Scalar implicatures of embedded disjunction*

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Abstract

Sentences with disjunction in the scope of a universal quantifier, *Every A is P or Q*, tend to give rise to distributive inferences that each of the disjuncts holds of at least one individual in the domain of the quantifier, *Some A is P & Some A is Q*. These inferences are standardly derived as an entailment of the meaning of the sentence together with the scalar implicature that it is not the case that either disjunct holds of every individual in the domain of the quantifier, ¬*Every A is P &* ¬*Every A is Q* (plain negated inferences). This derivation faces a challenge in that distributive inferences may obtain in the absence of plain negated inferences. We address this challenge by showing that on particular assumptions about alternatives a derivation of distributive inferences as scalar implicatures can be maintained without necessitating the absent plain negated inferences. These assumptions accord naturally with the grammatical approach to scalar implicatures. The paper concludes by presenting experimental data that suggest that plain negated inferences are not only unnecessary for deriving distributive inferences, but might in fact be unavailable.

1 Distributive inferences

Disjunction in the scope of a universal quantifier tends to give rise to existential inferences pertaining to each of the disjuncts, specifically, that each of the disjuncts holds of at least one individual in the domain of the universal quantifier (henceforth, distributive inferences). This can make sense of the fact that a sentence like the following

(1) Every brother of mine is married to a woman or a man.

is perceived as infelicitous in a context in which all of the speaker's brothers are married to a woman (and none are known by the speaker to be married to a man), that is, in a context in which distributive inferences of the sentence, given in (2), are false.[1]

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[1] If in the context the speaker is taken to be opinionated about the alternatives induced by a sentence that she utters and if the alternatives are taken to be relevant, an SI of the sentence based on the alternatives is generally computed. Although a subsequent cancellation of the SI may be possible, which may require a reanalysis of what is relevant in the context (see Mayol & Castroviejo 2013 on conditions on SI cancellation), the sentence is perceived to convey false information in the context if the SI is false (cf. Gazdar 1979, Horn 1984, Levinson 2000, among others).

(2) **Distributive inferences**

a. Some brother of mine is married to a woman
b. Some brother of mine is married to a man

Distributive inferences are standardly characterized and derived as scalar implicatures (henceforth, SIs), not least because they bear the telltale sign of SIs – they disappear in downward-entailing environments. For example, if we embed the sentence in (1) under a downward-entailing operator, say, under the predicate *doubt*, as in (3), its distributive inferences disappear: the sentence in (3) entails that John doubts that every brother of mine is married, which is a stronger meaning than would obtain if distributive inferences were part of the meaning of the embedded clause – that is, that John doubts that every brother of mine is married and that some of them are married to a woman, while others are married to a man.

(3) John doubts that every brother of mine is married to a woman or a man.

There are two types of approaches to SIs, both of which can accommodate distributive inferences: the pragmatic approach, an instance of which is the neo-Gricean approach advocated by, for example, Sauerland (2004), and the grammatical approach advocated by, for example, Chierchia, Fox & Spector (2011). Both types of approaches take SIs of a sentence to be a product of an exhaustification of the sentence relative to a constrained set of alternatives induced by the sentence. To properly understand this computation, the approaches agree that a general theory of alternatives is needed that assigns to each expression an appropriate set of alternatives (see e.g. Sauerland 2004, Fox 2007, Katzir 2007). Moreover, they agree that these sets of alternatives satisfy the following condition (in addition to the abovementioned authors, see also Rooth 1992, Kratzer & Shimoyama 2002 for variants of this assumption and a more detailed discussion):

(4) **Standard assumption about alternatives**
A constituent, $\alpha = [\beta\ \gamma]$, has as its alternatives its subconstituents and the pointwise combinations of the alternatives to its sub-constituents,
$\mathrm{ALT}(\alpha) = \{\alpha' \mid \exists\beta', \gamma'\colon \beta' \in \mathrm{ALT}(\beta) \wedge \gamma' \in \mathrm{ALT}(\gamma) \wedge (\alpha' = [\beta'\ \gamma'] \vee \alpha' = \beta \vee \alpha' = \gamma)\}$

On the standard assumption about alternatives, a disjunctive constituent has as alternatives each of the disjuncts, a conjunctive alternative in which the disjunctive connective is replaced by the conjunctive one, and the alternatives induced by each of the disjuncts and their disjunctions and conjunctions (these latter alternatives are irrelevant for the purposes of this paper and will be ignored in the following; see Sauerland 2004, Fox 2007, Katzir 2007 for discussion).

(5) **Standard assumption about alternatives of disjunction (simplified)**
A disjunctive constituent, α *or* β, has as its alternatives the disjuncts as well as their conjunction, $\mathrm{ALT}(\alpha \textit{ or } \beta) = \{\alpha \textit{ or } \beta, \alpha, \beta, \alpha \textit{ and } \beta\}$

The two types of approaches to SIs differ with respect to the nature of exhaustification: on the pragmatic approaches the exhaustification involves pragmatic reasoning by conversational agents, while on the grammatical approach it takes place in grammar.

Nonetheless, at first glance, distributive inferences emerge on both types of approaches in a similar way – by exhautifying the matrix sentence, either by pragmatic reasoning or in grammar.

1.1 Distributive inferences on the neo-Gricean approach to SIs

On the neo-Gricean approach to SIs, SIs are derived by reasoning about speakers' mental states on the basis of two principles, a version of the Gricean maxim of quantity and the assumption of opinionatedness (see e.g. Sauerland 2004 for a detailed exposition). Specifically, upon hearing the utterance of the sentence (1), the hearer is assumed to reason as follows: The sentence has the alternatives in (6) – the standard alternatives to the disjunctive constituent combined pointwise with the universal quantifier (henceforth, plain alternatives). All of these alternatives are stronger than the sentence itself (the sentence itself is an alternative as well, albeit a trivial one, but we leave it out as such throughout this paper for reasons of brevity);

(6) ALT(Every brother of mine is married to a woman or a man) =
{ Every brother of mine is married to a woman,
Every brother of mine is married to a man,
Every brother of mine is married to a woman and a man }

since these alternatives are *ex hypothesi* relevant, stronger than the uttered sentence, and the speaker has not used them, we are licensed by the Maxim of Quantity to conclude that it is not the case that she believes any of them.

(7) a. Every brother of mine is married to a woman or a man.
b. $\rightsquigarrow \neg B_{speaker}$(Every brother of mine is married to a woman)
c. $\rightsquigarrow \neg B_{speaker}$(Every brother of mine is married to a man)

Furthermore, given that it holds according to the assumption of opinionatedness that for each of the alternatives in (6) the speaker either believes it is true or that it is false, the hearer is licensed to conclude from (7) that the speaker believes that all these alternatives are false.[2] And this yields the SIs of the sentence:

(8) a. Every brother of mine is married to a woman or a man.
b. $\rightsquigarrow B_{speaker}$($\neg$Every brother of mine is married to a woman)
c. $\rightsquigarrow B_{speaker}$($\neg$Every brother of mine is married to a man)

For ease of exposition, we will refer to these inferences, i.e., inferences that correspond to the negation of the plain alternatives of a sentence, as plain negated inferences.

(9) **Plain negated inferences**
a. $\neg$Every brother of mine is married to a woman
b. $\neg$Every brother of mine is married to a man

[2] In our particular example it is very implausible to assume that the speaker is not opinionated about the alternatives.

Distributive inferences follow from the meaning of the sentence together with plain negated inferences: if (I, the speaker, believe that) every brother of mine is married and not everyone of them is married to a woman and not everyone of them is married to a man, then (I, the speaker, believe that) some brother of mine is married to a woman and some brother of mine is married to a man.

1.2 Distributive inferences on the grammatical approach to SIs

On the grammatical approach to SIs, there is an exhaustification device, *exh*, in grammar that is akin to *only* and is responsible for generating SIs. Following much preceding work (e.g., Fox 2007, Chierchia, Fox & Spector 2011), we represent it as a clausal operator that takes two arguments: a set of relevant alternatives to the clause to which *exh* is adjoined (the domain of *exh*) and the meaning of the clause (the prejacent of *exh*). On this approach, the sentence in (1) may have a representation with a matrix exhaustification operator that operates on the set of plain alternatives described in (6).

(10) a. Every brother of mine is married a woman or a man.
b. exh(C)(Every brother of mine is married a woman or a man)
c. C = ALT(Every brother of mine is married a woman or a man)

The import of the exhaustification operator is to convey that its prejacent is true but that the appropriately excludable relevant alternatives are false:

(11) $\text{exh(C)(p)} = \lambda\text{w. p(w)} \wedge \forall\text{q} \in \text{Excl(C,p)}(\neg\text{q(w)})$

An alternative is thereby appropriately excludable given a set of alternatives and the prejacent of *exh* if it is in all the maximal sets of alternatives whose negation is jointly consistent with the prejacent, (12) (see Fox 2007).

(12) **Definition of excludable alternatives** (as presented in Magri 2009)

a. $\text{X} \subseteq \text{C}$ is a set of excludable* alternatives given C and p iff $\text{p} \wedge \bigwedge_{q \in X} \neg\text{q} \neq \bot$

b. $\text{X} \subseteq \text{C}$ is a maximal set of excludable* alternatives given C and p iff there is no X′ such that $\text{X} \subset \text{X}'$ and X′ is a set of excludable* alternatives given C and p

c. Excl(C,p) is the set of excludable alternatives given C and p iff it is the intersection of all maximal sets of excludable* alternatives given C and p

In the case of the representation in (10), all the alternatives in the domain of the exhaustification operator are excludable since their negations can be consistently conjoined with the prejacent. Accordingly, the output of the exhaustification is the conjunction of the prejacent and the plain negated inferences.

(13) Every brother of mine is married a woman or a man $\wedge$
$\neg$Every brother of mine is married to a woman $\wedge$
$\neg$Every brother of mine is married to a man

The result is overall the same as in the neo-Gricean approach described above: distributive inferences are derived from the conjunction of the prejacent and the plain negated inferences.[3]

1.3 Summary

Distributive inferences can be derived in a closely related way in the pragmatic and the grammatical approach to SIs – by exhaustifying the matrix sentence, either by abductive reasoning about speakers' mental states or by an application of a grammatical exhaustification device, respectively. On both types of derivations, if alternatives to the matrix sentence are the plain alternatives – that is, the standard alternatives of disjunction combined pointwise with the universal quantifier, as exemplified in (6) –, distributive inferences emerge as entailments of the sentence together with plain negated inferences.

