An account for the homogeneity effects triggered by plural definites and conjunction based on double strengthening*

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Abstract Plural definites such as *the boys* and conjunctions such as *Adam and Bill* display *homogeneity effects*: they are interpreted universally/conjunctively in upward entailing environments but existentially/disjunctively in downward entailing environments. This paper argues that plural definites have a *plain* existential semantics. Their universal reading arises in upward entailing environments through a mechanism of *double strengthening* modeled on Spector (2007). The idea is that the indefinite *some boys* triggers the "only-some" implicature; that the definite *the boys* triggers the implicature that this "only-some" implicature is false; and that the universal reading of the definite thus arises through a "not-only-some" implicature. No strengthening happens in downward entailing environments, where definites therefore reveal their plain existential semantics. The *dual* of this pragma-semantics is extended to conjunction, thus capturing its parallel homogeneity effects.

Keywords: definites, conjunction, homogeneity effects, monotonicity, scalar implicatures.

1 Introduction

The plural definite *the boys* receives a universal interpretation in sentence (1a), whereby the perceived equivalence with the universally quantified sentence (1b). Plural definites have thus been assumed to have a universal semantics. According to one classical implementation of this assumption, the plural definite *the boys* denotes the maximal sum of boys (Sharvy 1980, Link 1984), yielding a universal interpretation (through collective predication or through a *distributive operator* with universal force).

(1) a. Mary saw the boys.
b. Mary saw each of the boys.

This assumption that plural definites have a universal semantics runs into the well known problem of *homogeneity effects*: in the scope of negation and other downward entailing (henceforth: DE) operators, plural definites surprisingly lose their universal

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interpretation and seem instead to contribute existential force to the meaning of the sentence (Fodor 1970; von Fintel 1997; Löbner 1985, 2000; Gajewski 2005; Breheny 2005; Malamud 2012). In Section 2, I review in detail these homogeneity effects that arise when plural definites are embedded in environments of different monotonicity, and I point out a complete analogy with the behavior of the plurality inference triggered by English plural morphology.

This analogy calls for a unified account. In Section 3, I review the pragma-semantics for the behavior of the plurality inference developed in Spector (2006, 2007) and I trivially extend it to plural definites. Here is the gist of the resulting pragma-semantics for definites. The *plain* meaning of a plural definite such as *the boys* is always just existential, whereby it is equivalent to the corresponding indefinite *some boys*. The universal meaning of the definite arises through a mechanism of *double strengthening*, that works roughly as follows. The corresponding indefinite *some boys* triggers the "only-some" (1st order) scalar implicature. The choice of the definite over the indefinite triggers the "not-only-some" (2nd order) scalar implicature that this "only-some" implicature is false. And it is this "not-only-some" scalar implicature that yields the universal reading of the plural definite. No strengthening happens in the scope of negation and other DE operators, where plural definites therefore reveal their plain weak existential semantics, leading to homogeneity effects.

Besides homogeneity effects, the traditional assumption that plural definites have a universal plain semantics runs into a further challenge, known in the literature as *sloppy existential readings*: in certain conversation contexts or with certain lexical predicates, also unembedded matrix plural definites receive an existential rather than universal interpretation (Yoon 1994, 1996; Krifka 1996; Gajewski 2005; Malamud 2012). My assumption that plural definites have a plain existential semantics might come handy in tackling the puzzle of their sloppy existential readings. In fact, suppose that in certain conversation contexts or with certain lexical predicates, the indefinite *some boys* triggers no (1st order) "only-some" implicature. In all such cases, the corresponding definite *the boys* cannot trigger any strengthening and is therefore predicted to reveal its plain existential reading. In Section 4, I thus put forward the conjecture that the cases where plural definites display sloppy existential readings are the cases where the corresponding indefinites do not undergo strengthening.

The term conjunction *Adam and Bill* in (2a) is once again equivalent to the universal quantifier *each of the boys* in (2b), as long as Adam and Bill are the only two boys in the domain of quantification.

(2) a. Mary saw Adam and Bill.
    b. Mary saw each of the boys.

Conjunction has been shown to display homogeneity effects as well: in the scope of negation and other DE operators, (unfocused/unstressed) conjunction surprisingly seems to be interpreted as disjunction (Szabolsci & Haddican 2004). The account for the homogeneity effect triggered by the plural definite *the boys* sketched above and developed in Section 3 cannot be extended straightforwardly to the conjunction *Adam and Bill*, for two reasons. First, because such an extension would require the unpalatable assumption that *Adam and Bill* has a plain meaning equivalent to *Adam or Bill* and that Natural Language conjunction therefore means disjunction! Furthermore, suppose that the proposed pragma-semantics for plural definites indeed predicts sloppy existential readings, as suggested in Section 4. A straightforward extension of that pragma-semantics to conjunction would then predict sloppy existential readings for conjunction as well. But no such effects seem to be attested: matrix conjunction is interpreted as conjunction, no matter the conversation context. Yet in Section 5, I show that Spector's pragma-semantics can be *dualized*. I thus derive the parallel homogeneity effects triggered by plural definites and conjunction by assuming that plural definites fall under the *primal* pragma-semantics while conjunction falls under its *dual* version.

English bare plurals such as *firemen* are well known to display homogeneity effects as well: they allow for a universal or an existential interpretation depending (among other factors) on the monotonicity of the environment (von Fintel 1997). The account for homogeneity effects based on double-strengthening developed in this paper extends from the case of definites and conjunction to the case of bare plurals, as argued in Magri (2012). The final Section 6 summarizes the three cases of definites, conjunction, and bare plurals one next of each other, thus outlining a general theory of homogeneity effects based on double strengthening.

2 Homogeneity effects triggered by plural definites

In Subsection 2.1, I review from the literature the surprising observation that plural definites lose their universal force in DE environments. This flexibility of the meaning of plural definites has become known in the literature as *homogeneity effects* (Fodor 1970; von Fintel 1997; Löbner 1985, 2000; Gajewski 2005; Breheny 2005; Malamud 2012). In Subsection 2.2, I then observe that the plurality inference triggered by English plural morphology displays the exact same behavior relative to embedding in environments of different monotonicity (Schwarzschild 1996; Chierchia 1996; Sauerland 2003; Spector 2006, 2007). The two types of effects have not been related to each other. Yet, the complete analogy between the two effects calls for a unified account, that will be developed below in Section 3.

2.1 The behavior of plural definites in environments of different monotonicity

The plural definite *the boys* in sentence (3a) receives a universal interpretation, whereby Mary saw each of the boys.

(3) a. Mary saw the boys.
b. Mary saw each of the boys.
c. Mary saw some of the boys.

Sentence (3a) thus feels equivalent to sentence (3b) with the universal quantifier *each of the boys* and both feel stronger than sentence (3c) with the existential quantifier *some of the boys*. In fact, the latter sentence (3c) would feel true in a scenario where Mary saw only some of the boys, contrary to the two sentences (3a) and (3b).

Surprisingly, the interpretation of plural definites is weakened to existential force in DE environments such as the scope of negation, the restrictor and the nuclear scope of the determiner *no*, the restrictor of the determiner *every*, etcetera. This surprising phenomenon has become known is the literature as *homogeneity effects* (Fodor 1970; von Fintel 1997; Löbner 1985, 2000; Gajewski 2005; Breheny 2005; Malamud 2012). For instance, sentence (4a) with the plural definite embedded under negation feels equivalent to sentence (4c) with the existential quantifier and both feel stronger than sentence (4b) with the universal quantifier. In fact, the latter sentence (4b) would feel true in a scenario where Mary saw only some of the boys, contrary to the other two sentences (4a) and (4c).[1]

(4) a. Mary didn't see the boys.
b. Mary didn't see each of the boys.
c. Mary didn't see any of the boys.

(5) a. #Mary didn't see the boys, but she did see some of them.
b. Mary didn't see each of the boys, but she did see some of them.
c. #Mary didn't see any of the boys, but she did see some of them.

Indeed, only sentence (4b) with the universal quantifier can be felicitously continued with *but she did see some* as in (5b), while that continuation feels odd in the case of sentences (4a) and (4c) with a definite and an existential quantifier, as indicated in (5a) and (5c).[2]

1 From (3c) to (4c), I have switched from *some* to *any* because of the PPIness of the former, assuming the two items to be equivalent for all intended purposes.

2 The observations in (3) and (4) can be summarized informally by saying that a predicate must hold *homogeneously* of the individuals denoted by a plural definite such as *the boys*: either Mary saw all of the boys or she saw none of them. Based on this intuition, the facts documented in this subsection

One strategy to derive the surprising reading of sentence (4a), while maintaining the assumption of a uniform universal semantics for plural definites, would be to assume that the plural definite scopes out of negation in (4a), yielding the desired interpretation that each boy was not seen by Mary. But Breheny (2005) points out that this reduction of homogeneity effects to scope does not extend to cases like (6).

(6) a. No woman likes the boys in her care.
b. No woman likes each of the boys in her care.
c. No woman likes any of the boys in her care.

The nuclear scope of the quantifier *no* triggers a homogeneity effect analogous to that triggered by clausal negation: the plural definite in (6a) behaves as the existential quantifier in (6c), not as the universal quantifier in (6b). But an account based on scope is not viable in the case of (6a), as the quantifier *no* binds a pronoun within the definite, requiring the definite to scope below the quantifier.

The example in (6) already shows that definites behave alike in the scope of clausal negation and the quantifier *no*. The examples in (7) and (8) document the same behavior for other DE environments, namely the nuclear scope of the quantifier *at most one* and the restrictor of a universal quantifier.[3]

(7) I know that there are three boys: Adam, Bill, and Carl. Furthermore, I know that both Adam and Bill only saw some of the pictures. Thus...
a. #At most one boy has seen the pictures.
b. At most one boy has seen all of the pictures.
c. #At most one boy has seen some of the pictures.

(8) Last week, John held several office hours for his students. A few times, only some of his students showed up, and he was sad about that; but...
a. #Every time John met with his students, he enjoyed it.
b. Every time John met with all of his students, he enjoyed it.
c. #Every time John met with some of his students, he enjoyed it.

Again, sentences (7a) and (8a) with the embedded definite pattern with sentences (7c) and (8c) with the embedded existential quantifier, not with sentences (7b) and (8b) with the embedded universal quantifier.

have become known in the literature has *homogeneity effects*. Throughout the paper, I retain this standard denomination of this set of facts, although the underlying intuition that plural definites contribute homogeneity will not play any role in the proposed account.

