Exh*, which Spector, 2016 abbreviates as Exh_{ie}) and an *Exh* based on minimal worlds/models (which Spector, 2016 abbreviates as Exh_{mw}) operating on a set of alternatives derive the same results when alternatives are closed under conjunction. He also notes that the two operators may deliver different results when disjunctions are embedded under other operators.[13] Following Fox (2007), Spector notes that Exh_{ie} operating on a Sauerland defined set of alternaives: $\{\Diamond\ (A \vee B), \Diamond A, \Diamond B, \Diamond\ (A \wedge B)\}$ will retrun the proposition: $\Diamond\ (A \vee B) \wedge \neg \Diamond\ (A \wedge B)$ which is compatible with the proposition $\Diamond\ A \wedge \Diamond B$. Spector also notes that Exh_{mw} delivers different results: $\Diamond\ (A \vee B) \wedge \neg\ (\Diamond A \wedge \Diamond B)$, which is obviously stronger. Spector also notes that in a Sauerland defined set of alternatives (i.e. $\{\Box\ (A \vee B), \Box\ A, \Box B, \Box\ (A \wedge B)\}$), the alternative $\Box\ (A \wedge B)$ is equivalent to the alternative $\Box\ A \wedge \Box\ B$ which is closed under conjunction. Inspired by Spector (2016), I assume that the set of alternatives in the wide scope reading includes alternatives closed under conjunction.

With this background and tools and assumptions in hand, I begin by accounting for the wide scope effects and ignorance inferences of *-hari* disjunctions in the scope of a universal quantifier in the next section.

4.2. Deriving the wide scope effects and ignorance inferences

In Section 3.5, we saw that a Fox defined *exh* operating on a Sauerland defined set of alternatives is not able to rightly capture the exclusivity inferences akin to wide scope effects. In

[12] I maintain this assumption implicitly in all the derivations in this paper. A discussion and representation of this approach with the syntactic diagrams are beyond the scope of this paper. See Weerasooriya (2019) for a detailed account of this approach. Owing to this limitation in the body of the paper, in the abstract and introduction, I opted to say that I mainly follow the grammatical approach to derivation of implicatures.

[13] The reader is referred to Spector (2016) for a discussion of different formulations of Exh. As Spector discusses (as Fox, 2007 also notes), closing alternatives under conjunction blocks free-choice effects. This needs to be considered.

this section, I propose to derive these effects by including alternatives closed under conjunction in a Sauerland defined set of alternatives. Note that alternatives closed under conjunction will include the set of alternatives in (25).

(25) $\{ \forall x\, G(x) \wedge \forall x\, M(x)\}$

Fox (2007) (following a conversation with Gennaro Chierchia) notes that *Alt* ($\forall$x (P(x) $\vee$ Q(x)) contains additional members: $\exists$x (P(x) $\vee$ Q(x)), $\exists$x (P(x)), $\exists$x (G(x)). Now, observe the entailment patterns in (26).

(26) $\forall x\, (G(x) \wedge M(x)) \rightarrow \exists x\, (G(x) \wedge M(x))$
$\forall x\, G(x) \wedge \forall x\, M(x) \rightarrow \exists x\, G(x) \wedge \exists x\, M(x)$

When alternatives are closed under conjunction, the set of *Alt* ($\forall$x (G(x) $\vee$ M(x)) will include:

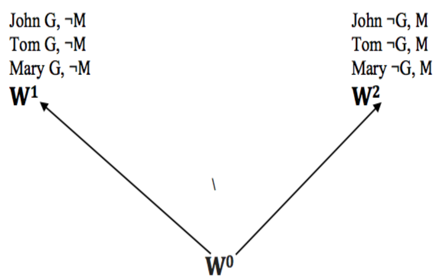
(27) $\{\forall x\, G(x) \wedge \forall x\, M(x), \exists x\, G(x) \wedge \exists x\, M(x)\}$.