(14) **Exhaustification based on plain alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification operates on its plain alternatives (*Every A is P, Every A is Q*), distributive inferences (*Some A is P, Some A is Q*) are derived from their negation (¬*Every A is P*, ¬*Every A is Q*)

2 A puzzle about distributive inferences

In parallel to our discussion of the example in (1), its slightly modified variant using present perfect in (15) is also perceived as infelicitous in a context in which all my brothers have been married to a woman but none of them have ever been married to a man.

(15) [Every brother of mine has been married to a woman and none have been married to a man:] #Every brother of mine has been married to a woman or a man.

This is as expected given our above discussion: since the sentence in (15) gives *ceteris paribus* rise to plain negated inferences and, consequently, distributive inferences, a clash with the described context ensues – both conjunction of the prejacent and plain negated inferences, given in (16), as well as the distributive inferences, given in (17), are incompatible with the supposition that none of my brothers have ever been married to a man, explaining the perceived infelicity of the sentence in the context. So far, so good.

(16) **Plain negated inferences**
a. ¬Every brother of mine has been married to a woman
b. ¬Every brother of mine has been married to a man

(17) **Distributive inferences**
a. Some brother of mine has been married to a woman
b. Some brother of mine has been married to a man

[3] In the grammatical approach a parse without exhaustification would be implausible, since it would lead to the pragmatic inference that speaker is not opinionated about the relevant alternatives (Fox 2007, 2013). See previous footnote.

Strikingly, the felicity of the sentence in (15) improves markedly in a context in which, say, the speaker has three brothers, Adam, Bob and Carl, who in college got married to Ann, Beth and Christine, respectively; at some point Adam and Ann get divorced and Adam marries Arthur. That is, the felicity of the sentence improves markedly in a context in which all of my brothers have been married to a woman and at least one of them has also been married to a man.[4]

(18) [Every brother of mine has been married to a woman and some of them have been married to a man:] Every brother of mine has been married to a woman or a man.

Distributive inferences that the sentence gives rise to, (17), are compatible with the described context and, thus, they are in line with its perceived felicity. However, the inferences in (16), which we have seen to be a necessary ingredient in the derivation of distributive inferences on approaches that assume that the matrix sentence has the plain alternatives, are incompatible with the described context, namely, all of my brothers have been married to a woman. The distributional pattern of distributive and plain negated inferences described in this section is thus problematic for the prediction of approaches that rely on exhaustification of the matrix sentence based on plain alternatives – the contrast in felicity of (15) and (18) suggests that distributive inferences and the negation of plain alternatives can be dissociated.

(19) **A puzzle about distributive inferences**
A disjunction in the scope of a universal quantifier may give rise to distributive inferences without giving rise to plain negated inferences

In the following we show that the puzzle can be resolved on the grammatical approach to SIs without giving up standard assumptions about alternatives. The remainder of the paper has the following structure: Section 3 resolves the puzzle about distributive inferences. Section 4 presents experimental data that suggest that distributive inferences are not only possible in the absence of plain negated inferences but are in fact preferably obtained in this way – or, perhaps, can be obtained only in this way –, a state of affairs that we attempt to explain in section 5. Section 6 concludes the paper by pointing to several questions for future research.

3 A resolution of the puzzle

We have observed that the distribution of distributive inferences is not be captured on extant approaches to SIs if the matrix sentence containing disjunction under a universal

[4] The minimal difference between the sentence in (1) and the sentence in (15)/(18) is that in the former sentence it is (contextually) impossible that both disjuncts hold of a brother of mine: a brother of mine being married to a woman contextually entails him not being married to a man (you can only be married to one individual at a given time). Accordingly, we get a crisp judgment that the sentence is marked in any context in which, say, all of my brothers are married to a woman (i.e., distributive inferences may not be true in any such context). This is not the case for the sentence used in (15)/(18): a brother of mine having been married to a woman is compatible with him having been married to a man as well (i.e., distributive inferences may be true in contexts in which the negation of one of the plain alternatives is false).

quantifier is taken to induce plain alternatives, that is, alternatives in which the disjunction is replaced by the disjuncts or by their conjunction:

(14) **Observation about exhaustification based on plain alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification operates on its plain alternatives (*Every A is P, Every A is Q*), distributive inferences (*Some A is P, Some A is Q*) are derived from their negation ($\neg$*Every A is P,* $\neg$*Every A is Q*)

However, this does not mean that exhaustification of the matrix sentence *Every A is P or Q* fails to yield distributive inferences in the absence of plain negated inferences on all conceivable sets of alternatives. If the alternatives were different, specifically, if instead of the alternative *Every A is P* one would have the alternative *Every A is only P* or, more explicitly, *Every A is P but not Q*, and instead of the alternative *Every A is Q* one would have the alternative *Every A is only Q* or, more explicitly, *Every A is Q but not P* (henceforth, exhaustified alternatives), the SIs of the sentence would entail distributive inferences but not the negated inferences based on plain alternatives.

(20) a. Every A is P or Q $\wedge$ $\neg$Every A is P but not Q $\wedge$ $\neg$Every A is Q but not P
b. $\Rightarrow$ Some A are P $\wedge$ Some A are Q
c. $\not\Rightarrow$ $\neg$Every A is P $\wedge$ $\neg$Every A is Q

That is, given exhaustified alternatives, distributive inferences can be derived as SIs even in the absence of plain negated inferences.

(21) **Observation about exhaustification based on exhaustified alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification is based on its exhaustified alternatives (*Every A is only P, Every A is only Q*), distributive inferences (*Some A is P, Some A is Q*) are derived in the absence of plain negated inferences ($\neg$*Every A is P,* $\neg$*Every A is Q*)

In light of the prediction in (21), we are faced with the question whether the alternatives required to derive distributive inferences in the absence of plain negated inferences are compatible with the standard assumptions about alternatives, repeated below.

(4) **Standard assumption about alternatives**
A constituent, $\alpha = [\beta\ \gamma]$, has as its alternatives its subconstituents and the pointwise combinations of the alternatives to its sub-constituents,
$\mathrm{ALT}(\alpha) = \{\alpha' \mid \exists\beta', \gamma': \beta' {\in} \mathrm{ALT}(\beta) \wedge \gamma' {\in} \mathrm{ALT}(\gamma) \wedge (\alpha' = [\beta'\ \gamma'] \vee \alpha' = \beta \vee \alpha' = \gamma)\}$

We show below that exhaustified alternatives are compatible with the standard assumptions about alternatives on the grammatical approach to SIs. Subsequently, we present a derivation of distributive inferences in the absence of plain negated inferences in that approach and point out that it must be coupled with a constraint on what counts as a legitimate domain of an exhaustification operator or else it would yield outlandish predictions.

3.1 Embedding *exh*

As reviewed in the introductory section, on the grammatical approach to SIs, SIs are generated by an exhaustification operator, *exh*, in grammar. Similar to other operators in grammar, *exh* may be embedded, in particular, it may be embedded in the scope of a universal quantifier (see e.g. Chemla & Spector 2011, Chierchia, Fox & Spector 2011, Magri 2011, Crnič 2013 for arguments for embedded SIs). Furthermore, nothing prevents an occurrence of *exh* embedded under another occurrence of *exh* (Fox 2007). Accordingly, the sentence in (22-a) may be parsed as having a structure with two occurrences of *exh*, (22-b), one occurrence at the matrix level and one embedded immediately below the universal quantifier.[5]

(22) a. Every brother of mine has been married to a woman or a man.
b. exh(C_2)(every brother$_x$ (exh(C_1)(x has been married to a woman or a man)))

The meaning of the structure in (22) depends on the resolution of the domains of the two occurrences of the exhaustification operator, C_1 and C_2. Given this parse and the standard assumption about alternatives, the sentence in (22-a) may have as its alternatives the exhaustified alternatives, that is, alternatives that we have seen to be required to generate distributive inferences in the absence of plain negated inferences, as we show in the following.

3.2 Exhaustified alternatives and pruning

The standard alternatives of embedded disjunction in (22) are given in (23), some of which will constitute the domain of the embedded exhaustification operator (the set referred to as C_1 in (22)) and, thus, figure in the computation of the exhaustified meaning of the sentence.

(23) a. x has been married to a woman
b. x has been married to a man
c. x has been married to a woman and a man

If the conjunctive alternative is pruned from the domain of the embedded exhaustification operator in (22), as represented in (24),

(24) C_1 = {x has been married to a woman, x has been married to a man}

the operator does not affect the (assignment-dependent) meaning of the sister of the universal quantifier, (25). Namely, neither of the two alternatives in C_1 is excludable given the prejacent and C_1 (see definition of excludable alternatives in (12)): both alternatives form their own maximal set of excludable* alternatives and so neither alternative is in the intersection of such sets, that is, in the set of excludable alternatives. And since there are no excludable alternatives, the import of embedded exhaustification is vacuous. However, as we will see shortly, embedded exhaustification, though locally vacuous, turns

[5] In fact, following Magri (2011), we will suggest in section 5 that this is the only grammatical parse of the sentence, that is, that the presence of embedded and matrix *exh* is obligatory.

out to affect the alternatives for matrix *exh* and thereby does affect the overall meaning of the sentence.

(25) $\text{exh}(C_1)$(x has been married to a woman or a man) =
λw. x has been married to a woman or a man in w

The alternatives to the sister of the matrix exhaustification operator that may enter into the computation of the exhaustified meaning are given in (26). They are built on the two disjuncts and on the conjunctive connective, that is, they are derived from the structure in (22) in line with the standard assumption about alternatives, (4).[6]

(26) a. every brother_x ($\text{exh}(C_1)$(x has been married to a woman))
b. every brother_x ($\text{exh}(C_1)$(x has been married to a man))
c. every brother_x ($\text{exh}(C_1)$(x has been married to a woman and a man))

The meaning of the prejacent of the matrix exhaustification operator in (22) is that every brother has been married to a woman or a man – as we have noted, the embedded *exh* does not affect the meaning of the scope of the universal quantifier –, while the alternatives based on the two disjuncts correspond to every brother of mine having been married to a woman but not to a man and to every brother of mine having been married to a man but not to a woman.