3 In the case of (8), I assume that *his students* is equivalent to *the students of John*, and thus displays the same properties of plural definites.

Finally, consider the case of non-monotonic environments,[4] illustrated in (9). Sentence (9a) with the definite differs from sentence (9c) with the existential quantifier in the same respect that the unembedded sentence (3a) differs from (3c): only (9c) but not (9a) feels true in a scenario where the unique student who solved problems solved only some of them. In other words, plural definites display a universal interpretation in the upward entailing (UE) component of the non-monotonic meaning.[5]

(9) a. Exactly one student solved the problems.
b. Exactly one student solved all the problems.
c. Exactly one student solved some of the problems.

(10) a. Exactly one student solved the problems...
#And two other students solved some of them.
b. Exactly one student solved all of the problems...
And two other students solved some of them.
c. Exactly one student solved some of the problems...
#And two other students solved some of them.

Furthermore, sentence (9a) with the definite differs from sentence (9b) with the universal quantifier in the same way that sentence (4a) differs from sentence (4b): only (9b) but not (9a) would feel true in a scenario where, besides the unique student who solved all of the problems, there are a few more students who solved only some of them. In other words, plural definites display an existential interpretation in the DE component of the non-monotonic meaning. The latter intuition is brought out in (10) by completing sentences (9) with the proper continuation.

2.2 The parallel behavior of plural morphology in environments of different monotonicity

Sentence (11a) with plural morphology on the object *(some) books* triggers the *plurality inference* that John bought more than one book.

(11) a. John bought (some)[6] linguistic books.
b. John bought (at least) two linguistic books.

4 The following observation concerning homogeneity effects in non-monotonic environments mimics an elegant observation on English plural morphology in non-monotonic environments due to Spector (2006, 2007), reported below at the end of Subsection 2.2.

5 The meaning of a sentence such as *Exactly one student P* can be paraphrased as the conjunction of two clauses: "at least one student *P*" and "at most one student *P*". Let me refer to the former as the *UE component* and the latter as the *DE component* of the non-monotonic meaning.

6 Through out the paper, I ignore differences between existential bare plurals and overt indefinites.

c. John bought a linguistic book.

Sentence (11a) thus feels equivalent to sentence (11b) with the numerical indefinite *(at least) two books* and both feel stronger than sentence (11c) with the singular indefinite *a book*. In fact, the latter sentence (11c) would feel true in a scenario where John bought a single linguistic book, contrary to sentences (11a) and (11b).

It is well known that the plurality inference triggered by English plural morphology surprisingly disappears in DE environments, such as the scope of negation, the restrictor and the nuclear scope of the determiner *no*, and the restrictor of the determiner *every* (Schwarzschild 1996; Chierchia 1996; Sauerland 2003; Spector 2006, 2007). For instance, sentence (12a) with plural morphology on the object embedded under negation feels equivalent to sentence (12c) with the singular indefinite and both feel stronger than sentence (12b) with the numerical indefinite. In fact, the latter sentence (12b) would feel true in a scenario where John bought a single linguistic book, contrary to the other two sentences (12a) and (12c). Indeed, only sentence (12b) with the numerical indefinite can be felicitously continued with *but he did buy one* as in (13b), while that continuation feels odd in the case of sentences (12a) and (12c) with a plural and a singular indefinite, as indicated in (13a) and (13c).

(12) a. John didn't buy linguistic books.
b. John didn't buy (at least) two linguistic books.
c. John didn't buy a linguistic book.

(13) a. #John didn't buy linguistic books, but he did buy one.
b. John didn't buy (at least) two linguistic books, but he did buy one.
c. #John didn't buy a linguistic book, but he did buy one.

(14) a. Every time Jack sees horses, he gets afraid. [from Spector (2007)]
b. Every time Jack sees two horses, he gets afraid.
c. Every time Jack sees a horse, he gets afraid.

The triplet of sentences in (14) makes the same point, using the restrictor of a universal quantifier as the relevant DE environment. According to sentence (14a), a single horse suffices to scare Jack, despite the plural *horses*. When embedded in the restrictor of a universal quantifier, the plural *horses* thus behaves as the singular *a horse* of sentence (14c), not as the numerical indefinite *two horses* of sentence (14b).

Spector (2006, 2007) adds the elegant observation (which I have mimicked above for the definites) that the behavior displayed in UE environments and the behavior displayed in DE environments are both detectable in non-monotonic environments such as the scope of *exactly one student* in (15).

(15) a. Exactly one student solved (some) difficult problems.
b. Exactly one student solved (at least) two difficult problems.

c. Exactly one student solved a difficult problem.

Sentence (15a) with the plural indefinite differs from sentence (15c) with the singular indefinite in the same respect that the unembedded sentence (11a) differs from (11c): only (15c) but not (15a) would feel true in a scenario where the unique student mentioned here solved only one of the problems. In other words, the plurality inference is visible in the UE component of the non-monotonic meaning. Furthermore, sentence (15a) with the plural indefinite differs from sentence (15b) with a numerical indefinite in the same respect that the sentence (12a) differs from (12b): only (15b) but not (15a) would feel true in a scenario where, besides the unique student who solved two or more problems, there are a few more students who solved only one. In other words, the plurality inference is not visible in the DE component of the non-monotonic meaning.

2.3 Summary

The behavior (3)-(9) displayed by definites relative to embedding in environments of different monotonicity is completely analogous to the behavior (11)-(15) displayed by English plural morphology: in UE environments, we get a strong meaning (definites are interpreted universally and plural morphology triggers a plurality inference); in DE environments, we get a weak meaning (plural definites are interpreted existentially and plural morphology is interpreted as singular morphology); in non-monotonic environments, we get both the strong and the weak interpretation in the UE and DE components of the non-monotonic meaning, respectively. This analogy calls for a unified account.[7]

3 A unified account: extending Spector's pragma-semantics from plural morphology to definites

The behavior of plural definites reviewed in Subsection 2.1 and the behavior of plural morphology reviewed in Subsection 2.2 have been accounted for with very

7 Despite the parallelism between plural morphology and definites documented here, Jacopo Romoli (p.c.) points out to me the following contrast:

(i) a. *I don't know if every boy has solved the problem, but they have definitely solved the problem.

b. I don't if John has bought two or more books, but he definitely bought books.

The *but*-sentence (ia) sounds bad, showing that *they* (which I take to be elliptical for the definite *the boys*) receives a strong universal interpretation. The *but*-sentence (ib) instead sounds fine, showing that plural morphology on *books* receives a weak at-least-one interpretation. The parallelism between plural morphology and definites thus breaks down in contexts where ignorance is explicitly asserted.

different tools in the literature. The behavior of plural definites has traditionally been accounted for through a dedicated presupposition, called the *Homogeneity presupposition* (Fodor 1970; von Fintel 1997; Beck 2001; Gajewski 2005). The behavior of plural morphology has instead been accounted for in terms of a competition with singular morphology, cast within the framework of the theory of scalar implicatures (Spector 2006, 2007) or the closely related theory of *Maximize Presupposition* (Heim 1991, Sauerland 2003).

Yet, the analogy between the two behaviors calls for a unified account. Should the implicature-based account for plural morphology be extended to the homogeneity effects triggered by definites? Or vice versa, should the presupposition-based account for definites be extended to the distribution of the plurality inference triggered by plural morphology? In this Section, I develop the former strategy: I review Spector's (2007) implicature-based account for the distribution of the plurality inference and straightforwardly extend it to the homogeneity effects displayed by definites. I leave for future work a discussion of the alternative strategy, based on the Homogeneity Presupposition and its extension to the plurality inference.

3.1 Preliminaries on scalar implicatures: the exhaustivity operator

Textbook semantics counterintuitively assumes sentence (16a) to be true in a scenario where John solved all of the problems. Since seminal work by Grice (1975), this assumption has been reconciled with intuitions as follows. Indeed, the *plain meaning* of sentence (16a) is (16b), whereby it would be true in a scenario where John solved all of the problems. Yet, the choice of the item *some* triggers the *scalar implicature* that he did not solve all of them. And the sentence together with its implicature effectively ends up equivalent to (16c), as desired.

(16) a. John solved some of the problems.
b. Joh solved at least some of the problems. $= [\![(16a)]\!]$
c. John solved only some of the problems. $= [\![\![(16a)]\!]\!]$

The conjunction of the plain meaning of a sentence with its scalar implicatures is called its *strengthened meaning*. I use the standard notation $[\![\cdot]\!]$ for the plain meaning[8] and the notation $[\![\![\cdot]\!]\!]$ for the strengthened meaning (for a mnemonic, think of your mobile phone: more bars means stronger signal). In this Subsection, I introduce background assumptions on the computation of the strengthened meaning.

As illustrated in (16), the strengthened meaning $[\![\![\varphi]\!]\!]$ of a sentence φ can be described as the plain meaning of the sentence obtained by adding an overt *only* associating with the scalar item. Fox (2007) interprets this observation algorithmically,

8 As is common in the literature, I often drop $[\![\cdot]\!]$, sloppily using the same symbol φ for both an LF and its plain meaning.

as in (17): the strengthened meaning of a sentence is obtained by appending to its LF a covert variant of *only*, called the *exhaustivity operator* and notated EXH.

(17) $[\![\![\varphi]\!]\!] = [\![\text{EXH } \varphi]\!]$

By (17), the theory of the strengthened meaning is reduced to the semantics of the exhaustivity operator EXH or, equivalently, of its overt counterpart *only*. Many approaches (Groenendijk & Stokhof 1984, Fox 2007, Chierchia, Fox & Spector 2012 among many others) assume that the exhaustivity operator EXH takes a *prejacent* proposition φ and does two things, as in (18). First, it asserts the prejacent φ. Second, it negates a bunch of alternatives ψ, namely all the alternatives ψ in the set $Exc(\varphi)$ of *alternatives excludable* with respect to φ.

(18) $[\![\text{EXH}(\varphi)]\!] = [\![\varphi]\!] \wedge \bigwedge_{\psi \in Exc(\varphi)} [\![\neg\psi]\!]$

Each conjunct $\neg\psi$ in (18) is called a *scalar implicature*.