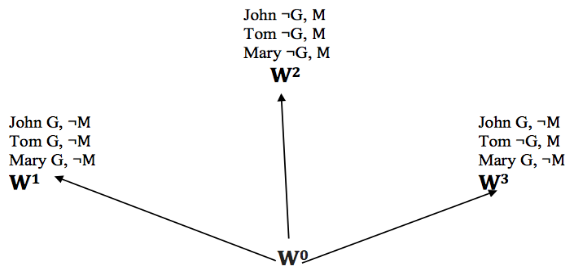
The negation of the alternative: $\exists x\, G(x) \wedge \exists x\, M(x)$ gives rise to a stronger inference than the negation of the alternative: $\forall x\, G(x) \wedge \forall x\, M(x)$. The strongest meaning (wide scope effect) could be derived by negation (exhaustivity) applied to $\exists x\, G(x) \wedge \exists x\, M(x)$ as seen in (28d). Matrix exhaustification (i.e. *Exh* operator scoping above the doxastic operator) with respect to domain alternatives derives the ignorance inferences related to wide scope as shown in (28c) (cf also: Nicolae, 2017 as in (18)).

(28) a. $\Box$ [hæmə lamə-ek-mə Giita-hari Maala-hari hambə-un-a.]
" Every student met Giita or Maala."
b. Assertion: $\Box\, [\forall x\, (G(x) \vee M(x))]$
c. Domain Implicatures: $Alt_D(\Box\, [\forall x\, (G(x) \vee M(x))]) = \{\Box\, \forall x G(x), \Box\, \forall x M(x)\}$
$Exh_D\, (\Box\, [\forall x\, (G(x) \vee M(x))]) = \Box\, [\forall x\, (G(x) \vee M(x))] \wedge \neg \Box\, [\forall x\, G(x)] \wedge \neg \Box\, [\forall x\, M(x)]$
d. Scalar Implicatures: $Alt_S(\forall x\, (G(x) \vee M(x))) = \{\forall x\, (G(x) \wedge M(x)), \exists x\, G(x) \wedge \exists x\, M(x)\}$
$Exh_S\, (\forall x\, (G(x) \vee M(x)) = \forall x\, (G(x) \vee M(x)) \wedge \neg\, (\exists x\, G(x) \wedge \exists x\, M(x))$
e. Total meaning: $= \Box\, [\forall x\, (G(x) \vee M(x))] \wedge \neg \Box\, [\forall x\, G(x)] \wedge \neg \Box\, [\forall x\, M(x)] \wedge \Box\, \neg\, [\exists x\, G(x) \wedge \exists x\, M(x)]$

So, the result of applying the *Exh* as in Fox (2007) with a set of alternatives closed under conjunction is that it returns an exclusivity implicature which is stronger than that in (22e). The LF as derived in (28e) accounts for the wide scope effects of disjunction as depicted in the situation in (29). In (29), we have two worlds W1 and W2 epistemically accessible to the speaker in W0. In W1, the proposition that all the boys met Giita is true and the proposition that all the boys met Maala is false. In W2, the proposition that all the boys met Maala is true and the proposition that all the boys met Giita is false. The LF as derived in (28e) is only felicitous in a context similar to one in (29) (crucially not similar to one in (30)), where it amounts to the meaning that in all the world epistemically accessible to the speaker either all the students met Giita or they met Maala, thus a meaning akin to a wide scope effect.

(29)





(30) #

This way, I speculate that a Fox defined *Exh* operating on a Sauerland inspired set of alternatives including a subset of alternatives closed under conjunction can derive both the wide scope and ignorance effects of a *-hari* disjunction with respect to a universal quantifier.

In the next section, I show that exhaustification below the doxastic operator is responsible for obviation of ignorance inferences.

4.3. Accounting for the narrow scope effects and obviation of ignorance inferences

Local exhaustification (i.e. *Exh* operator scoping below the doxastic operator) with respect to both domain and scalar alternatives serves to account for both narrow scope effects and obviation of ignorance inferences as illustrated in (31) and the explanation that follows it.