(27) a. every brother_x ($\text{exh}(C_1)$(x has been married to a woman)) =
λw. Every brother of mine has been married to a woman but not to a man in w
b. every brother_x ($\text{exh}(C_1)$(x has been married to a man)) =
λw. Every brother of mine has been married to a man but not to a woman in w

These alternatives correspond to the exhaustified alternatives needed to derive distributive inferences in the absence of plain negated inferences, (21). If the domain of the matrix exhaustification operator C_2 is constituted from the alternatives in (26), the structure in (22) entails that they are all false, namely, they are all excludable: the prejacent conjoined with the negations of all three alternatives yields a consistent meaning.

(28) $\text{exh}(C_2)$(every brother_x ($\text{exh}(C_1)$(x has been married to a woman or a man))) =
λw. Every brother of mine has been married to a woman or a man in w $\wedge$
$\neg$Every brother of mine has been married to a woman but not to a man in w $\wedge$
$\neg$Every brother of mine has been married to a man but not to a woman in w $\wedge$
$\neg$Every brother of mine has been married to a man and a woman in w

[6]On the standard assumption about alternatives, further alternatives can be derived from the structure in (22) – for example, alternatives without the embedded *exh*. We assume here that these alternatives are pruned from the domain of the matrix *exh* (if they were not pruned, matrix exhaustification would yield plain negated inferences, as in section 1). But see section 5.2 where we propose that, in fact, alternatives without embedded *exh* cannot be generated (see esp. footnote 16).

The meaning in (28) satisfies our desiderata: it entails distributive inferences but not plain negated inferences. First, distributive inferences are entailed since if it holds that everyone of my brothers has been married to a man or a woman and that not everyone of my brothers has been married to a woman but not to a man, then some brother of mine must have has been married to a man and vice versa. Second, plain negated inferences are not entailed since it may well be the case that every brother of mine has been married to a woman as long as at least one (but not all) of them has also been married to a man and that every brother of mine has been married to a man as long as at least one (but not all) of them has also been married to a woman.

(29) a. (28) $\Rightarrow$ Some brother of mine has been married to a woman
$\wedge$ Some brother of mine has been married to a man
b. (28) $\not\Rightarrow$ $\neg$Every brother of mine has been married to a woman
$\wedge$ $\neg$Every brother of mine has been married to a man

Moreover, it is worth noting that we obtain distributive inferences in the absence of plain negated inferences also if we prune the conjunctive alternative from the domain C_2 of the matrix exhaustification operator:

(30) C_2' = {every brother$_x$ (exh(C_1)(x has been married to a woman)),
every brother$_x$ (exh(C_1)(x has been married to a man))}

Unsurprisingly, the meaning that we get on such resolution is logically weaker than the meaning that we get if we do not prune the conjunctive alternative. In fact, the meaning that we get on this resolution is equivalent to the conjunction of the prejacent and distributive inferences.

(31) exh(C_2')(every brother$_x$(exh(C_1)(x has been married to a woman or a man))) =
λw. Every brother of mine has been married to a woman or a man in w $\wedge$
$\neg$Every brother of mine has been married to a woman but not to a man in w $\wedge$
$\neg$Every brother of mine has been married to a man but not to a woman in w

To summarize, we have shown that if a sentence containing a disjunction in the scope of a universal quantifier has a parse on which both the matrix and the embedded clause are exhaustified, which is a possible parse on the grammatical approach to SIs,

(32) a. Every brother of mine has been married to a woman or a man.
b. exh(C_2)(every brother$_x$ (exh(C_1)(x has been married to a woman or a man)))

the standard assumption about alternatives warrants that the sentence has as its alternatives the exhaustified alternatives necessary to derive distributive inferences in the absence of plain negated inferences, as summed up in (21).

(33) a. Every brother of mine has been married to a woman but not to a man
b. Every brother or mine has been married to a man but not to a woman

If the conjunctive alternative is pruned from the domain of the embedded exhaustification operator, the sentence entails distributive inferences – in the case of (32), that some brother of mine is married to a woman and some brother of mine is married to a man – without entailing plain negated inferences – in the case of (32), that not every brother of mine has been married to a woman and not every brother of mine has been married to a man. This holds both when the conjunctive alternative is pruned from the domain of the matrix exhaustification operator and when it is not.

This resolves the puzzle about distributive inferences. The resolution keeps to the standard assumptions about alternatives and to those of the grammatical approach to SIs. However, the assumption that conjunctive alternatives can sometimes be pruned is not without consequences and a pertinent remaining task is to ensure that it does not lead to wrong predictions elsewhere.

3.3 Constraint on pruning

On the grammatical approach to SIs, if one were allowed to freely prune conjunctive alternatives, one would predict that plain disjunction may have a conjunctive meaning, contrary to fact (see Chierchia 2010, Fox & Katzir 2011, Meyer 2012, Ivlieva 2013 and, in particular, Katzir 2013). We illustrate this in the following: if the sentence in (34-a) would have a recursively exhaustified structure, (34-b), where the domains of exhaustification would contain alternatives built on just one of the disjuncts and no conjunctive alternatives, the sentence would entail that both disjuncts are true.

(34) a. John ate cake or ice-cream.
b. exh(C_2)((exh(C_1)(John ate cake or ice-cream)))
c. C_1 = {John ate cake, John ate ice-cream}
d. C_2 = {exh(C_1)(John ate cake), exh(C_1)(John ate ice-cream)}

Namely, the meaning of the sentence would be that it is true that John ate cake or ice-cream but false that he ate just cake and false that he ate just ice-cream, (35) (note that both alternatives in C_2 are excludable given the prejacent and C_2, that is, the prejacent conjoined with negations of the alternatives is consistent). This exhaustified meaning, in turn, is equivalent to John eating both cake and ice-cream (Singh et al. 2013).

(35) exh(C_2)((exh(C_1)(John ate cake or ice-cream))) =
λw. John ate cake or ice-cream in w $\wedge$
$\neg$John ate cake but not ice-cream in w $\wedge$
$\neg$John ate ice-cream but not cake in w
$\Leftrightarrow$ λw. John ate cake in w $\wedge$ John ate ice-cream in w

The problem is obviously that the sentence in (34) never conveys such a conjunctive meaning. The explanation of the puzzle that we provided in the preceding subsection thus leads us, all else being equal, to expect that disjunction may have readings that we in fact fail to observe.

(36) **Prediction**
On the grammatical approach to SIs and the assumption of unconstrained pruning of alternatives, plain disjunction may convey a conjunctive meaning

The need to constrain the pruning of alternatives in order to avoid undesirable results has been independently acknowledged and tackled by Fox & Katzir (2011). Their constraint, though successful in blocking conjunctive meaning for simple disjunctive sentences, would block the pruning that we rely on in this paper. We thus propose a different constraint: pruning of alternatives needs to result in structures that are asymmetrically entailed by their counterparts in which at least some of those alternatives have not been pruned (see also Katzir 2013 for another closely related possibility).

(37) **Constraint on pruning**
exh(C)(S) is licensed for $C \subseteq ALT(S)$ only if for any C′, $C \subset C' \subseteq ALT(S)$, exh(C′)(S) asymmetrically entails exh(C)(S)

The constraint in (37) correctly rules out a parse of a plain disjunctive sentence entertained in (34): although pruning of the conjunctive alternative from the domain of the embedded *exh* complies with (37), subsequent pruning of the conjunctive alternative from the domain of the matrix *exh* does not, as we elaborate on in the following. Pruning and embedded *exh*: Pruning of the conjunctive alternative from the domain of embedded *exh* is legitimate because the meaning that we obtain – that John ate cake or ice-cream, that is, the exhaustification is vacuous – is entailed by the meaning of the structure in which the conjunctive alternative is not pruned – that John ate cake or ice-cream but not both. Pruning and matrix *exh*: A subsequent pruning of the conjunctive alternative from the domain of the matrix *exh* leads to a meaning – that John ate cake and ice-cream – that entails the meaning of the structure in which the conjunctive alternative is not pruned – that John ate cake or ice-cream. More to the point, if the domain of the matrix exhaustification operator contains all the alternatives, as represented in (38-c), none of the alternatives are excludable with respect to it and the prejacent.

(38) a. exh(C_2')(exh(C_1)(John ate cake or ice-cream))
b. C_1 = {John ate cake, John ate ice-cream}
c. C_2' = {exh(C_1)(John ate cake), exh(C_1)(John ate ice-cream), exh(C_1)(John ate cake and ice-cream)}

For example, the prejacent conjoined with the negations of the two non-conjunctive alternatives is consistent and entails the conjunctive alternative, showing that the conjunctive alternative is not in every maximal set of alternatives that can be consistently negated and conjoined with the prejacent and, thus, that it is not excludable. Accordingly, the structure fails to trigger any SI and fails to entail that John ate cake and ice-cream, which is the meaning of the parse of the sentence in which the conjunctive alternative is pruned, (35).

(39) exh(C_2')(exh(C_1)(John ate cake or ice-cream)) $\not\Rightarrow$
exh(C_2)(exh(C_1)(John ate cake or ice-cream))

This means that the parse on which the conjunctive alternative is pruned from the domain of matrix exhaustification – a parse that yields the unwanted conjunctive interpretation of plain disjunction – is ruled out by the constraint on pruning in (37) that requires pruning to lead to weaker meanings.[7]

(40) **Consequence of the constraint on pruning**
For all C_2', $C_2 \subset C_2' \subseteq$ ALT(exh(C_1)(John ate cake or ice-cream)),
exh(C_2')(exh(C_1)(J. ate cake or ice-cream)) $\not\Rightarrow$ / $\not\Leftarrow$
exh(C_2)(exh(C_1)(J. ate cake or ice-cream))

In contrast, the proposed resolution of domains of the two exhaustification operators in (22) that yields distributive inferences in the absence of plain negated inferences, repeated below, complies with the constraint on pruning.