The set $Exc(\varphi)$ of excludable alternatives is usually defined in two steps. To start, the set $Alt(\varphi)$ of *scalar alternatives* of the prejacent φ is defined as the set of those LFs that can be obtained from the target LF φ by replacing one or more scalar items in φ with their *Horn-mates*. I will come back below to the proper definition of Horn-mateness. The set of excludable alternatives $Exc(\varphi)$ is then defined as a proper subset of the set of scalar alternatives. Various such definitions of excludable alternatives have been considered in the literature. A simple option is to declare *excludable* those alternatives ψ that asymmetrically entail the prejacent φ (i.e., $\psi \rightarrow \varphi$, $\varphi \not\rightarrow \psi$) or that can be individually negated consistently with the prejacent (i.e., $\varphi \wedge \neg\psi \neq \emptyset$). The proper definition of excludable alternatives is immaterial for most of the paper, but for the discussion in the Appendix, where I will make use of a more sophisticated definition of excludable alternatives, from Fox (2007).

3.2 Preliminaries on scalar implicatures: iterated exhaustivity operators

Fox (2007) (building on Kratzer & Shimoyama 2002) and Spector (2007) modify the framework just sketched, by replacing assumption (17) with the variant in (19), that allows for an iterated exhaustivity operator.[9]

(19) $[\![\![\varphi]\!]\!] = [\![\text{EXH}\big(\text{EXH}(\varphi)\big)]\!]$

As will become clear later on, the intuition behind the switch from (17) to (19) can be characterized as follows: according to the classical assumption (17), it is only

9 Spector (2007) actually allows the exhaustivity operator to be in principle iterated not just twice but an arbitrary number of times. In fact, he shows that no further strengthening happens after a finite number of iterations, under mild assumptions on the set of alternatives. In all the cases considered in this paper, no further strengthening happens after two iterations of the exhaustivity operator. I can thus limit myself to (19) without loss of generality.

the *plain meaning* of the alternatives that plays a role in the computation of the strengthened meaning of the prejacent; the revised assumption (19) instead allows the *strengthened meaning* of the alternatives to play a role as well.

Before learning how to exploit the revised assumption (19) below in Subsections 3.3-3.4, let me show that it actually turns out to be equivalent to the original assumption (17) in all ordinary cases. Consider again the prejacent (16a), abbreviated as SOME in (20a). Consider furthermore the two alternatives obtained by replacing *some* with *many* and *all*, abbreviated as MANY and ALL in (20b) and (20c).

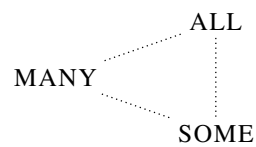
(20) a. SOME = John solved some of the problems.
b. MANY = John solved many of the problems.
c. ALL = John solved all of the problems.

Obviously, ALL asymmetrically entails MANY which in turn asymmetrically entails SOME, as indicated in (21a), where the arrows stand for asymmetric entailment.

(21) a.

$$\begin{array}{c} \text{ALL} \\ \downarrow \\ \text{MANY} \\ \downarrow \\ \text{SOME} \end{array}$$

b.



Furthermore, the three items *some*, *many*, and *all* are assumed to be Horn-mates of each other, as depicted in (21b), where the dotted lines stand for Horn-mateness.[10]

By the original assumption (17), the strengthened meaning of the prejacent SOME boils down to the conjunction of the prejacent SOME itself with the negation of its alternative MANY as in (22). The alternative ALL can be ignored, because its negation is in turn entailed by the negation of the alternative MANY.

(22) $[\![\![\text{SOME}]\!]\!] = \text{EXH}(\text{SOME}) = \text{SOME} \wedge \neg\text{MANY}$

By the revised assumption (19), we get the same result, but through the slightly more cumbersome computation (23). In step (23a), I have unpacked through (18) the outer exhaustivity operator: it asserts its prejacent EXH(SOME) and it negates the alternative EXH(MANY) obtained by replacing *some* with the Horn-mate *many* (again, the alternative EXH(ALL) can be ignored). In step (23b), I have unpacked the inner exhaustivity operator (again ignoring the alternative ALL in the computation of EXH(SOME) because it is irrelevant). Step (23c) finally holds by logical equivalence.

(23)
$$\begin{aligned} [\![\![\text{SOME}]\!]\!] &= \text{EXH}\big(\text{EXH}(\text{SOME})\big) \\ &\overset{(a)}{=} \text{EXH}(\text{SOME}) \quad \wedge\ \neg\text{EXH}(\text{MANY}) \\ &\overset{(b)}{=} \big(\text{SOME} \wedge \neg\text{MANY}\big) \ \wedge\ \neg\big(\text{MANY} \wedge \neg\text{ALL}\big) \\ &\overset{(c)}{=} \text{SOME} \wedge \neg\text{MANY} \end{aligned}$$

10 From now on, I conflate scalar items with the corresponding sentences, whereby Horn-mateness holds among scalar items as well as among clausal alternatives.

This example shows that the iteration of the exhaustivity operator in (19) has no effects in standard cases. We need special configurations of entailment and Horn-mateness in order for iteration to have an effect. One such case is described by Spector (2007), as reviewed below.

3.3 Spector's pragma-semantics for English plural morphology

In Subsection 2.2, we have seen that the plural morphology of *books* in sentence (24a) (abbreviated as PL) patterns as the singular morphology of *a book* in sentence (24c) (abbreviated as SING) in certain environments but as the numerical indefinite *two books* in sentence (24b) (abbreviated as TWO) in certain other environments.

(24) a. PL = John bought (some) linguistic books.
b. TWO = John bought (at least) two linguistic books.
c. SING = John bought a linguistic book.

We have a clear understanding of the semantics and the pragmatics of the two sentences SING and TWO. With respect to their semantics, we know that TWO asymmetrically entails SING, as represented by the arrow in (25a).

(25)

With respect to their pragmatics, we know that TWO is a scalar alternative of SING, as represented by the dotted line in (25b). The latter assumption is needed in order for SING to trigger the "only-one" implicature.

Now we want to fit sentence PL into the picture (25). Let's start with its semantics. The issue is tricky, as PL was found in Subsection 2.2 to behave as TWO in UE environments but as SING in DE environments. Spector (2007) assumes that plural morphology has a weak semantics equivalent to singular morphology, whereby PL and SING are logically equivalent, as stated in (26aii). Both are thus asymmetrically entailed by TWO, as stated in (26ai) and (26aiii).

(26)

Furthermore, Spector assumes that PL and SING are scalar alternatives, as stated in (26bii). Crucially, he assumes that, while SING is a scalar alternative of TWO as repeated in (26bi), PL is not an alternative of TWO, as represented by the broken dotted line (26biii). This is the only difference between SING and PL. Note that the diagram in (26b) requires Horn-mateness not to be transitive.

Spector shows that the strengthened meaning computed through assumptions (18), (19), and (26) accounts for the behavior of plural morphology relative to embedding documented in Subsection 2.2. To start with the case of UE environments, consider the unembedded sentence *John bought some books*, that was abbreviated as PL in (24a). We want its strengthened meaning to say that John bought at least two books. And that is indeed what we get, through the computation in (27).

$$
\begin{aligned}
(27) \qquad [\![\![\text{PL}]\!]\!] &\overset{(a)}{=} \text{EXH}\big(\text{EXH}(\text{PL})\big) \\
&\overset{(b)}{=} \text{EXH}(\text{PL}) \wedge \neg\text{EXH}(\text{SING}) \\
&\overset{(c)}{=} \text{PL} \qquad \wedge \neg\big(\text{SING} \wedge \neg\text{TWO}\big) \\
&\overset{(d)}{=} \qquad\qquad\qquad\qquad \text{TWO}
\end{aligned}
$$

In step (27a), I have used the assumption (19) that the strengthened meaning is computed through an iterated exhaustivity operator. In step (27b), I have used (18) to unpack the outer exhaustivity operator into the prejacent EXH(PL) and the negation of its unique alternative EXH(SING). In step (27c), I have unpacked the inner exhaustivity operator. The alternative SING is not excludable relative to PL because it is equivalent to it, so that EXH(PL) boils down to just PL. The alternative TWO is excludable relative to SING, so that EXH(SING) boils down to SING $\wedge \neg$TWO. By the equivalence in (27d), the strengthened meaning of our sentence PL thus says that John bought at least two books, as desired.

If we wanted to recast the idea of the computation (27) in intuitive "Gricean talk", it would go as follows. The two alternatives SING and PL have the same plain meaning, by (26a). They only differ because of their alternatives, by (26b). In particular, SING comes with the alternative TWO, whereby SING triggers the *uniqueness* (1st order) implicature that $\neg$TWO. But PL does not come with the alternative TWO, whereby PL triggers no (1st order) uniqueness implicature. As this is the only difference between SING and PL, the only reason why the speaker has chosen PL over SING is that (s)he does not endorse the uniqueness implicature that would have been triggered by SING. The *plurality inference* triggered by PL thus arises as the (2nd order) implicature $\neg\neg$TWO that the uniqueness implicature $\neg$TWO that would have been triggered by SING is false.

This computation (27) concretely illustrates the core idea behind the switch from the classical definition (17) of the strengthened meaning in terms of a *single* exhaustivity operator to the alternative definition (19) in terms of an *iterated* exhaustivity operator. According to the classical definition (17), it is only the plain meaning of the alternatives that plays a role in the computation of the strengthened meaning of the prejacent. In the specific case considered here, that means that it is only the plain meaning of SING that would play a role in the computation of the strengthened meaning of PL, which of course would buy us nothing, as the two

items have the same plain meaning. According to the revised definition (19) instead, the strengthened meaning of the alternatives does enter into the computation of the strengthened meaning of the prejacent. This is how, in the specific case considered here, the prejacent sentence PL manages to trigger the (2nd order) implicature that the (1st order) uniqueness implicature triggered by the alternative SING is false.

Consider next the case where plural morphology is embedded in a DE environment, such as the scope of negation in sentence (28a), abbreviated as *not*PL. As noted in Subsection 2.2, plural morphology in DE operators surprisingly behaves as singular morphology, whereby the perceived equivalence between the two sentences (28a) and (28c).

(28) a. *not*PL = John didn't buy any linguistic books.
b. *not*TWO = John didn't buy (at least) two linguistic books.
c. *not*SING = John didn't buy a linguistic book.