(31) a. $\Box$ [hæmə gooləy-ek-mə Giita-hari Maala-hari hambə-un-a.]
" Every student met Giita or Maala."
b. Assertion: $\Box[\ \forall x\ (G(x) \lor M(x))]$
c. Domain Implicatures: $Alt_D(\forall x\ (G(x) \lor M(x))) = \{\ \forall x G(x), \forall x M(x)\ \}$
$Exh_D\ (\forall x\ (G(x) \lor M(x))) = \forall x\ (G(x) \lor M(x)) \land \neg\ \forall x\ G(x) \land \neg\ \forall x\ M(x)$
d. Scalar Implicature: $Alt_S\ (\ \forall x\ (G(x) \lor M(x))) = \{\forall x\ (G(x) \land M(x))\}$
$Exh_S\ (\ \forall x\ (G(x) \lor M(x))) = \forall x\ (G(x) \lor M(x)) \land \neg\ \forall x\ (G(x) \land M(x))$
e. Total meaning: $\Box\ [\forall x\ [G(x) \lor M(x)]] \land \Box \neg \forall x\ G(x) \land \Box \neg \forall x\ M(x) \land \Box \neg \forall x\ [G(x) \land M(x)]]$

In (31a), we have the *-hari* disjunction sentence with the universal quantifier with the covert doxastic operator adjoined at the matrix level at LF. Assertion of (31a) is represented in (31b). The domain implicatures are drawn by exhaustification with respect to non-modalized domain alternatives (i.e. *Exh* operator scoping below the doxastic operator) as represented in (31c). This serves to generate the narrow scope effect of meaning as a distribution effect, that some students did not meet with Giita and some students did not meet with Maala. The scalar exhaustification also occurs below the doxastic operator as shown in (31d). In (31e), the union of the domain and scalar implicatures results in a derivation compatible with a meaning that all the students met at least one of the two individuals and the speaker knows who met whom.

Note that the derivation in (31e) is equivalent to the following.

(32) $\Box\ [\forall x\ (G(x) \lor M(x))] \land \Box\ \exists(x) \neg\ G(x) \land \Box\ \exists(x) \neg\ M(x) \land \Box\ \exists(x) \neg\ [G(x) \land M(x)]$

The LF derived in (31e) is also compatible with (33).

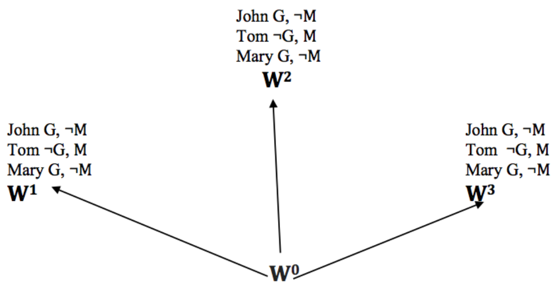
(33) $\Box\, [\forall x\, (G(x) \lor M(x))] \land \Box\, \exists(x)\, M(x) \land \Box\, \exists(x)\, G(x)$

In other words,

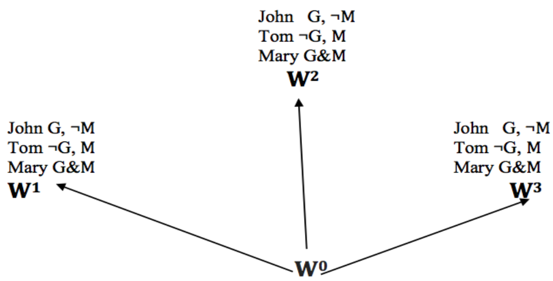
(34) In all of the speaker's doxastically accessible worlds every student met Giita or Maala and in all of the speaker's doxastically accessible worlds some students met Maala and in all of the speaker's doxastically accessible worlds some students met Giita.