(41)
a. Every brother of mine has been married to a woman or a man.
b. exh(C_2)(every brother$_x$ (exh(C_1)(x has been married to a woman or a man)))
c. C_1 = {x has been married to a woman, x has been married to a man}
d. C_2 = {every brother$_x$ (exh(C_1)(x has been married to a woman)),
every brother$_x$ (exh(C_1)(x has been married to a man))}

(42) exh(C_2)(every brother$_x$ (exh(C_1)(x has been married to a woman or a man))) =
λw. Every brother of mine has been married to a woman or a man in w $\wedge$
$\neg$Every brother of mine has been married to a woman but not to a man in w $\wedge$
$\neg$Every brother of mine has been married to a man but not to a woman in w

In particular, if the domain of the matrix exhaustification operator were to contain in addition to the non-conjunctive alternatives also the conjunctive alternative, given in (43-d), all the alternatives in C_2' would be excludable with respect to the prejacent and C_2' – the prejacent conjoined with negations of the three alternatives is consistent.

(43)
a. Every brother of mine has been married to a woman or a man.
b. exh(C_2')(every brother$_x$ (exh(C_1)(x has been married to a woman or a man)))
c. C_1 = {x has been married to a woman, x has been married to a man}
d. C_2' = {every brother$_x$ (exh(C_1)(x has been married to a woman)),
every brother$_x$ (exh(C_1)(x has been married to a man)),
every brother$_x$ (exh(C_1)(x has been married to a woman and a man))}

Accordingly, the meaning of the structure would be the following:

(44) exh(C_2')(every brother$_x$ (exh(C_1)(x has been married to a woman or a man))) =
λw. Every brother of mine has been married to a woman or a man in w $\wedge$
$\neg$Every brother of mine has been married to a woman but not to a man in w $\wedge$
$\neg$Every brother of mine has been married to a man but not to a woman in w $\wedge$
$\neg$Every brother of mine has been married to a man and to a woman in w

[7] Building on preceding observations by Braine & Rumain (1981), Singh et al. (2013) show that there is a population of children that interpret plain disjunction conjunctively. To account for this behavior, Singh et al. propose that that population of children lacks conjunctive alternatives altogether (more generally, they lack substitution alternatives, that is, alternatives that are derived by substituting lexical items in the prejacent). Their proposal is thus compatible with the constraint on pruning in (37).

Since this meaning asymmetrically entails the meaning that we obtain by pruning the conjunctive alternative (note that (44) differs from (42) only in the former having an additional conjunct), the representation in which the conjunctive alternative is pruned satisfies the constraint on pruning in (37).

3.4 Summary

In this section we have provided an account of the puzzle about distributive inferences, that is, the puzzle that disjunction in the scope of a universal quantifier can give rise to distributive inferences in the absence of plain negated inferences. Our starting point was the observation that distributive inferences can be derived as SIs in the absence of plain negated inferences if exhaustified alternatives are assumed.

(21) **Observation about exhaustification based on exhaustified alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification is based on its exhaustified alternatives (*Every A is only P, Every A is only Q*), distributive inferences (*Some A is P, Some A is Q*) are derived in the absence of plain negated inferences (¬*Every A is P,* ¬*Every A is Q*)

While on approaches to SIs that do not allow for embedded exhaustification exhaustified alternatives are unavailable given the standard assumptions about alternatives, on the grammatical approach to SIs they are available if the respective sentences are exhaustified at the embedded level in addition to the matrix level.

(45) a. Every A is P or Q.
b. $\text{exh}(C_2)(\text{every } A_x\ (\text{exh}(C_1)(x \text{ is P or Q})))$

Moreover, if we prune the conjunctive alternative from the domain of the embedded exhaustification operator (and no other alternatives are pruned), we obtain distributive inferences in the absence of plain negated inferences.

(46) $\text{exh}(C_2)(\text{every } A_x\ (\text{exh}(C_1)(x \text{ is P or Q})))$
$\Rightarrow$ Every A is P or Q $\wedge$ ¬Every A is P but not Q $\wedge$ ¬Every A is Q but not P
$\Rightarrow$ Some A is P $\wedge$ Some A is Q
$\not\Rightarrow$ ¬Every A is P $\wedge$ ¬Every A is Q

To avoid overgeneration, we suggested a constraint on pruning requiring it to lead to meanings that are logically weaker from the meaning that we obtain without pruning.

4 Experiment

In the preceding section, we have shown how to derive distributive inferences in the absence of plain negated inferences. The following section presents results of a sentence verification experiment that suggest that such a derivation of distributive inferences is not only possible but, in our task, preferred to a derivation with plain negated inferences.

More precisely, the experiment provides evidence that distributive inferences are computed but no evidence for the computation of plain negated inferences.

4.1 Experimental items and predictions

A sentence verification experiment was devised in which subjects were presented with a picture accompanied by a sentence and asked to evaluate whether the sentence provides a true or false description of the picture. The pictures had the form exemplified by the experimental item in Figure 1: there were five boxes with each box containing some letters from A to F, positioned into six columns.

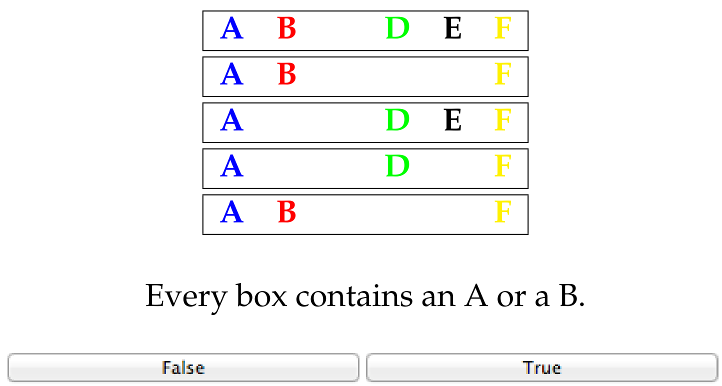


Figure 1: An example of an experimental item used in the experiment.

The position of letters in the respective columns stayed fixed throughout the experiment, following alphabetical order from left to right. Which letter was shown in which box varied however: for example, the letter A need not appear in every box but if it does it would always appear in the first position. The distribution of letters satisfied certain constraints across all the trials, such that the right choice of letters would allow us to create any configuration of interest (see below). Specifically, there was a letter that was in every box (e.g., A and F in Figure 1), there was a letter that was missing from every box (e.g., C in Figure 1), there was always a pair of letters such that every box contained a member of the pair, but no single member of the pair was in every box (e.g., B and D in Figure 1), and there was always a pair of letters such that each of the two letters was in some box, but some box contained neither letter (e.g., B and E, D and E in Figure 1). The pertinent experimental sentences had the form given in (47) where the two letters varied across trials and were taken from A to F. After the picture and the paired sentence were displayed, the subject had to evaluate whether the sentence is a true description of the picture.

(47) Every box contains an A or a B.

The primary goal of the experiment was to establish whether there is a relation between the computation of distributive inferences, exemplified in (48-b), and the computation of plain negated inferences, exemplified in (48-c).

(48) a. **Experimental sentence**
Every box contains an A or a B.

b. **Distributive inferences**
Some box contains an A ∧ Some box contains a B

c. **Plain negated inferences**
¬Every box contains an A ∧ ¬Every box contains a B

Recall that we have described two derivations of distributive inferences and they give rise to different predictions. Section 1 presented a derivation of distributive inferences that relied on the exhaustification of the matrix sentence on the basis of plain alternatives; this derivation crucially relies on generating plain negated inferences.

(14) **Observation about exhaustification based on plain alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification operates on its plain alternatives (*Every A is P, Every A is Q*), distributive inferences (*Some A is P, Some A is Q*) are derived from their negation (*¬Every A is P, ¬Every A is Q*)

Section 3 presented a derivation of them that relied on exhaustified alternatives, a derivation that is available on the grammatical approach to SIs coupled with the standard assumptions about alternatives but not on pragmatic approaches; this derivation did not involve generating plain negated inferences.

(21) **Observation about exhaustification based on exhaustified alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification is based on its exhaustified alternatives (*Every A is only P, Every A is only Q*), distributive inferences (*Some A is P, Some A is Q*) are derived in the absence of plain negated inferences (*¬Every A is P, ¬Every A is Q*)

We now describe the different conditions of the experiment and the predicted responses given the two derivations of distributive inferences. The appropriate responses to picture sentence pairs given the two derivations match in certain cases. They match, first, for picture sentence pairs where every box in the picture contains one of the two letters and where the plain negated inferences of the sentence are true (both exhaustifications are true, M1); second, for picture sentence pairs where not every box in the picture contains one of the two letters (both exhaustifications are false, M2 and M3); and, third, for picture sentence pairs where every box contains one of the two letters and no box contains the other letter, that is, in picture sentence pairs on which the distributive inferences are false (both exhaustifications are false, M4). (See Figure 2 for a visual presentation of the conditions.)

(49) **Matching conditions**
M1: Prejacent is true & plain negated (and distributive) inferences are true
M2: Prejacent is false & both letters in the disjunction are in some box
M3: Prejacent is false & only one letter in the disjunction is in some box
M4: Prejacent is true & distributive (and plain negated) inferences are false

(50) **Predicted responses to matching conditions on both derivations**

M1: True (prejacent is true, exhaustified inferences are true)
M2: False (prejacent is false)
M3: False (prejacent is false)
M4: False (prejacent is true, exhaustified inferences are false)

On the other hand, appropriate responses come apart for picture sentence pairs in which distributive inferences of the sentence are true but plain negated inferences are false.