This equivalence is straightforwardly accounted for, as follows. By (26a), the two embedded sentences PL and SING have a weak plain meaning. When embedded underneath negation, the two resulting sentences *not*PL and *not*SING thus have a strong plain meaning. The two matrix sentences thus do not undergo any strengthening. And their perceived equivalence follows straightforwardly from the assumption (26aii) that PL and SING have an equivalent plain meaning. In other words, pragmatic effects are wiped out in DE environments, where we can therefore probe into the actual plain semantics of singular and plural morphology.

Finally, consider the case where plural morphology is embedded in the scope of a non-monotonic operator, such as *only one student* in sentence (29a), abbreviated as $\exists!$PL. As noted in Subsection 2.2, the sentence requires the unique student mentioned to have solved at least two problems, yielding a plurality inference in the UE component of the meaning; furthermore, it requires the other students not to have solved any problem at all, whereby the plurality inference disappears in the DE component of meaning.

(29) a. $\exists!$PL = Exactly one student solved some difficult problems.
b. $\exists!$TWO = Exactly one student solved (at least) two difficult problems.
c. $\exists!$SING = Exactly one student solved a difficult problem.

Spector notes that this complex behavior follows from the proposed pragma-semantics, as shown in the computation (30). Here and in what follows, I use the following notational conventions: $\exists!$ stands for *exactly one student*, $\exists_1$ stands for *at least one student*, $\exists_2$ stands for *at least two students*, and $\nexists_2$ stands for its negation (namely for *at most one student*).

$$
\begin{array}{llll}
(30) & [\![\exists!\text{PL}]\!] & = & \text{EXH}\big(\text{EXH}(\exists!\text{PL})\big) \\
 & & = & \text{EXH}(\exists!\text{PL}) \quad \wedge \quad \neg\text{EXH}(\exists!\text{SING}) \\
 & & = & \exists!\text{PL} \quad \wedge \quad \neg\big(\exists!\text{SING} \wedge \neg\exists!\text{TWO}\big) \\
 & & = & \exists!\text{PL} \quad \wedge \quad \exists!\text{TWO} \\
 & & = & \big[\exists_1\text{PL} \wedge \nexists_2\text{PL}\big] \quad \wedge \quad \big[\exists_1\text{TWO} \wedge \nexists_2\text{TWO}\big] \\
 & & = & \nexists_2\text{PL} \quad \wedge \quad \exists_1(\text{TWO})
\end{array}
$$

The first three steps of the computation in (30) are identical to the first three steps of the computation in (27); the remaining steps are straightforward logical equivalences, that follow from the fact that both PL and SING mean *at least one problem*.

3.4 A straightforward extension of Spector's pragma-semantics to definites

In Subsection 2.1, we have seen that the definite of sentence (31a) (abbreviated as THE) patterns as the universal quantifier of sentence (31b) (abbreviated as ALL) in certain environments but as the existential quantifier of sentence (31c) (abbreviated as SOME) in certain other environments.

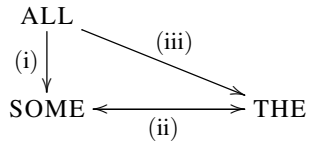
(31) a. THE = Mary saw the boys
b. ALL = Mary saw all of the boys.
c. SOME = Mary saw some of the boys.

More precisely, we have seen that the behavior relative to embedding displayed by the three sentences in (31) is formally analogous to the behavior displayed by the three sentences in (24), through the formal correspondences in (32).

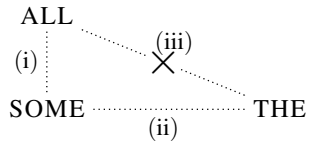
(32) THE $\longleftrightarrow$ PL SOME $\longleftrightarrow$ SING ALL $\longleftrightarrow$ TWO

In Subsection 3.3, we have seen that the behavior under embedding of the three sentences (24) follows from the pragma-semantic assumptions (26). Hence, the analogous behavior of the three sentences (31) follows from assumptions (33), formally analogous to (26) through the correspondences in (32).

(33) a.



b.



Sentence THE with the plural definite is assumed to have the same plain meaning as the existentially quantified sentence SOME, by (33aii). In other words, plural definites contribute nothing more than existential force to the plain meaning. Both sentences THE and SOME are thus asymmetrically entailed by the universally quantified sentence ALL, as stated in (33ai) and (33aiii). With respect to the pragmatics,

SOME and ALL are of course alternatives, as stated in (33bi), whereby the existentially quantified sentence SOME can trigger the implicature that Mary did not see each of the boys. Furthermore, THE and SOME are alternatives of each other, as stated in (33bii).[11] The crucial difference between these two alternatives is that THE, contrary to SOME, is not an alternative of ALL, as stated in (33biii).

The facts observed in Subsection 2.1 now follow straightforwardly. To start with the case of UE environments, consider again the sentence *Mary saw the boys*, that was abbreviated as THE in (31). We want its strengthened meaning to say that Mary saw each boy. And that is indeed what we get, through the computation in (34), which is completely analogous to the one in (27).

(34)
$$\begin{aligned} [\![\text{THE}]\!] &= \text{EXH}\big(\text{EXH}(\text{THE})\big) \\ &= \text{EXH}(\text{THE}) \wedge \neg\text{EXH}(\text{SOME}) \\ &= \text{THE} \wedge \neg\big(\text{SOME} \wedge \neg\text{ALL}\big) \\ &= \text{ALL} \end{aligned}$$

Th intuitive idea behind this computation can be brought out as follows. The existentially quantified sentence SOME triggers the (1st order) implicature that the corresponding universally quantified sentence ALL is false, whereby the "only-some" inference. Again through double strengthening, the definite of sentence THE triggers the (2nd order) implicature that the latter "only-some" implicature is false. The universal interpretation of the definite thus arises as a "not-only-some" implicature.

Let me now turn to DE environments, such as the scope of negation. As noted in Subsection 2.1, plural definites in the scope of negation surprisingly behave as existential quantifiers, whereby the perceived equivalence between the two sentences (35a) and (35c), abbreviated as *not*THE and *not*SOME.

(35) a. *not*THE = Mary didn't see the boys.
b. *not*ALL = Mary didn't see each of the boys.
c. *not*SOME = Mary didn't see any of the boys.

This equivalence is straightforwardly accounted for: in DE environments, definites trigger no implicatures (because the resulting matrix sentence *not*THE already has the strongest meaning) and thus reveal their plain existential meaning.

Finally, consider the case where the definite is embedded in non-monotonic environments, such as the scope of *only one student* in sentence (36a), abbreviated as ∃!THE. As noted in Subsection 2.1, this sentence requires the unique student mentioned to have solved all the problems, whereby the definite receives a universal

11 More precisely, I assume that plural *definites* and plural *indefinites* are Horn-mates. English has singular indefinites (like *a boy*) but lacks plural indefinites, and I therefore have to use *some*-indefinites. The assumption that definites and indefinites are Horn-mates fits well with proposals such as Chierchia (2001), that assume that the semantics of definites and indefinites shares a common core.

interpretation in the UE component of the non-monotonic meaning; furthermore, it requires the other students not to have solved any problem at all, whereby the definite receives an existential interpretation in the DE component of the non-monotonic meaning.

(36) a. $\exists!\textsc{the}$ = Exactly one student solved the problems.

b. $\exists!\textsc{all}$ = Exactly one student solved all the problems.

c. $\exists!\textsc{some}$ = Exactly one student solved some of the problems.

This complex behavior follows from the proposed pragma-semantics, as shown in the computation (37), which is completely analogous to the one in (30).

(37)
$$\begin{aligned}
[\![\exists!\textsc{the}]\!] &= \textsc{exh}\big(\textsc{exh}(\exists!\textsc{the})\big) \\
&= \textsc{exh}(\exists!\textsc{the}) && \wedge\ \neg\textsc{exh}(\exists!\textsc{some}) \\
&= \exists!\textsc{the} && \wedge\ \neg\big(\exists!\textsc{some} \wedge \neg\exists!\textsc{all}\big) \\
&= \exists!\textsc{the} && \wedge\ \exists!\textsc{all} \\
&= \big[\exists_1\textsc{the} \wedge \nexists_2\textsc{the}\big] && \wedge\ \big[\exists_1\textsc{all} \wedge \nexists_2\textsc{all}\big] \\
&= \nexists_2\textsc{the} && \wedge\ \exists_1\textsc{all}
\end{aligned}$$

Note that the first three steps of the computation in (37) are identical to the first three steps of the computation in (34); the remaining steps are straightforward logical equivalences, that follow from the fact that both THE and SOME mean *at least one problem*.

3.5 Summary

Plural morphology triggers a plurality inference in matrix position and other UE environments. Spector (2006, 2007) suggests to derive this inference as a scalar implicature. He assumes that the plural *books* and the singular *a book* are both equivalent to *at least one book*. Yet, the singular *a book* triggers a "only-one" scalar implicature while the plural *books* triggers the "not-only-one" implicature that this "only-one" implicature triggered by the corresponding singular is false, whereby the plurality inference. Spector shows that these assumptions yield an accurate account of the complex behavior of the plurality inference triggered by plural morphology relative to embedding in environments of various monotonicity.

Plural definites are interpreted universally in matrix position and other UE environments. This universal reading displays a complex behavior relative to embedding in environments of different monotonicity (so called *homogeneity effects*), completely analogous to that displayed by plural morphology. I have thus straightforwardly extended Spector's pragma-semantics to definites. I have assumed that the definite *the boys* is equivalent to the indefinite *some boys*. Yet, the indefinite *some boys* triggers a "only-some" scalar implicature while the definite *the boys* triggers

the "not-only-some" implicature that this "only-some" implicature triggered by the corresponding indefinite is false, whereby the universal reading.

4 A conjecture on sloppy existential readings

In Section 2, we have seen that the actual force of plural definites varies depending on the monotonicity of the embedding environment: in UE environments, definites have universal force; in DE environments, they have existential force. The literature has documented one further degree of variability in the meaning of plural definites: also unembedded matrix plural definites can display existential force in certain conversational context (Yoon 1994, 1996; Krifka 1996; Gajewski 2005; Malamud 2012). Following Yoon, I refer to these cases as *sloppy existential reading*. In this section, I take a brief look at these puzzling reading.

Gajewski (2005) reports the contrast in (38), attributed to Philippe Schlenker (p.c.). The definite *the girls* of sentence (38a) sounds surprisingly fine in the scenario considered, despite the fact that only a small portion of the girls actually raised their hands. The definite thus cannot have a universal interpretation, as shown by the fact that overt universal quantifiers (38c)-(38e) are unacceptable in this scenario. I thus conclude that the matrix definite in (38a) displays a sloppy existential interpretation.