Thus, the meaning of a *-hari* disjunction as derived in (31e) is compatible with a narrow scope reading of disjunction with respect to the universal quantifier and with a reading where the speaker knows who met who. For instance, the LF as derived in (31e) is compatible with any of the situations depicted in (35) or (36). In (35) and (36), we have the worlds W1, W2 and W3 epistemically accessible to the speaker from W0. In (35), in all the worlds epistemically accessible to the speaker, the proposition: John met Giita is true, and the proposition: John met Maala is false. This shows that the speaker knows that John met Giita and not Maala. (35) also shows that the speaker knows that Mary met Giita and not Maala and Tom met Maala not Giita. In (36), in all the worlds epistemically accessible to the speaker, the proposition: John met Giita is true, and the proposition: John met Maala is false. This shows that the speaker knows that John met Giita and not Maala. (36) also shows that the speaker knows that Mary met both Giita and Maala and Tom met Maala not Giita.

(35)



(36)



Thus, the LF in (31e) is compatible with any of the situations depicted in (35) and (36) which are situations where the speaker knows who met who.

This way, I account for the derivation of both the narrow scope reading and obviation of ignorance effects of a *-hari* disjunction under a universal quantifier based on exhaustification with respect to both domain and scalar alternatives below the doxastic operator.

The derivations in (28) and (31) are modeled on disjunctions with *-hari*. In the next section, I propose to extend the same analysis to indefinites with the assumption that the general function of indefinites is to introduce alternatives (building on Kratzer and Shimoyama, 2002).

4.4. Extensions to the domain of indefinites

Kratzer and Shimoyama (2002) argue that, like focus (cf. Rooth, 1985), indefinites too introduce sets of alternatives. They argue that indefinite pronouns denote sets of individuals as individual alternatives, rather than as properties. Thus, building on Kratzer and Shimoyama (2002), for the derivations involving indefinites, I assume that *-hari* indefinites introduce contextually relevant alternatives and the *Exh* operator and the sets of alternatives work in the same manner. Suppose that the domain of the indefinite in (1b) includes the alternatives Gita, Mala and Sita. The wide scope effects and related ignorance inferences are derived as in (37).

(37) a. $\Box$ [hæmə lamə-ek-mə kaawə-hari hambə-un-a.]
" Every student met somebody."
b. Assertion: $\Box$ [$\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))]
c. Domain Implicatures: Alt_D($\Box$ [$\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))]) = {$\Box$ $\forall$xG(x), $\Box$ $\forall$xM(x), , $\Box$ $\forall$xS(x)}
Exh_D ($\Box$ [$\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))]) = $\Box$ [$\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))] $\wedge$ $\neg$ $\Box$ [$\forall$x G(x)] $\wedge$ $\neg$ $\Box$ [$\forall$x M(x)] $\wedge$ $\neg$ $\Box$ [$\forall$x S(x)]
d. Scalar Implicatures: Alt_S($\forall$x (G(x) $\vee$ M(x) $\vee$ S(x)) = {$\forall$x (G(x) $\wedge$ M(x)), $\forall$x (G(x) $\wedge$ S(x)), $\forall$x (M(x) $\wedge$ S(x)), $\forall$x (G(x) $\wedge$ M(x) $\wedge$ S(x)), $\exists$x M(x), $\exists$x G(x) $\wedge$ $\exists$x S(x), $\exists$x M(x) $\wedge$ $\exists$x S(x), $\exists$x G(x) $\wedge$ $\exists$x M(x) $\wedge$ $\exists$x S(x)}
Exh_S ($\forall$x (G(x) $\vee$ M(x) $\vee$ S(x)) = $\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))] $\wedge$ $\neg$ ($\exists$x G(x) $\wedge$ $\exists$x M(x)), $\wedge$ $\neg$ ($\exists$x G(x) $\wedge$ $\exists$x S(x)), $\wedge$ $\neg$ ($\exists$x M(x) $\wedge$ $\exists$x S(x)), $\wedge$ $\neg$ ($\exists$x G(x) $\wedge$ $\exists$x M(x) $\wedge$ $\exists$x S(x))
e. Total meaning: = $\Box$ [$\forall$x (G(x) $\vee$ M(x))] $\wedge$ $\neg$ $\Box$ [$\forall$x G(x)] $\wedge$ $\neg$ $\Box$ [$\forall$x M(x)] $\wedge$ $\neg$ $\Box$ [$\forall$x S(x)] $\wedge$ $\Box$ $\neg$ ($\exists$x G(x) $\wedge$ $\exists$x M(x)) $\wedge$ $\Box$ $\neg$ ($\exists$x G(x) $\wedge$ $\exists$x S(x)) $\wedge$ $\Box$ $\neg$ ($\exists$x M(x) $\wedge$ $\exists$x S(x)) $\wedge$ $\Box$ $\neg$ ($\exists$x G(x) $\wedge$ $\exists$x M(x) $\wedge$ $\exists$x S(x))