(51) **Distinguishing conditions**

D1: Prejacent is true, distributive inferences are true, but plain negated inferences are false; only one of the letters in the sentence is in all of the boxes
D2: Prejacent is true, distributive inferences are true, but plain negated inferences are false; both letters in the sentence are in all of the boxes

On the exhaustification described in section 1 these sentences should, to the extent that SIs are computed, be judged as false, (14), while on the exhaustification discussed in section 3 these sentences should be judged as true, (21). More specifically, we will be interested in the following prediction. The rejection rate of M4 provides an evaluation of the base derivation rate of plain negated inferences. If (a) distributive inferences are tied to negated plain inferences, D1 and D2 should be just like M4, but if (b) distributive inferences can be derived independently of plain negated inferences, we expect that the rejection rate could be lower for D1 and D2.

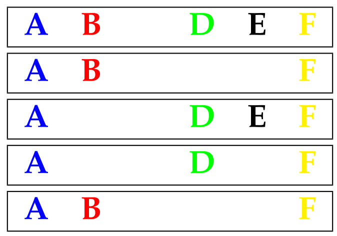
(52) **Predicted responses to distingushing conditions**

D1, D2: False (exhaustification with plain alternatives)
D1, D2: True (exhaustification with exhaustified alternatives)[8]

The conditions and the predicted responses on the two types of exhaustification are summarized in the table in Figure 2; the conditions on which the two types of exhaustification make distinguishable predictions are highlighted.

[8]Note that this prediction holds if the conjunctive alternative is pruned from the domains of both embedded and matrix *exh*. If the conjunctive alternative is pruned from the domain of the embedded but not the matrix *exh*, the predicted response is True for D1 and False for D2. If the conjunctive alternative is not pruned from the domain of the embedded *exh*, the predicted response is False for all conditions (esp. condition M1). In any case, the predictions of exhaustification based on plain and exhaustified alternatives are distinct. See sections 4.3 and 5.3 for further discussion.

Conditions	Predicted responses	
	Plain alternatives	Exhaustified alternatives
M1 *(B or D)*	T	T
M2 *(B or E)*	F	F
M3 *(B or C)*	F	F
M4 *(A or C)*	F	F
D1 *(A or B)*	F	T
D2 *(A or F)*	F	T



M1: Every box contains a B or a D
M2: Every box contains a B or an E
M3: Every box contains a B or a C
M4: Every box contains an A or a C
D1: Every box contains an A or an B
D2: Every box contains an A or an F

Figure 2: Summary of the conditions.

4.2 Subjects and procedure

Fifty-three native English speaking subjects performed the experiment on Amazon Turk for payment of $1.05. Each of the conditions appeared eight times with the exception of the first control condition, M1, on which both distributive and plain negated inferences are true, which appeared sixteen times to counterbalance negative responses; there were also sixty filler items that did not contain disjunction. Two subjects were excluded from the analysis due to poor performance on the first three matching conditions (less than 75% correct responses).[9]

4.3 Results

We analyzed the proportions of subjects' responses to the experimental sentences. Figure 3 presents the main result. We see that subjects responded as expected in the first three matching conditions: the mean of True responses to the sentences in condition M1 was

[9]Without screening the subjects, we obtain practically indistinguishable results. The means and standard errors of the conditions without screening ($n = 53$) are M1 - mean 93, std. error 1; M2 - mean 4.8, std. error 1.1; M3 - mean 0.8, std. error 0.5; M4 - mean 75.2, std. error 2.1; D1 - mean 93.3, std. error 1.2; D2 - mean 92.2, std. error 1.3. Furthermore, a by-subjects Wilcoxon Signed-rank test reveals that the differences between the distinguishing conditions D1 and D2 and the matching condition M4, are significant (M4 vs. D1: W = 10, Z = -4.62, $p < 0.0001$; M4 vs. D2: W = 27.5, Z = -4.4, $p < 0.0001$). Moreover, the difference between the matching condition M4 and the matching condition M1 is significant as well (M1 vs. M4: W = 8, Z = -4.29, $p < 0.0001$). See footnote 19 for some further discussion of the screened subjects.

97% (std. error 1%), while the mean of True responses to the sentences in conditions M2 and M3 was about 5% (std. error 1.4%) and 1% (std. error 0.4%), respectively.

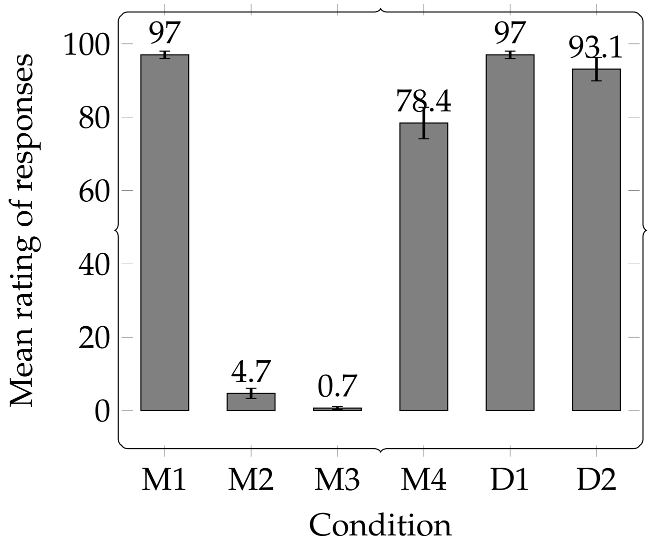


Figure 3: Mean acceptability ratings with error bars representing standard error.

There is a contrast between the responses of subjects in the remaining three conditions: on the one hand, the mean of True responses in conditions D1 and D2 was about 97% (std. error 1%) and 93% (std. error 3.2%), respectively, that is, in conditions in which distributive inferences are true but plain negated inferences are false. On the other hand, the mean of True responses was only 78% (std. error 4.3%) in condition M4, that is, in a condition in which distributive inferences are false. A by-subjects ($n = 51$) Wilcoxon Signed-rank test reveals that the differences between the distinguishing conditions in which distributive inferences are true but plain negated inferences are false, D1 and D2, and the matching condition on which distributive inferences are false, M4, is significant (M4 vs. D1: W = 9, Z = -4.52, $p < 0.0001$; M4 vs. D2: W = 27.5, Z = -4.23, $p < 0.001$). Moreover, the difference between the matching condition M4, on which distributive inferences are false, and the matching condition M1, on which both distributive and plain negated inferences are true, is significant as well (M1 vs. M4: W = 8, Z = -4.29, $p < 0.0001$). No other relevant pairwise comparison provided a significant difference (in all comparisons $W > 40$, $p > 0.2$),[10] except for the difference between the matching conditions M2 and M3.[11] Thus, the acceptability ratings of the sentences in the distinguishing conditions D1 and D2 are

[10] There is no significant difference between the distinguishing conditions D1 and D2 (D1 vs. D2: W = 41, Z = -0.16, $p > 0.5$) nor between the distinguishing conditions D1 and D2 and the matching condition M1 (M1 vs. D1: W = 42.5, Z = -0.53, $p > 0.5$; M1 vs. D2: W = 65.5, Z = 1.64, $p > 0.2$).

[11] A Wilcoxon Signed-rank test shows that the difference between the matching condition M2, on which the prejacent is false and the picture contains both of the letters mentioned in the experimental sentence, and the matching condition M3, on which the prejacent is false and the picture contains just one of the letters mentioned in the experimental sentence, is significant as well (M2 vs. M3: W = 5.5, Z = -2.4, $p < 0.01$). We defer the pursuit of the reasons for this difference to another occasion.

at the level of those in the matching condition M1, on which both distributive and plain negated inferences are true; the acceptability ratings of the sentences drop significantly in the matching condition M4, on which the prejacent is true but distributive inferences are false.

An exploration of individual subjects' responses reveals that the population is not homogeneous – specifically, groups of subjects appear to employ different response strategies on certain conditions. We focus on two conditions in the following – the condition M4, where subjects could be divided into different populations, and the condition D1, where we observe homogeneous behavior; we return to other conditions in the subsequent section where we elaborate on possible sources for the differences in subjects' response patterns.

First: We have seen that the responses on condition M4, on which the distributive inferences are false, are significantly different from the responses on all other conditions. The question is whether this difference results from a homogenous population that on average tends to reject the sentence more often on this condition than on others, or whether there are sub-populations that behave in a more uniform fashion. The individual subjects' behavior can be gleaned from the breakdown of the responses by number of times a subject responded with True represented in Figure 4.[12]

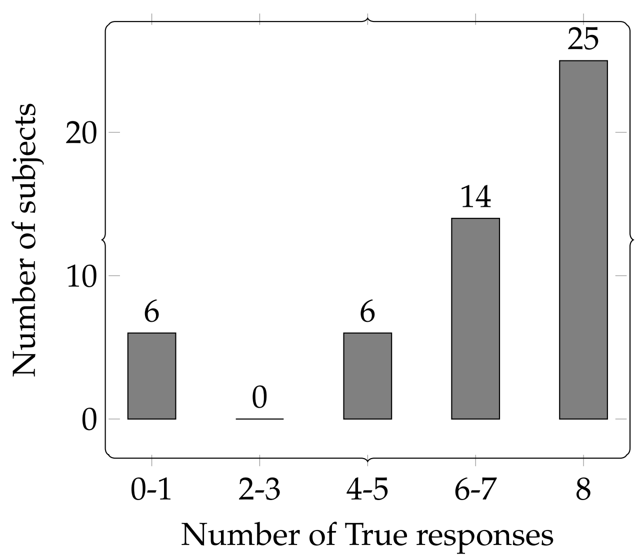


Figure 4: Responses on condition M4, on which distributive inferences are false. (All 51 subjects evaluated 8 items of the condition.)

The population is not homogeneous on this condition. More to the point, the data suggest that there are at least two populations of subjects that differ in their response strategies

[12]Each of the 51 subjects was presented with eight items of condition M4 using Latin square design. Among the 51 subjects, 3 subjects responded with True to none of the eight items; 3 subjects responded with True to one item; 3 subjects responded with True to four items; 3 subjects responded with True to five items; 7 subjects responded with True to six items; 7 subjects responded with True to seven items; 25 subjects responded with True to eight items.

– that is, subjects that compute SIs and subjects that do not (see the following section for further elaboration). This distribution of response strategies is in line with previous experimental studies on SIs that have observed that there tends to be a substantial subpopulation of subjects that appear not to compute SIs (suggestively dubbed 'logicians' by Noveck 2000, Bott & Noveck 2004).