(38) There are ten girls and ten boys in the class. Three girls raise their hands. I alert the speaker as follows:

a. Wait, the girls have a question!

b. #Wait, the three girls have a question!

c. #Wait, the girls each have a question!

d. #Wait, every girl has a question!

e. #Wait, all the girls have a question!

Crucially, the deviance of sentence (38b) shows that the sloppy existential reading displayed by sentence (38a) cannot be explained away as an instance of *domain restriction* (von Fintel 1994), namely by assuming that the definite is quantifying universally over a domain of quantification restricted to the three mentioned girls, as such a strategy should then plausibly be available also for (38b).

Yoon (1994, 1996) notes the contrast in (39), that she explains as follows: "all the glasses should be clean in order for [Mary] to be able to say [(39b)], while some of the glasses being dirty could be enough for her to say [(39a)]." In other words, the definite *the glasses* displays a sloppy existential reading in (39a), but not in (39b).

(39) John and Mary invited some friends over to their house. Mary takes some glasses out of the cupboard and realizes that a couple of the glasses have spots on them. Addressing John, she says:

a. The glasses are spotted.

b. #The glasses are spotless.

Analogously, the plural definite *the windows* allows for a sloppy existential reading in sentence (40a), whose preferred interpretation is that Mary thought that she had left one or more of the windows open. The preferred interpretation in (40b) is instead universal, whereby she found out in the end that all windows were indeed closed.

(40) a. Mary thought she had left the windows open.

b. But when she came back, she found that the windows were closed.

Building on Rossdeutscher & Kamp (1992), Yoon argues that predicates can be divided into two classes: *partial* predicates are those that allow definites to receive a sloppy existential interpretation, such as *dirty*, *open*, *sick*, and *wet*; *total* predicates are those that do not seem to allow for sloppy existential readings, such as *clean*, *closed*, *healthy*, and *dry*.

Contrary to what suggested by Yoon, Krifka (1996) and Malamud (2012) note that the availability of a sloppy existential interpretation for plural definites is not strictly a lexical property. Thus, the predicates *open* and *closed*, that count as partial and total respectively according to Yoon's classification, can be forced into the opposite class when the proper conversation context is constructed. To illustrate, Krifka considers the two sentences (41) in the following scenario: the local bank has a safe that is accessible only through a hallway with three doors, all of which must be open to reach the safe.

(41) a. The doors were open and I could reach the safe.

b. The doors were closed and I could not reach the safe

Krifka notes that, in the scenario described, the definite *the doors* receives a universal interpretation in (41a), according to which all the doors were open. And that it receives a sloppy existential interpretation in (41b), which expresses the fact that at least some of the doors were closed.

How can definites' sloppy existential readings be handled within the pragma-semantics put forward above in Section 3? According to the semantics proposed in (33a), a plural definite has a *plain* existential meaning, equivalent to an indefinite. Existential force will be the final meaning of the definite, unless that plain existential meaning gets strengthened into a universal meaning. According to the pragmatics proposed in (33b), this strengthening comes about through the negation of the "only-some" implicature triggered by the corresponding indefinite. Of course, if it happened to be the case that the corresponding indefinite triggered no "only-some" implicature, then there would be nothing to negate and thus no strengthening of the existential plain meaning of the definite into a universal meaning. In other words,

the proposed pragma-semantics (33) predicts the universal reading of the definite to be parasitic on the "only-some" implicature of the corresponding indefinite, as stated in (42).

(42) A matrix plural definite has a universal (existential) reading in a certain conversational context if and only if the corresponding indefinite triggers (does not trigger) the "only-some" implicature.

It is thus tempting to use this prediction (42) to account for definites' sloppy existential readings, by trying to characterize the conversational contexts that license these sloppy existential readings as exactly those contexts where the corresponding indefinites do not trigger the "only-some" implicature. Pursuing this line of investigation falls outside of the scope of this paper, which is focused on homogeneity effects. Yet, the rest of this section provides some preliminary data that seem to support this approach.[12]

In the context described in (43), the definite *le ragazze* ('the girls') in (43a) was found above to admit a sloppy existential interpretation. Analogously, I submit that the indefinite *delle ragazze* ('some-of-the girls') is fine in (43b) even though all girls raised their hands. Thus, the context where the definite allows for a sloppy existential interpretation is also a context where the corresponding indefinite triggers no "only-some" implicature.

(43) There are ten girls and ten boys in the class.

a. Three girls raise their hands. I alert the speaker as follows:

Le ragazze hanno una domanda.
the girls have a question.

b. The ten girls each raise their hands. I alert the speaker as follows:

Delle ragazze hanno una domanda.
some-of-the girls have a question.

(44) There are ten girls and ten boys, split into two teams. In order for a team to win, each of its ten members needs to individually solve the problem before the other team. In order to announce the winning team, I shout:

a. Le ragazze hanno risolto il problema.
the girls have solved the problem.

b. #Delle ragazze hanno risolto il problema.
some-of-the girls have solved the problem.

12 In these examples, I have switched from English to Italian because Italian has plural indefinites, while English only has *some*-indefinites; see footnote 11. In the rest of the paper, it did not make a substantial difference whether the definite was competing with the indefinite or with a *some*-indefinite. But I suspect the difference to matter when investigating the correlation (42).

The opposite pattern is displayed in (44): the definite *le ragazze* in (44a) does not allow for a sloppy existential interpretation and the corresponding indefinite *delle ragazze* in (44b) is deviant because it triggers a "only-some" implicature which mismatches with the stated rules of the competition. Thus, the context where the definite does not allow for a sloppy existential interpretation is also a context where the corresponding indefinite does trigger its "only-some" implicature.

The examples in (45)-(46) make the same point. The definite *le porte* ('the doors') in (45a) was found above to allow for a sloppy existential interpretation, so that the sentence would feel true if only some of the doors happened to be closed. In that same context, the indefinite of sentence (45b) does not trigger the "only-some" implicature, so that the sentence would feel fine also if all the doors happened to be closed.

(45) There is a corridor with five consecutive doors. We cannot get in:

a. Le porte sono chiuse.
the doors are closed.

b. Delle porte sono chiuse.
some-of-the doors are closed.

(46) There is a corridor with five consecutive doors. We can get it:

a. Le porte sono aperte.
the doors are open.

b. #Delle porte sono aperte.
some-of-the doors are open.

The context (46) illustrates the opposite pattern: the definite of sentence (46a) does not allow a sloppy existential interpretation, and the indefinite of sentence (46b) sounds deviant because of its "only-some" implicature.

5 Extension to conjunction through duality

The conjunction *Adam and Bill* has been observed to display homogeneity effects analogous to those displayed by the definite *the boys* (Szabolsci & Haddican 2004), as reviewed below in Subsection 5.1. Yet, the account for the homogeneity effects triggered by the definite *the boys* developed in Section 3 cannot be extended straightforwardly to the conjunction *Adam and Bill*, for two reasons. First, because that would require the unpalatable assumption that *Adam and Bill* is logically equivalent to *Adam or Bill* and that Natural Language conjunction thus means disjunction. Second, because that would predict *sloppy disjunctive readings* for conjunction, along the lines of sloppy existential readings for definites discussed in Section 4. But no such effects seem to be attested for conjunction: matrix conjunction is interpreted

as conjunction, no matter the conversation context. In order to overcome these problems, in Subsection 5.2, I take a more abstract look at Spector's pragma-semantics, and show that it can be *dualized*. The dual version thus obtained can then be applied to conjunction and its homogeneity effects, without running into the two problems just mentioned, as explained in Subsections 5.3-A. The intuitive similarity between *the boys* and *Adam and Bill* is thus captured by assuming that they fall under the *primal* and the *dual* versions of the same pragma-semantics. Subsection 5.4 offers a preliminary comparison between the primal and the dual theory.

5.1 Homogeneity effects triggered by unfocused conjunction

Sentence (47a) with the conjunction *Adam and Bill* of course says that Mary saw both of the two boys.

(47) a. Mary saw Adam and Bill.
b. Mary saw both Adam and Bill.
c. Mary saw Adam or Bill.

Thus, sentence (47a) feels equivalent to sentence (47b) with the universal quantifier *both Adam and Bill* and both feel stronger than sentence (47c) with the disjunction *Adam or Bill*. In fact, the latter sentence (47c) feels true in a scenario where Mary saw only one of the two boys, contrary to the two sentences (47a) and (47b).

Szabolsci & Haddican (2004) note that English has both focused/stressed and unfocused/unstressed conjunction, which I will notate as and_{F} and and_{unF}, respectively. Of course, they are semantically indistinguishable in UE environments: the facts described in (47) do not in any way depend on whether conjunction is focused or not. Yet, Szabolcsi and Haddican note that unfocused conjunction and_{unF} (but not focused conjunction and_{F}) displays *homogeneity effects* analogous to those displayed by definites: although it receives a conjunctive interpretation in UE environments, it receives a disjunctive interpretation in DE environments, such as the scope of negation, the restrictor and the nuclear scope of the determiner *no*, and the restrictor of the determiner *every*. To illustrate, sentence (48a) with unfocused conjunction and_{unF} embedded in the scope of clausal negation feels equivalent to sentence (48c) with disjunction and both feel stronger than the universally quantified sentence (48b). In fact, the latter sentence (48b) would feel true in a scenario where Mary saw one of the two boys, contrary to the other two sentences (48a) and (48c).

(48) a. Mary didn't see Adam and$_{\mathrm{unF}}$ Bill.
b. Mary didn't see both Adam and Bill.
c. Mary didn't see Adam or Bill.

(49) a. #Mary didn't see Adam and$_{\mathrm{unF}}$ Bill, but she did see one of them.

b. Mary didn't see both Adam and Bill, but she did see one of them.

c. #Mary didn't see Adam or Bill, but she did see one of them.

Indeed, only sentence (48b) with the universal quantifier can be felicitously continued with *but she did see one of them* as in (49b), while that continuation feels odd in the case of sentences (48a) and (48c) with unfocused conjunction and with disjunction, as indicated in (49a) and (49c).