Thus, as in the case of disjunction, the *Exh* operator scoping over the doxastic operator with respect to domain alternatives and operating on a subset of alternatives closed under conjunction with respect to scalar alternatives derives the predicted wide scope and ignorance effects.

I propose to derive the narrow scope effects and obviation of ignorance inferences of a *-hari* indefinite under a universal quantifier as in (38).

(38) a. $\Box$ [hæmə laməy-ek-mə kaawə-hari hambə-un-a.]
" Every student met somebody."
b. Assertion: $\Box$[$\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))]
c. Domain Implicatures: Alt_D($\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))) = { $\forall$xG(x), $\forall$xM(x), $\forall$xS(x) }
Exh_D ($\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))) = $\forall$x (G(x) $\vee$ M(x) $\vee$ S(x)) $\wedge$ $\neg$ $\forall$x G(x) $\wedge$ $\neg$ $\forall$x M(x) $\wedge$ $\neg$ $\forall$x S(x)
d. Scalar Implicatures: Alt_S ($\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))) = {$\forall$x (G(x) $\wedge$ M(x)), $\forall$x (G(x) $\wedge$ S(x)), $\forall$x (M(x) $\wedge$ S(x)), $\forall$x (G(x) $\wedge$ M(x) $\wedge$ S(x))}
Exh_S ($\forall$x (G(x) $\vee$ M(x) $\vee$ S(x))) = $\forall$x (G(x) $\vee$ M(x) $\vee$ S(x)) $\wedge$ $\neg$ $\forall$x (G(x) $\wedge$ M(x)) $\wedge$ $\neg$ $\forall$x (G(x) $\wedge$ S(x)) $\wedge$ $\neg$ $\forall$x (M(x) $\wedge$ S(x)) $\wedge$ $\neg$ $\forall$x (G(x) $\wedge$ M(x) $\wedge$ S(x))
e. Total meaning: $\Box$ [$\forall$x [G(x) $\vee$ M(x) $\vee$ S(x)]] $\wedge$ $\Box$ $\neg$ $\forall$x G(x) $\wedge$ $\Box$ $\neg$ $\forall$x M(x) $\wedge$ $\Box$ $\neg$ $\forall$x S(x) $\wedge$ $\Box$ $\neg$ $\forall$x [G(x) $\wedge$ M(x)] $\wedge$ $\Box$ $\neg$ $\forall$x [G(x) $\wedge$ S(x)] $\wedge$ $\Box$ $\neg$ $\forall$x [M(x)

$\wedge$ S(x)] $\wedge$ $\Box$ $\neg$ $\forall$x [G(x) $\wedge$ M(x) $\wedge$ S(x)]]

Again, as in the case of disjunction, the *Exh* operator scoping below the doxastic operator and operating on a regular Sauerland defined set of alternatives accounts for the predicted narrow scope and obviation of ignorance effects.

5. Summary and conclusion

This paper made a proposal to account for a link between wide/narrow scope effects and the related epistemic effects of *-hari* disjunctions/indefinites with respect to DPs with universal quantificational force in Sinhala. It argued that both the relative scope of the *Exh* operator with respect to a doxastic operator and the way alternatives are characterized are crucial in accounting for the related scope and epistemic effects. It also proposed to extend the application of exhaustivity based approaches (i.e. grammaticalized implicatures: cf. Chierchia et al., 2012) that were mostly limited to the domain of disjunction to the domain of indefinites to address certain issues still in debate in that domain. It also derived wide scope effects without manipulating syntactic scope, which is important for a novel analysis of wide scope disjunctions/indefinites.

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