Second: Unlike in the case of condition M4, subjects' behavior appears to be homogeneous on condition D1, on which distributive inferences are true but plain negated inferences are not. More to the point, the data suggest that subjects do not to compute plain negated inferences. The breakdown of the responses is represented in Figure 5.[13]

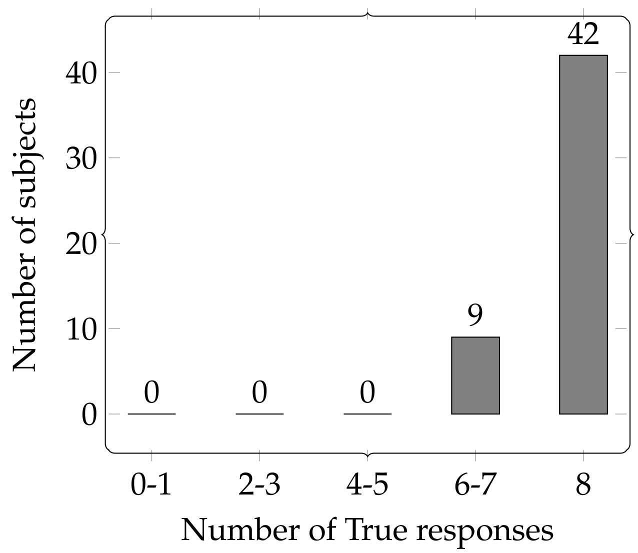


Figure 5: Responses on condition D1, on which distributive inferences are true but plain negated inferences are false. (All 51 subjects evaluated 8 items of the condition.)

All in all, the results presented in this section are concordant with distributive inferences being generated in the absence of plain negated inferences. This conforms to our observation that distributive and plain negated inferences can be dissociated. However, we found no evidence for other readings that should in principle be available (as we will see in detail shortly). We, thus, need to refer to certain additional principles that would disprefer (or block) the unattended readings.

5 More on the experimental results

We have seen that although distributive inferences in the absence of plain negated inferences cannot be derived on approaches that rely on exhaustification based on plain

[13]Each of the 51 subjects was presented with eight items of condition D1 using Latin square design. Among the 51 subjects, 42 subjects responded with True to eight of the eight items; 6 subjects responded with True to seven items; 3 subjects responded with True to six items.

alternatives, they can be derived on approaches that rely on exhaustification based on exhaustified alternatives, that is, alternatives that are available on the grammatical approach to SIs and standard assumptions about alternatives. This holds also for the experimental sentences described in the preceding section.

(53) a. **Experimental sentence**
Every box contains an A or a B.
b. **Distributive inferences**
Some box contains an A $\wedge$ Some box contains a B
c. **Plain negated inferences**
$\neg$Every box contains an A $\wedge$ $\neg$Every box contains a B

In case of these sentences, distributive inferences are derived without plain negated inferences from parses of the form given in (54) that contain two occurrences of *exh* and in which the conjunctive alternative is pruned from the domains of both occurrences of *exh* (though recall that distributive inferences without plain negated inferences obtain even if the conjunctive alternative is not pruned from the domain of the matrix *exh*, see below).

(54) a. exh(C_2)(every box_x (exh(C_1)(x contains an A or a B)))
b. C_1 = {x contains an A, x contains a B}
c. C_2 = {every box_x (exh(C_1)(x contains an A)),
every box_x (exh(C_1)(x contains a B))}
d. λw. Every box contains an A or a B in w $\wedge$ Some box contains an A in w $\wedge$ Some box contains a B in w

5.1 Ambiguity in exhaustification

In addition to the parse in (54), the grammatical approach to SIs allows for several other parses of the sentence in (53) and, accordingly, for several other readings of the sentence. In particular, it allows for a reading with no distributive inferences, which can be derived, say, from a parse with no exhaustification operators. It allows for a reading that gives rise to plain negated inferences, as discussed at length in section 1.

(55) a. exh(C)(every box contains an A or a B)))
b. C = {every box contains an A, every box contains a B}

(56) **Plain negated inferences**
a. $\neg$Every box contains an A
b. $\neg$Every box contains a B

It also allows for readings that entail the negation of the conjunctive alternative to the matrix sentence, which can derived by the matrix *exh* having the conjunctive alternative in its domain. A parse that entails the negation of the conjunctive alternative to the matrix sentence and distributive inferences is provided in (57), where the conjunctive alternative has been pruned from the domain of the embedded *exh* but not the matrix *exh*.

(57) a. $\text{exh}(C_2)(\text{every box}_x\ \text{exh}(C_1)(\text{x contains an A or a B}))$
b. C_1 = {x contains A, x contains a B}
c. C_2 = {every box_x ($\text{exh}(C_1)$(x contains an A)),
every box_x ($\text{exh}(C_1)$(x contains a B)),
every box_x ($\text{exh}(C_1)$(x contains an A and B))}
d. λw. Every box contains an A or a B in w $\wedge$ Some box contains an A in w $\wedge$ Some box contains a B in w $\wedge$ $\neg$Every box contains an A and a B in w

(58) **Matrix negation of conjunctive alternative**
$\neg$Every box contains an A and a B

Finally, the grammatical approach to SIs allows for readings with embedded strengthening of disjunction, which can be derived by embedded *exh* having the conjunctive alternative in its domain.

(59) a. every box_x ($\text{exh}(C)$(x contains an A or a B))
b. C = {x contains an A, x contains a B, x contains an A and B}
c. λw. Every box contains an A or a B but not both A and B in w
(= λw. Every box contains just one of A or B in w)

(60) **Embedded negation of conjunctive alternative**
Every box contains an A or a B but not both A and B
(= Every box contains just one of A or B)

The results of the experiment described in the preceding section, however, provide support for only some of these readings for sentences like (53) – specifically, (a) readings with distributive inferences but no plain negated inferences and (b) a reading with no distributive inferences.

(61) **Available readings**
Two types of readings of disjunction under a universal quantifier are supported by the experimental results in section 4: (a) readings with distributive inferences but no plain negated inferences and (b) a reading without distributive inferences

That is, we found no evidence for the existence of several other readings that can be generated on the grammatical approach to SIs, in particular, readings that entail plain negated inferences. Namely, while on the condition on which distributive inferences were false, M4, the mean of responses was significantly lower than on other pertinent conditions and there was a population that systematically judged the sentences as false, this was not the case on conditions on which plain negated inferences were false (see the discussion of the contrast between conditions M4 and D1 in the preceding section, esp. Figures 3-5).

On the face of it, this means that the results of the experiment described in the preceding section present a puzzle for the grammatical approach to SIs: namely, the approach admits representations and thus readings for which we lack evidence.[14] Accordingly, an

[14]In general, the grammatical approach provides for many more readings of sentences in which scalar items are embedded under other operators than the pragmatic approach since it, all else being equal, allows for recursive exhaustification and exhaustification in embedded scope positions. This possibility has been construed as an argument for the grammatical approach to SIs and has been taken as an argument against

account is needed on which (a) grammatical means rein in the representations admitted by the grammatical approach or (b) there is a selection mechanism that picks out the preferred representations from those admitted by the approach or (c) on which both (a) and (b) hold and together yield limitations on attested readings. The remaining goal of the paper is to provide a tentative account for the constraint described in (61) by relying on the strategy in (c). (The account is tentative in the sense that alternative accounts are conceivable and may lead to distinct predictions in other domains of SI computation, something that we hope to pursue at another occasion. See section 6 for further discussion.)

5.2 Unavailable readings

We put forward that the state of affairs described in (61) emerges from an interaction of two grammatical principles. We have already introduced one pertinent grammatical principle above, the constraint on pruning, repeated below.

(37) **Constraint on pruning**
exh(C)(S) is licensed for $C \subseteq ALT(S)$ only if for any C′, $C \subset C' \subseteq ALT(S)$, exh(C′)(S) asymmetrically entails exh(C)(S)

The other grammatical principle relates to obligatoriness of exhaustification: an exhaustification operator is generated at every scope position, an assumption that has been extensively discussed and argued for by Magri (2011).[15,16]

(62) **Obligatoriness of exhaustification**
Every phrase of type t is either a sister of an exhaustification operator or an exhaustification operator is one of its daughters

An immediate consequence of these two principles is that parses that give rise to plain negated inferences without embedded strengthening of disjunction are ruled out. Recall that we generated such readings in section 1 by relying on matrix exhaustification based on plain alternatives. On the assumption of obligatoriness of exhaustification at every scope position, this would correspond to a parse on which all the alternatives of the embedded *exh* are pruned:

the grammatical approach by others (see e.g. Fox & Hackl 2006, Chierchia, Fox & Spector 2011, Chemla & Spector 2011, Magri 2011, Crnič 2013, among others; Russell 2006, Geurts & Pouscoulous 2009 for a differing view). In any event, it is clear that the grammatical approach would need to constrain the distribution of embedded exhaustification (e.g., Fox & Spector 2009, Chierchia, Fox & Spector 2011).

[15]Under this approach a sentence will lack an SI when the obligatory exhaustification operators will have no (innocently excludable) alternatives.

[16]If we take alternatives to an expression be other well-formed expressions in the language that are derived from the expression by certain manipulations (say, by replacement of scalar items with other scalar items), as is commonly assumed (e.g., Sauerland 2004, Katzir 2007), the grammatical principle in (62) has the consequence that all embedded clauses in alternatives will contain an exhaustification operator. This consequence is pertinent for our discussion in the main text because it greatly constrains the number of possible parses we need to consider. See Magri (2011) for various questions raised by the assumption of the principle in (62), e.g., questions pertaining to economy conditions on the distribution of the exhaustification operator.

(63) a. exh(C_2)(every box$_x$ (exh(C_1)(x contains an A or a B)))
b. $C_1 = \emptyset$
c. C_2 = {every box$_x$ (exh(C_1)(x contains an A)),
every box$_x$ (exh(C_1)(x contains a B))}

However, this parse is ruled out by the constraint on pruning, specifically, the constraint is violated by embedded exhaustification, whose import is given in (64).