Embedding into other DE environments besides negation triggers the same effect. To illustrate this point with the restrictor of a universal quantifier, consider (50), from Breheny (2005). He writes: "consider that Philby, Burgess and MacLean were a famous cohort of Cold War double-agents, then [(50a)] can be understood to involve quantification over people who were briefed by any of the three" (p. 62). In other words, the unfocused conjunction and_{unF} in the restrictor of a universal quantifier in (50a) behaves as the disjunction in (50c), not as the universal quantifier in (50b).

(50) a. Everyone who was briefed by Philby, Burgess and_{unF} MacLean was misinformed.

b. Everyone who was briefed by each of Philby, Burgess and MacLean was misinformed.

c. Everyone who was briefed by Philby, Burgess or MacLean was misinformed.

The data reviewed so far show that unfocused conjunction $\textit{and}_{\text{unF}}$ displays homogeneity effects parallel to those documented in Subsection 2.1 for definites: they receive a strong universal/conjunctive interpretation in UE environments and a weak existential/disjucntive interpretation in DE environments. Subsection 5.3 will show how to properly capture this parallelism between definites and conjunction. The case of embedding in non-monotonic environments is more delicate; its discussion is thus relegated to an Appendix.

5.2 Duality

Let me start by taking a more abstract look at the pragma-semantics described in Section 3. We started from pairs of items we know everything about, namely the pair SING/TWO in (24) for Spector's original case of English plural morphology and the pair SOME/ALL in (31) for the extension to definites. We know that the second item in the pair asymmetrically entails the first item, as indicated by the arrow in (51a). Here and in what follows, I have unified these two cases by using WEAK in place of SING and SOME and STRONG in place of TWO and ALL.

(51) a. STRONG = TWO/ ALL
$\downarrow$
WEAK = SING/SOME

b. STRONG
⋮
WEAK

Furthermore, we know that the weak item in the pair triggers the implicature that the corresponding strong item is false, whereby we need the two items to be Horn-mates, as indicated by the dotted line in (51b).

Now we turn to plural morphology PL and plural definites THE. To unify the two cases, let me refer jointly to these two items as MYSTERY, as they display a mysteriously, apparently non-compositional behavior: in certain environments, MYSTERY behaves as STRONG (namely, PL and THE behave as TWO and ALL, respectively); in some other environments, MYSTERY behaves as WEAK (namely, PL and THE behave as ONE and SOME, respectively). The question is: where does MYSTERY fit into the well established assumptions (51)? According to Spector's original proposal, it fits in at the bottom of the two diagrams, as stated in (52). According to (52a), MYSTERY is semantically equivalent to WEAK, whereby both are asymmetrically entailed by STRONG. According to (52b), MYSTERY and WEAK are Horn-mates, although only the latter but not the former happens to also be a Horn-mate of STRONG.

(52) a. STRONG
$\downarrow$ $\searrow$
WEAK $\longleftrightarrow$ MYSTERY

b. STRONG
⋮ ⋱ ⋮
WEAK ⋯⋯ MYSTERY

The theory that results from the pragma-semantic assumptions (52) is summarized in (53). When MYSTERY is embedded in a DE environment such as negation, nothing happens: its weak plain meaning yields a global plain meaning which is already strongest, so that no further strengthening happens, as indicated in (53a).

(53) a. $[\![\![\textit{not}\,\text{MISTERY}]\!]\!] = [\![\textit{not}\,\text{MISTERY}]\!]$

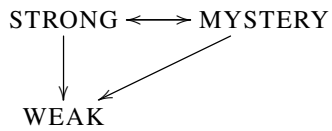
b. $$\begin{aligned}[\![\![\text{MISTERY}]\!]\!] &= \text{EXH}\big(\text{EXH}(\text{MISTERY})\big)\\ &= \text{EXH}(\text{MISTERY}) \wedge \neg\text{EXH}(\text{WEAK})\\ &= \text{MISTERY} \wedge \neg\big(\text{WEAK} \wedge \neg\text{STRONG}\big)\\ &= \text{STRONG}\end{aligned}$$

All the action happens when MYSTERY sits in a UE environment: the process of double strengthening detailed in (53b) makes MISTERY equivalent to STRONG. This computation (53b) is just an abstract version of the two formally identical computations performed above in (27) and (34).

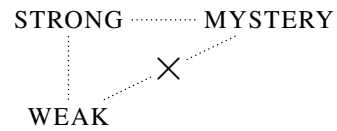
I now would like to consider a variant of the theory, whereby MYSTERY is fit into the diagram (51) not at the bottom as in (52), but rather at the top as in (54). According to (54a), MYSTERY is semantically equivalent to STRONG, whereby both

asymmetrically entail WEAK. According to (54b), MYSTERY and STRONG are Horn-mates, although only the latter but not the former happens to also be a Horn-mate of WEAK.

(54) a.



b.



The theory that results from the pragma-semantic assumptions (54) is summarized in (55). When MYSTERY sits in a UE environment, nothing happens: its plain meaning is already strong, so that no further strengthening happens, as indicated in (55b).

(55) a.
$$\begin{aligned} [\![\![\textit{not}\,\text{MISTERY}]\!]\!] &= \text{EXH}\big(\text{EXH}(\textit{not}\,\text{MISTERY})\big) \\ &= \text{EXH}(\textit{not}\,\text{MISTERY}) \;\wedge\; \neg\text{EXH}(\textit{not}\,\text{STRONG}) \\ &= \textit{not}\,\text{MISTERY} \;\wedge\; \neg\big(\textit{not}\,\text{STRONG} \wedge \neg\textit{not}\,\text{WEAK}\big) \\ &= \textit{not}\,\text{WEAK} \end{aligned}$$

b.
$$[\![\![\text{MISTERY}]\!]\!] = [\![\text{MISTERY}]\!]$$

All the action happens when MYSTERY is embedded in a DE environment such as the scope of negation. In this case, the strong plain meaning of MYSTERY yields a plain global meaning which is weak. This triggers the process of double strengthening detailed in (55a), which effectively renders MISTERY apparently equivalent to WEAK in that embedded position. We will see a concrete example of this abstract computation (55a) below in (61).

The two sets of pragma-semantic assumptions (52) and (54) are one specular to the other. The corresponding theories (53) and (55) derive the same net result (but see below Subsection 5.4), but in a specular way. Henceforth, I will call (52) the *primal* theory and (54) its *dual* counterpart, as the latter is obtained, so to speak, by turning the former upside down. In Subsection 3.4 above, I have suggested that plural definites fall under the primal theory. In the rest of this Section (and in the Appendix), I will explore the idea that unfocused conjunction falls under the dual theory.

5.3 A dual pragma-semantics for unfocused conjunction

In Subsection 5.1, we have seen that unfocused conjunction $\textit{and}_{\text{unF}}$ in sentence (56a) patterns as the disjunction of sentence (56c) in certain environments but as the focused term conjunction $\textit{and}_{\text{F}}$ of sentence (56b) in some other environments. The latter is in turn equivalent to *both* in the case of conjunctions of two terms only. Henceforth, I abbreviate these three sentences as AND_{unF}, AND_{F}/BOTH, and OR.

(56) a. AND_{unF} = Mary saw Adam and_{unF} Bill.

b. AND_{F}/BOTH = Mary saw Adam and$_{\text{F}}$ Bill / both Adam and Bill.

c. OR = Mary saw Adam or Bill.

More precisely, we have seen that the behavior relative to embedding in UE and DE environments (let's ignore non-monotonic environments for the moment) displayed by the three sentences in (56) is formally analogous to the behavior displayed by the three sentences in (31), through the formal correspondences in (57).

(57) $\text{AND}_{\text{unF}} \longleftrightarrow$ THE OR $\longleftrightarrow$ SOME AND_{unF}/BOTH $\longleftrightarrow$ ALL

These correspondences seem to suggest a straightforward extension of the pragma-semantics of Subsection 3.4 from definites to conjunction, yielding assumptions (58). These assumptions would represent one more instance of the primal theory abstractly described in (52).

(58) a.
$$\begin{tikzcd} \text{AND}_{\text{F}}/\text{BOTH} \arrow[d] \arrow[dr] & \\ \text{OR} \arrow[r, leftrightarrow] & \text{AND}_{\text{unF}} \end{tikzcd}$$
b.
$$\begin{tikzcd} \text{AND}_{\text{F}}/\text{BOTH} \arrow[d, dotted] \arrow[dr, dotted] & \\ \text{OR} \arrow[r, dotted] & \text{AND}_{\text{unF}} \end{tikzcd}$$

Yet, this approach requires the unpalatable assumption (58a) that focused and unfocused conjunction have a different plain meaning and in particular that unfocused conjunction in Natural Language is equivalent to disjunction. Furthermore, assume that sloppy existential readings of plural definites do indeed follow from the proposed pragma-semantics (33), as suggested in Section 4. A straightforward extension of that pragma-semantics to conjunction as in (58) would then predict *sloppy disjunctive readings* for unfocused conjunction, namely it would predict that matrix conjunction could mean disjunction in certain conversation contexts. But this prediction is not borne out: matrix conjunction means conjunction, irrespectively of the conversation context.

These difficulties can be overcome by switching from the primal version (52) of the theory to its dual counterpart (54), as discussed above in Subsection 5.2 (but see below footnote 13 concerning sloppy readings). In the specific case considered here, the dual theory takes the form of the pragma-semantic assumptions (59).

(59) a.
$$\begin{tikzcd} \text{AND}_{\text{F}}/\text{BOTH} \arrow[r, leftrightarrow, "\text{(iii)}"] \arrow[d, "\text{(i)}"'] & \text{AND}_{\text{unF}} \arrow[dl, "\text{(ii)}"] \\ \text{OR} & \end{tikzcd}$$
b.
$$\begin{tikzcd} \text{AND}_{\text{F}}/\text{BOTH} \arrow[r, dotted, "\text{(iii)}"] \arrow[d, dotted, "\text{(i)}"'] & \text{AND}_{\text{unF}} \arrow[dl, dotted, "\text{(ii)}"] \\ \text{OR} & \end{tikzcd}$$

By (59aiii), Natural Language conjunction uniformly has the same meaning ($\wedge$), independently of whether it is focused or unfocused. Thus in particular both sentences AND_{F}/BOTH and AND_{unF} asymmetrically entail the corresponding disjunctive sentence OR, as stated in (59ai) and (59aii). With respect to the pragmatics, disjunction OR and focused conjunction AND_{F}/BOTH are of course Horn-mates, as stated in

(59bi), whereby disjunction in sentence OR can receive its exclusive meaning through strengthening. Furthermore, focused conjunction AND_{F}/BOTH and unfocused conjunction AND_{unF} are Horn-mates of each other, as stated in (59biii). The crucial difference between these two alternatives is that unfocused conjunction AND_{unF}, contrary to focused conjunction AND_{F}/BOTH, is not an alternative of disjunction OR, as stated in (59bii).

When unfocused conjunction sits in matrix position or is embedded in UE environments, nothing happens: AND_{unF} already has a strong plain semantics, and the plain meaning of sentence (56a) thus already coincides with the desired one. As noted in Subsection 5.1, unfocused conjunction surprisingly receives a disjunctive interpretation when embedded in a DE environment such as the scope of negation, whereby the perceived equivalence between the two sentences (60a) and (60c), abbreviated as *not* AND_{unF} and *not* OR.

(60) a. *not* AND_{unF} = Mary didn't see Adam and_{unF} Bill.
b. *not* AND_{F} = Mary didn't see Adam and_{F} Bill / both Adam and Bill.
c. *not* OR = Mary didn't see Adam or Bill.

Indeed, when unfocused conjunction is embedded in a DE environment, its strong plain meaning yields a global plain meaning which is weak, and thus undergoes the double strengthening computed in (61). In step (61a), I have used the assumption (19) that the strengthened meaning is computed through an iterated exhaustivity operator. In step (61b), I have unpacked the outer exhaustivity operator using (18) into the prejacent $\text{EXH}(\textit{not}\,\text{AND}_{\text{unF}})$ and the negation of its unique alternative $\text{EXH}(\textit{not}\,\text{AND}_{\text{F}})$. In step (27c), I have unpacked the inner exhaustivity operator. By the logical equivalence in (61d), the strengthened meaning says that Mary saw neither of the two boys.

(61)
$$
\begin{aligned}
[\![\textit{not}\,\text{AND}_{\text{unF}}]\!] &\overset{(a)}{=} \text{EXH}\big(\text{EXH}(\textit{not}\,\text{AND}_{\text{unF}})\big) \\
&\overset{(b)}{=} \text{EXH}(\textit{not}\,\text{AND}_{\text{unF}}) \wedge \neg\text{EXH}(\textit{not}\,\text{AND}_{\text{F}}) \\
&\overset{(c)}{=} \textit{not}\,\text{AND}_{\text{unF}} \qquad \wedge \neg\big(\textit{not}\,\text{AND}_{\text{F}} \wedge \neg\textit{not}\,\text{OR}\big) \\
&\overset{(d)}{=} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \textit{not}\,\text{OR}
\end{aligned}
$$

This computation (61) is a special case of the more abstract computation (55) that illustrates the general shape of the dual theory.[13]

13 Suppose that in certain conversation contexts, disjunction does not get strengthened into an exclusive disjunctive meaning. In those contexts, the primal pragma-semantics (58) predicts unfocused conjunction to display its plain weak disjunctive meaning. In other words, this primal pragma-semantics predicts that unfocused conjunction in matrix position could display *sloppy disjunctive readings* in certain conversation contexts — just as it predicted definites to admit sloppy existential readings,

5.4 Pulling apart the primal from the dual

Let me take stock. In this paper, I have focused on definites and unfocused conjunction, that behave surprisingly when embedded in environments of different monotonicity, leading to so called *homogeneity effects*. Let me refer to these two mysterious items that display homogeneity effects as MYSTERY. According to Spector's primal assumptions (52), MYSTERY has a weak plain semantics that gets double strengthened in UE environments, while DE environments reveal the plain weak semantics of MYSTERY, as illustrated in (53). As seen in Subsection 5.2, Spector's pragma-semantics can be *dualized* as in (54), by assuming that MYSTERY has a strong plain semantics that gets globally double strengthened in DE environments, while UE environments reveal the plain strong semantics of MYSTERY, as illustrated in (55). In Subsection 3.4, I have accounted for the mysterious behavior of definites by assuming that they fall under the *primal* version of the theory. In Subsection 5.3, I have accounted for the mysterious behavior of unfocused conjunction by assuming that it falls under the *dual* version of the theory (plus some refinements in Subsection A, in order to deal with the peculiar case of non-monotonic environments).

Benjamin Spector (p.c.) points out that questions could potentially provide the proper environment to pull apart the primal from the dual variant of the theory, and thus to test the proposed division of labor between the primal and dual theory in accounting for homogeneity effects triggered by definites and conjunction. In fact, questions seem to provide an environment that does not license strengthening. Under this assumption, the primal theory predicts that MYSTERY should have a weak meaning in questions, as its weak plain meaning cannot get strengthened. The dual theory instead makes the opposite prediction, namely that MYSTERY should exhibit its plain strong meaning in questions. My assumption that plural definites and unfocused conjunction fall under the primal and the dual theory respectively thus predicts that they should behave differently in questions: plural definites should display their plain weak existential force (not universal force); while unfocused

along the lines sketched in Section 4. This prediction seems off-track in the case of conjunction: matrix conjunction is always interpreted as conjunction, no matter whether it is focused or not. The dual pragma-semantics (59) correctly predicts that.

Yet, the latter dual semantics as well predicts "sloppy readings" for disjunction. In fact, suppose that in certain conversation contexts, the focused conjunction *Adam and*$_{\text{F}}$ *Bill* (or *both Adam and Bill*) embedded in a DE environment (say, in the scope of negation) does not undergo strengthening. In those contexts, the unfocused conjunction *Adam and*$_{\text{unF}}$ *Bill* is predicted to display its plain conjunctive meaning. In conclusion, the dual pragma-semantics (59) predicts "conjunctive readings" in DE environments which are "sloppy" (so to speak), namely arise only when the proper conversation contexts are set up. It is tempting to try to connect this prediction of the dual pragma-semantics with Szabolsci & Haddican's (2004) observation that the availability of the disjunctive interpretation for unfocused conjunction in the scope of negation heavily depends on the conversation context. I leave the exploration of this prediction for future research.

conjunction should display its plain strong conjunctive force (not disjunctive force).

The following data seem to borne out this prediction. The answer *Yes, I talked to two thirds of them* is equally fine, no matter whether the question contains an existential quantifier as in (62a) or a definite as in (62b). The fact that (62b) is not degraded relative to (62a) shows that definites are (or at least can be) interpreted existentially in questions.

(62) a. Did you talk to some of the students?
Yes, I talked to two thirds of them.

b. Did you talk to the students?
Yes, I talked to two thirds of them.

The case in (63) seems to me different: the answer *Yes, I talked to Adam and Bill* seems to me degraded in the case of the question (63b) containing conjunction compared to the case of question (63a) containing disjunction, even if conjunction is kept unfocused/unstressed in (63b). If the contrast is real, then it suggests that indeed unfocused conjunction is interpreted conjunctively in questions.

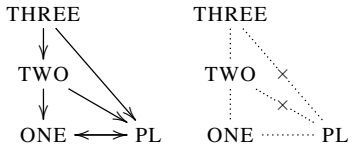
(63) a. Did you talk to Adam, Bill, or Carl?
Yes, I talked to Adam and Bill.

b. Did you talk to Adam, Bill, and Carl?
#Yes, I talked to Adam and Bill.

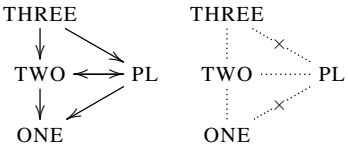
A more through empirical investigation of this issue is left for future research.[14]

14 Benjamin Spector (p.c.) points out an argument in favor of the *primal* rather than the *dual* theory for the case of plural morphology, considered above in Subsection 3.3. In fact, in my original discussion of that case in Subsection 3.3, I have ignored the fact that TWO has a further alternative THREE. Once that alternative is added to the picture, Spector's primal theory takes the shape in (ia) and its dual counterpart takes the shape in (ib).

(i) a.



b.



This alternative THREE has no consequences for the primal theory (ia), as it is easy to check. But it does have undesired consequences for the dual theory (ib): it predicts the wrong result for sentence $\exists!\text{PL}$ obtained by embedding PL in the non-monotonic environment $\exists!$, as shown in (ii).

(ii)
$$\begin{aligned}
[\![\exists!\text{PL}]\!] &= \text{EXH}\big(\text{EXH}(\exists!\text{PL})\big)\\
&= \text{EXH}(\exists!\text{PL}) \wedge \neg\text{EXH}(\exists!\text{TWO})\\
&= \exists!\text{PL} \wedge \neg\big(\exists!\text{TWO} \wedge \neg\exists!\text{ONE} \wedge \neg\exists!\text{THREE}\big)\\
&= \exists!\text{PL} \wedge \big(\exists!\text{ONE} \vee \exists!\text{THREE}\big)\\
&= \big(\exists_1\text{THREE} \wedge \nexists_2\text{TWO}\big) \vee \big(\exists_1\text{TWO} \wedge \nexists_2\text{ONE}\big)
\end{aligned}$$

The additional disjunct $(\exists_1\text{THREE} \wedge \nexists_2\text{TWO})$ makes the predicted strengthened meaning too weak.

5.5 Summary

In Section 3, we have seen how to apply Spector's (2007) pragma-semantics to the homogeneity effects triggered by definites. In Subsection 5.1, we have seen that unfocused conjunction displays analogous homogeneity effects. Yet, a straightforward application of Spector's pragma-semantics to the case of unfocused conjunction would require the unpalatable assumption that unfocused conjunction in Natural Language has a disjunctive meaning. Furthermore, it would predict matrix conjunction to display sloppy disjunctive readings in certain conversation contexts, which do not seem to be attested. In order to overcome these two problems, in Subsection 5.2 I have shown how to *dualize* Spector's pragma-semantics. And in Subsection 5.3, I have applied this dual version to the case of unfocused conjunction. In the Appendix, I will discuss the predictions of this dual theory for unfocused conjunction in non-monotonic environments. Finally in Subsection 5.4, I have offered a preliminary comparison between the primal and the dual approach.