(64) a. exh(C_1)(x contains an A or a B))
b. $C_1 = \emptyset$
c. λw. x contains an A or a B in w

Namely, there is a proper superset of the set C, given in (65), relative to which embedded exhaustification yields a meaning that does not asymmetrically entail the meaning in (64) but is rather equivalent to it. This is due to the fact that neither alternative in this superset of C is excludable and, accordingly, neither alternative is negated by exhaustification. This means that (64) and, as a consequence, (63) violate the constraint on pruning.

(65) a. exh(C_1')(x contains an A or a B))
b. C_1' = {x contains an A, x contains a B}
c. λw. x contains an A or a B in w

(66) **Entailment relation between (64) and (65)**
exh(C_1)(x contains an A or a B)) $\Leftrightarrow$ exh(C_1')(x contains an A or a B))

(67) **Consequence of the constraint on pruning**
For all C_1', $C_1 \subset C_1' \subseteq$ ALT(x contains an A or a B),
exh(C_1')(x contains an A or a B)) $\not\Rrightarrow$ exh(C_1)(x contains an A or a B))

The parse that yields plain negated inferences without embedded strenthening of disjunction is thus correctly ruled out by the two grammatical principles. This explains why no subjects had a tendency of responding with False to all the conditions on which plain negated inferences are false (in particular, to both conditions M4 and D1).[17] The idealized response profile accompanying the precluded parse is represented in Figure 6.

Parse	Idealized response profile	Inferences			
		Dist.	Mat. neg. conj.	Emb. neg. conj.	Plain neg.
(63)	[M4: 0], [D1: 0], [D2: 0]	✓	✓	✗	✓

Figure 6: Idealized response profile corresponding to the precluded parse (63) with a specification of what inferences are entailed by the parse.

By accounting for the unavailability of plain negated inferences, we have achieved the primary goal of this section. In the remainder of the section, we explore some more fine-grained predictions of our proposal (pertaining to the parses of the experimental sentence

[17]Recall that all subjects responded with True to at least six of the eight condition D1 items (see Figure 5 and the accompanying discussion).

that are admitted on our proposal), how they square with our experimental results, and point to some issues this raises for future research.

5.3 Available readings

The two principles do not affect the availability of other parses and thus other readings of the sentence. In particular, they allow for parses that yield (a) distributive inferences in the absence of plain negated inferences, as discussed in section 3, and parses that yield (b) no distributive inferences.

5.3.1 Readings with distributive inferences

There are three parses of the experimental sentence that comply with the principles introduced above and entail distributive inferences. First: if the conjunctive alternatives are pruned from the domains of both embedded and matrix *exh*, we obtain a parse that entails distributive inferences in the absence of the matrix negation of the conjunctive alternative and plain negated inferences. On this parse, repeated below, the experimental sentence should be judged as false in condition M4, in which distributive inferences are false, while it should be judged as true in conditions D1 and D2, in which distributive inferences are true but plain negated inferences are false. (See the first row of the summary in Figure 7.)

(54) a. exh(C_2)(every box_x (exh(C_1)(x contains an A or a B)))
b. C_1 = {x contains an A, x contains a B}
c. C_2 = {every box_x (exh(C_1)(x contains an A)),
every box_x (exh(C_1)(x contains a B))}
d. λw. Every box contains an A or a B in w $\wedge$ Some box contains an A in w $\wedge$ Some box contains a B in w

Second: if the conjunctive alternative is pruned from the domain of the embedded *exh* but not the matrix *exh*, the sentence entails distributive inferences and the matrix negation of the conjunctive alternative but not plain negated inferences. On this parse, repeated below, the experimental sentence should be judged as false in condition M4, in which distributive inferences are false, and in condition D2, in which the matrix negation of the conjunctive alternative is false; the experimental sentence should be judged as true in condition D1, in which distributive inferences and the matrix negation of the conjunctive alternative are true. (See the second row of the summary in Figure 7.)

(57) a. exh(C_2)(every box_x exh(C_1)(x contains an A or a B))
b. C_1 = {x contains A, x contains a B}
c. C_2 = {every box_x (exh(C_1)(x contains an A)),
every box_x (exh(C_1)(x contains a B)),
every box_x (exh(C_1)(x contains an A and B))}
d. λw. Every box contains an A or a B in w $\wedge$ Some box contains an A in w $\wedge$ Some box contains a B in w $\wedge$ $\neg$Every box contains an A and a B in w

Third: if the conjunctive alternatives is not pruned from the domain of embedded *exh*, the sentence entails distributive inferences and embedded strengthening of disjunction (and plain negated inferences if deletion alternatives are not pruned from the domain of the matrix *exh*). On this parse, represented in (68), the experimental sentence should be judged as false in all conditions in which distributive or embedded strengthening of disjunction inferences are false (which in our experiment means all conditions). (See the third row of the summary in Figure 7.)

(68) a. exh(C_2)(every box$_x$ (exh(C_1)(x contains an A or a B)))
b. C_1 = {x contains an A, x contains a B, x contains an A and a B}
c. $C_2 = \varnothing$
d. λw. Every box contains an A or a B but not both in w

Parse	**Idealized response profile**	**Inferences**			
		Dist.	Mat. neg. conj.	Emb. neg. conj.	Plain neg.
(54)	[M4: 0], [D1: 8], [D2: 8]	✓	✗	✗	✗
(57)	[M4: 0], [D1: 8], [D2: 0]	✓	✓	✗	✗
(68)	[M4: 0], [D1: 0], [D2: 0]	✓	✓	✓	✓

Figure 7: Idealized response profiles corresponding to the admitted parses (54), (57), (68) with a specification of what inferences are entailed (esp. distributive inferences).

In our sample, we find subjects that can be classified as consistently disambiguating the experimental sentence in favor of the parse represented in (54), on which the sentence induces distributive inferences but no other inferences, and subjects that can be classified as disambiguating the experimental sentence in favor of the parse represented in (57), on which the sentence induces distributive inferences and matrix negated conjunction inference.[18] There appear to be no subjects that computed embedded strengthening of disjunction – that is, subjects that can be classified as consistently disambiguating the experimental sentence in favor of the parse represented in (68).[19] We return to missing embedded strengthing of disjunction in section 5.4.

[18]The response profiles of the subjects whose behavior suggests that they disambiguate the experimental sentence in favor of the parse (54) are provided in (i) and of those whose behavior suggests that they disambiguate the experimental sentence in favor of the parse (57) are provided in (i) and (ii), respectively (where the subject identification number is followed by their response profile).

(i) S.125 ⟨[M4: 1], [D1: 6], [D2: 8]⟩, S.143 ⟨[M4: 0], [D1: 8], [D2: 8]⟩, S.152 ⟨[M4: 1], [D1: 6], [D2: 8]⟩

(ii) S.120 ⟨[M4: 0], [D1: 7], [D2: 3]⟩, S.123 ⟨[M4: 0], [D1: 6], [D2: 2]⟩, S.229 ⟨[M4: 1], [D1: 8], [D2: 0]⟩

[19]This needs to be qualified. The behavior of the two subjects that were precluded from the analysis is consistent with them computing embedded strengthening of disjunction. In particular, on conditions in the experiment not pertaining to disjunction (filler sentences of the form *Some boxes contain an A*), they behave similar to other subjects (specifically, they respond with True to sentences that are true descriptions of the picture on their strengthened meaning).

Parse	Idealized response profile	Number of subjects
(54)	[M4: 0], [D1: 8], [D2: 8]	3
(57)	[M4: 0], [D1: 8], [D2: 0]	3
(68)	[M4: 0], [D1: 0], [D2: 0]	0

Figure 8: Number of subjects exhibiting a preference to disambiguate the sentence in favor of the respective parse.

5.3.2 Readings without distributive inferences

There are three parses of the experimental sentence that comply with the conditions introduced above and do not entail distributive inferences. First: if all the alternatives are pruned from the domain of the matrix *exh* and the conjunctive alternative is pruned from the domain of the embedded *exh*, the sentences entails no distributive inferences as well as no matrix or embedded negation of conjunctive alternative. On this parse, represented in (69), the experimental sentence should be judged as true in all pertinent conditions, in particular, in condition M4, in which distributive inferences are false. (See the first row of the summary in Figure 9.)

(69) a. exh(C_2)(every box$_x$ (exh(C_1)(x contains an A or a B)))
b. C_1 = {x contains an A, x contains a B}
c. $C_2 = \emptyset$
d. λw. Every box contains an A or a B in w

Second: if the conjunctive alternative is pruned from the embedded *exh* and deletion alternatives are pruned from the matrix *exh*, the sentence entails no distributive inferences but it does entail the matrix negation of the conjunctive alternative. On this parse, represented in (70), the experimental sentence should be judged as true in conditions M4 and D1, in which the matrix negation of the conjunctive alternative is true, and as false in condition D2, in which the matrix negation of the conjunctive alternative is false. (See the second row of the summary in Figure 9.)

(70) a. exh(C_2)(every box$_x$ (exh(C_1)(x contains an A or a B)))
b. C_1 = {x contains an A, x contains a B}
c. C_2 = {every box$_x$ (exh(C_1)(x contains an A and a B))}
d. λw. Every box contains an A or a B in w $\wedge$ $\neg$Every box contains an A and a B in w

Third: if the conjunctive alternative is not pruned from the domain of embedded *exh* and deletion alternatives are pruned from the matrix *exh*, the sentence entails embedded strengthening of disjunction. On this parse, represented in (71), the experimental sentence should be judged as true in condition M4, in which distributive inferences are false, and as false in conditions D1 and D2, on which plain negated inferences are false.[20] (See the

[20]The sentence should also be judged as false in the condition M1, in which both distributive and plain negated inferences are true, since the embedded strengthening of disjunction is false in this condition as

third row of the summary in Figure 9.)

(71) a. $\text{exh}(C_2)(\text{every box}_x\ (\text{exh}(C_1)(\text{x contains an A or a B})))$
b. C_1 = {x contains an A, x contains a B, x contains A and B}
c. C_2 = {every box_x ($\text{exh}(C_1)$(x contains an A and a B))}
d. λw. Every box contains an A or a B but not both A and B in w
(= λw. Every box contains just one of A or B in w)

Parse	**Idealized response profile**	**Inferences**			
		Dist.	Mat. neg. conj.	Emb. neg. conj.	Plain neg.
(69)	[M4: 8], [D1: 8], [D2: 8]	✗	✗	✗	✗
(70)	[M4: 8], [D1: 8], [D2: 0]	✗	✓	✗	✗
(71)	[M4: 8], [D1: 0], [D2: 0]	✗	✓	✓	✗

Figure 9: Idealized response profiles corresponding to the admitted parses (69)–(71) with a specification of what inferences are entailed (not distributive inferences).

As discussed in section 4, the greatest proportion of subjects can be classified as consistently disambiguating the experimental sentence in favor of the parse represented in (69), on which no SIs are computed.[21] Furthermore, there are also subjects that can be classified as consistently disambiguating the experimental sentence in favor of the parse represented in (70), on which the sentence entails the negation of the conjunctive alternative to the matrix sentence.[22] Again, there appear to be no subjects that computed embedded negated conjunction inferences – that is, subjects that can be classified as consistently disambiguating the experimental sentence in favor of the parse represented in (71) (though see footnote 19).

Parse	**Idealized response profile**	**Number of subects**
(69)	[M4: 8], [D1: 8], [D2: 8]	32
(70)	[M4: 8], [D1: 8], [D2: 0]	1
(71)	[M4: 8], [D1: 0], [D2: 0]	0

Figure 10: Number of subjects exhibiting a preference to disamibiguate the sentence in favor of the respective parse

well (there is at least one box that contains both letters mentioned in the experimental sentence; see the description of the items in the preceding section).

[21]Each of the 51 subjects was presented with eight items of condition D1 using Latin square design. Among the 51 subjects, 32 subjects responded with True to at least seven of the eight items in condition M4. All of these subjects also responded with True to at least seven of the eight items in both conditions D1 and D2. See footnote 12 for further details.

[22]The response profiles of the subject whose behavior suggests that they disambiguate the experimental sentence in favor of the parse (70) is provided in (i).

(i) S.235 ⟨[M4: 8], [D1: 6], [D2: 1]⟩

5.4 Disambiguation strategies

Although all six of the parses of the experimental sentence that are admitted on our account should, all else being equal, be available to the subjects, there appear to be preferences among the parses – that is, subjects' response behavior tentatively suggests that different groups of subjects systematically disambiguate the experimental sentence in favor of just one of the parses discussed above. This finding is only tentative in that both the number of subjects apparently exhibiting a preference for a specific disambiguation and the number of items on which this conclusion is based are low. Additional experiments are needed to determine the distribution of disambiguation strategies among subjects.

There are further factors besides the grammatical ones discussed above that might influence the selection of a particular parse for a sentence and thus yield limitations on the attested readings, such as the lack of embedded strengthening of disjunction in our experiment. An important factor is arguably whether the respective reading is relevant in the context (see e.g. Gualmini et al. 2008, Singh et al. 2013). We speculate that our failure to find subjects who compute embedded strengthening of disjunction might be due to the respective reading not being made relevant enough in our sentence-picture pairs. Namely, as discussed by Chemla & Spector (2011), embedded SIs based on substitution alternatives are difficult to detect in sentence-picture matching tasks unless special care is taken in construction of pertinent experimental items. A detailed investigation of this hypothesis would, however, require more space than we can allot to it here.

To summarize, section 4 presented experimental data that suggest that disjunction under universal quantifiers gives rise solely to (a) distributive inferences in the absence of plain negated inferences or to (b) no distributive inferences at all. We have shown that this pattern can be construed as following from an interaction of the constraint on pruning and a principle of exhaustification at every scope position (Magri 2011) – both of these have been independently motivated. Although the two conditions correctly rule out certain parses, ambiguity in exhaustification is still permitted and, to some extent, reflected in subjects' behavior. We have suggested that further factors may be involved in what disambiguations are chosen by the parser, such as relevance given a question under discussion. We leave a development of a more comprehensive theory of parsing of exhaustified structures for another occasion.

(72) **Summary of predicted readings on our proposal**

Parse (obligatory *exh*): exh(C_2)(every box$_x$ (exh(C_1)(x contains an A or a B)))

a. **Admitted readings:** C_1 includes {x contains an A, x contains a B}
   - (i) No additional inferences
   - (ii) Matrix negated conjunction inference, no other inferences
   - (iii) Embededded negated conjunction inference, no other inferences
   - (iv) Distributive inferences, no other inferences
   - (v) Distributive inferences, matrix negated conjunction inference
   - (vi) Distributive inferences, embededded negated conjunction inference

b. **Precluded readings:** $C_1 = \emptyset$
   - (i) Plain negated inferences, no embedded negated conjunction inference

6 Conclusion and outlook

Disjunction in the scope of a universal quantifier tends to give rise to distributive inferences, which are inferences that bear telltale signs of SIs.

(73) a. Every box contains an A or a B.
b. **Distributive inferences**
Some box contains an A $\wedge$ Some box contains a B
c. **Plain negated inferences**
$\neg$Every box contains an A $\wedge$ $\neg$Every box contains a B

We have shown in section 2 that these inferences are not necessarily accompanied by plain negated inferences, which constitutes the puzzle about distributive inferences.

(19) **A puzzle about distributive inferences**
A disjunction in the scope of a universal quantifier may give rise to distributive inferences without giving rise to plain negated inferences

We have seen that although the puzzle is problematic for approaches to distributive inferences that take them to be generated by matrix exhaustification based on plain alternatives, (14), it can be resolved on approaches that provide for matrix exhaustification based on exhaustified alternatives, (21).

(14) **Observation about exhaustification based on plain alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification operates on its plain alternatives (*Every A is P, Every A is Q*), distributive inferences (*Some A is P, Some A is Q*) are derived from their negation (*¬Every A is P, ¬Every A is Q*)

(21) **Observation about exhaustification based on exhaustified alternatives**
For any sentence *Every A is P or Q*, if matrix exhaustification is based on its exhaustified alternatives (*Every A is only P, Every A is only Q*), distributive inferences (*Some A is P, Some A is Q*) are derived in the absence of plain negated inferences (*¬Every A is P, ¬Every A is Q*)

We have shown that exhaustified alternatives are naturally available on the grammatical approach to SIs and the standard assumptions about alternatives, not least because the grammatical approach to SIs provides for embedded exhaustification. Approaches to SIs that do not provide for embedded exhaustification might be able to resolve the puzzle with an alternative to the standard assumptions about alternatives. The remainder of the paper discussed an apparent tendency to compute distributive inferences in the absence of plain negated inferences, a tendency that we proposed to spring from exhaustification being obligatory at every scope position and a preference to prune substitution alternatives.

The behavior of disjunction in the scope of universal quantifiers as well as the analysis that we proposed for it raises several questions that we hope to pursue in the future. We conclude the paper by mentioning a few of them. They pertain to embedding of disjunction in the scope of quantificational elements other than universal nominal quantifiers and to parsing of exhaustified sentences more generally. First: We have not discussed distributive inferences in the scope of nominal quantifiers other than universal quantifiers. However, on the face of it, distributive inferences in the absence of corresponding plain negated inferences appear to be available with other quantifiers as well and can be derived in the framework described in this paper. For example, although the sentence in (74) is infelicitous, say, in a context in which none of my friends have a daughter, it is acceptable in a context in which many of my friends have a son and some of them also have a daughter. In parallel to our examples in this paper, this fact can be explained by recourse to embedded exhausitification.[23] It goes without saying that a more in-depth exploration of these issues is necessary to test and possibly fine-tune our proposal.

(74) Many of my friends have sons or daughters.

Second: The behavior of disjunction under modal quantifiers, both universal and existential ones, appears to differ from its behavior under nominal quantifiers. For example, sentences like the following are judged as infelicitous in contexts in which plain negated inferences are false, say, in which there is a requirement to wear sneakers in the gym. We hope to tackle the differences between nominal and modal quantifiers in this respect and their source at another occasion.[24]

(75) You are required to wear sneakers or running shorts.

Third: In section 5 we have touched upon the fact that the grammatical approach to SIs predicts that exhaustified sentences are multiply ambiguous. We think that the results of our experiment suggest that this prediction is correct, as discussed in section 5.4. However, there appear to be preferences among possible disambiguations of exhaustified sentences. In addition to the constraint on pruning in (37) and the principle of obligatory ex-

[23]The sentence in (i-a) can trigger distributive inferences, (i-b), in the absence of corresponding plain negated inferences, (i-c).

(i) a. Many of my friends have sons or daughters.
b. Some of my friends have sons $\wedge$ Some of my friends have daughters
c. $\neg$Many of my friends have sons $\wedge$ $\neg$Many of my friends have daughters

This reading follows from the parse in (ii) where there are three scope sites for the exhaustification operator: below the distributivity operator (cf. Schwarzschild 1996), above the distributivity operator but below the existential quantifier, and at the matrix level.

(ii) exh(C_3)(many friends$_x$ (exh(C_2)(x DIST$_y$ (exh(C_1)(y has sons or daughters)))))

If substitution alternatives are pruned from the domains of the embedded exhaustification operators and, say, all alternatives are pruned from the domain of the matrix exhaustification operator, the parse entails distributive inferences, (i-b), in the absence of plain negated inferences, (i-c).

[24]Standard SIs appear to us to be unavailable in the scope of modals (see Ippolito 2010, 2011 for discussion of unavailability of embedded SIs in certain modal environments). Disjunction under modals giving rise to distributive inferences by way of plain negated inferences might, accordingly, follow from the unavailability of embeded exhaustification in this environment (recall that in the absence of embedded exhaustification distributive inferences follow from plain negated inferences). An account along these lines would require a qualification of the principle of obligatoriness of exhaustification, stated in (62), effectively allowing for exhaustification to be obligatory only in specific environments, i.e., in environments in which it is available.

haustification in (62), two grammatical principles, further factors are arguably involved. Although we have presented some speculative remarks pertaining to some of these factors and how they relate to our results, a more detailed exploration of these issues should be undertaken. But this undertaking must await another occasion as well.

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