6 Conclusions

In Section 2, I have reviewed evidence that a plural definite such as *the boys* displays *homogeneity effects*: it behaves as the universal quantifier *each of the boys* in UE environments but as the existential quantifier *some of the boys* in DE environments. In Section 5, I have reviewed evidence that unfocused conjunction such as *Adam and*$_{\text{unF}}$ *Bill* displays analogous homogeneity effects: it behaves as *both Adam and Bill* in UE environments but as the disjunction *Adam or Bill* in DE environments. Finally, English bare plurals such as *firemen* are well known to display homogeneity effects as well: they allow for a universal or an existential interpretation depending (among other factors) on the monotonicity of the environment (von Fintel 1997). The items listed in the leftmost column of (64a)-(64c) are thus mysterious because they are interpreted as the corresponding item STRONG in UE environments and as the corresponding item WEAK in DE environments.

(64)

	MYSTERIOUS	STRONG	WEAK
a.	the boys	each of the boys	some of the boys
b.	And and$_{\text{unF}}$ Bill	(both) Adam and$_{\text{F}}$ Bill	Adam or Bill
c.	firemen	all firemen	some firemen
d.	books	two books	a book

How could such a behavior be explained? My starting point is the observation that plural morphology on a bare object such as *books* displays a behavior completely analogous to homogeneity effects: it behaves as the plural numerical indefinite *two books* in UE environments but as the singular indefinite *a book* in DE environments.

I thus suggest that homogeneity effects in (64a)-(64c) can be accounted for through a proper extension of the pragma-semantics originally proposed by Spector (2006, 2007) for the case of plural morphology (64d). In this paper, I have developed this approach for the cases (64a) and (64b) of definites and conjunction. In Magri (2012), I have developed this approach for the case (64c) of bare plurals. Here is an overview of the overall theory of homogeneity effects thus obtained.

In Section 3, I have looked at the case (64a) of definites. Contrary to standard nominal semantics (Sharvy 1980, Link 1984), I have assumed that the definite *the boys* has a plain meaning which is just existential. This assumption straightforwardly yields the desired weak interpretation in DE environments. The strong, universal interpretation in UE environments is obtained through Spector's (2007) mechanism of *double strengthening*. The idea is that the corresponding indefinite *some of the boys* triggers the (1st order) "only-some" scalar implicature. The definite *the boys* then triggers the (2nd order) scalar implicature that this "only-some" implicature is false. And the universal meaning of the definite thus arises as a "not-only-some" implicature. This pragma-semantics immediately predicts that, in conversation contexts where the indefinite triggers no "only-some" implicature, definites are not strengthened, and thus reveal their plain existential semantics, no matter the monotonicity of the environment. In Section 4, I have thus suggested that this could be the source for definites' *sloppy existential readings*, namely the observation that also matrix definites can be interpreted existentially in certain conversation contexts.

In Magri (2012), I have applied this exact same line of reasoning to the case (64c) of bare plurals. I have assumed that the bare plural *firemen* has a plain meaning which is always just existential. This assumption straightforwardly yields the desired interpretation in DE environments. The strong, generic interpretation in UE environments is obtained again through Spector's double strengthening. The corresponding indefinite *some firemen* triggers the (1st order) "only-some" scalar implicature. The bare plural *firemen* then triggers the (2nd order) scalar implicature that this "only-some" implicature is false. And the generic meaning of the bare plural thus arises once again as a "not-only-some" implicature. This pragma-semantics again predicts that, whenever the indefinite triggers no "only-some" implicature, bare plurals are not strengthened, and thus reveal their plain existential semantics, no matter the monotonicity of the environment. I argue that the latter prediction is on the right track, as it basically derives in purely semantic terms Diesing's (1992) syntactic generalization that bare plurals are interpreted generically (existentially) in those syntactic positions where indefinites are interpreted presuppositionally (non-presuppositionally), as long as we interpret Diesing's *presuppositional* indefinites as those that have a *partitive* meaning and therefore trigger the "only-some" implicature.

Finally in Section 5 of this paper, I have looked at the case of conjunction. According to Spector's original pragma-semantics, the item MYSTERY that displays

homogeneity effects has a plain meaning which is equivalent to WEAK. In UE environments, MYSTERY undergoes double-strengthening, and thus ends up equivalent to STRONG. In DE environments, it instead reveals its plain meaning, whereby the perceived equivalence with WEAK. I point out that Spector's pragma-semantics can be dualized. In the dual variant, MYSTERY has a plain meaning which is equivalent to STRONG, as is revealed in UE environments. In DE environments, its strong meaning yields a weak global meaning, that therefore undergoes double strengthening, giving the impression that MYSTERY is equivalent to WEAK in those environments. I have argued that the dual provides a better approach than the primal theory to the homogeneity effects triggered by unfocused conjunction, and I have offered some initial suggestions on how to pull apart the primal from the due variants of the theory.

A The case of unfocused conjunction in non-monotonic environments

A.1 Is there a homogeneity effect?

In Subsection 5.1, I have focused on DE environments and I have reviewed evidence that unfocused conjunction $\textit{and}_{\text{unF}}$ displays homogeneity effects parallel to those documented in Subsection 2.1 for definites. The case of non-monotonic environments is more delicate. Let's look separately at the UE and DE component of the non-monotonic meaning. With respect to the UE component, definites and unfocused conjunction pattern alike. In fact, sentence (65a) with the unfocused conjunction differs from sentence (65c) with disjunction in the same respect that the unembedded sentence (47a) differs from (47c): only (65c) but not (65a) feels true in a scenario where the unique girl mentioned saw only one of the two boys. In other words, unfocused $\textit{and}_{\text{unF}}$ receives a strong (conjunctive) interpretation in the UE component of the non-monotonic meaning, exactly as definites.

(65) a. Exactly one girl saw Adam and_{unF} Bill.
b. Exactly one girl saw Adam and_{F} Bill / both Adam and Bill.
c. Exactly one girl saw Adam or Bill.

The case of the DE component of the non-monotonic meaning is trickier. Consider a scenario where, besides the unique girl who saw both Adam and Bill, there are a few more girls who only saw one of the two boys. If unfocused conjunction $\textit{and}_{\text{unF}}$ did trigger a homogeneity effect analogous to the one documented in Subsection 2.1 for plural definites, only sentence (65b) should feel true in the scenario just described, while sentence (65a) should pattern with (65c) and feel false. That does not seem to me to be the case, although I acknowledge that the judgement is rather delicate. Indeed, although sentence (66c) feels clearly degraded relative to (66b), sentence (66a) sounds fine.

(66) a. Exactly one girl saw Adam and$_{\text{unF}}$ Bill.. . .
And two other girls saw only one of them.

b. Exactly one girl saw both Adam and Bill. . .
And two other girls saw only one of them.

c. Exactly one girl saw Adam or Bill.. . .
#And two other girls saw only one of them.

In conclusion, I (tentatively) submit that, although unfocused conjunction triggers a homogeneity effect when embedded in a DE environment such as negation, it does not trigger a homogeneity effect when embedded in a non-monotonic environment.

A.2 Blocking the homogeneity effect by adding the atomic conjuncts as alternatives

According to the pragma-semantics for unfocused conjunction outlined in Subsection 5.3, the strengthened meaning of sentence (65a), featuring unfocused conjunction embedded in a non-monotonic environment, is computed as in (67). Here, I am using again the abbreviations introduced in (56) together with the usual abbreviations $\exists!$, $\exists_1$ and $\exists_2$ for the operators *exactly one girl*, *at least one girl*, and *at least two girls* (for instance, sentence (65a) gets abbreviated as $\exists!\text{AND}_{\text{unF}}$). The first three steps of this computation are identical to the first three steps of the computation in (61); the remaining steps hold by logical equivalences.

(67)
$$
\begin{aligned}
[\![\exists!\text{AND}_{\text{unF}}]\!] &= \text{EXH}\big(\text{EXH}(\exists!\text{AND}_{\text{unF}})\big) \\
&= \text{EXH}(\exists!\text{AND}_{\text{unF}}) \quad \wedge\ \neg\text{EXH}(\exists!\text{AND}_{\text{F}}) \\
&= \exists!\text{AND} \quad \wedge\ \neg\big(\exists!\text{AND} \wedge \neg\exists!\text{OR}\big) \\
&= \exists!\text{AND} \quad \wedge\ \exists!\text{OR} \\
&= \big[\exists_1\text{AND} \wedge \nexists_2\text{AND}\big] \ \wedge\ \big[\exists_1\text{OR} \wedge \nexists_2\text{OR}\big] \\
&= \exists_1\text{AND} \quad \wedge\ \nexists_2\text{OR}
\end{aligned}
$$

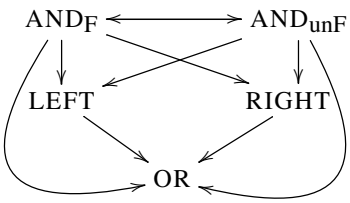
The first conjunct $\exists_1\text{AND}$ in the last line of the computation says that there is at least a girl who saw both Adam and Bill; the other conjunct $\nexists_2\text{OR}$ adds that there are no two girls who saw at least one boy. The current pragma-semantics thus predicts a homogeneity effect for unfocused conjunction in non-monotonic environments: unfocused conjunction is predicted to behave as disjunction in the DE component of the non-monotonic meaning, so that sentence (65a) is predicted to require all remaining girls to have seen neither of the two boys, just as sentence (65c). This prediction is incorrect, according to the (admittedly only tentative) conclusion reached at the end of the preceding Subsection. We thus need to tamper a bit with the current pragma-semantics in order to block the undesired homogeneity effect for unfocused conjunction in non-monotonic environments. But we need to do that carefully, because we don't want to lose the account for the homogeneity effect

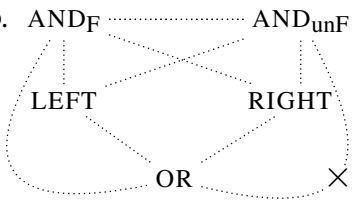
for unfocused conjunction in DE environments, developed in Subsection 5.3. In the rest of this Appendix, I illustrate one possible strategy to active this goal.

Consider again the paradigm (56), repeated in (68a)-(68c). Let LEFT and RIGHT be the two atomic clauses that are conjoined/disjoined, as in (68d)-(68e).

(68) a. AND_{unF} = Mary saw Adam and$_{\text{unF}}$ Bill.
b. AND_{F} = Mary saw Adam and$_{\text{F}}$ Bill / both Adam and Bill.
c. OR = Mary saw Adam or Bill.
d. LEFT = Mary saw Adam.
e. RIGHT = Mary saw Bill.

The semantic relations of entailment in (59a) can thus be enriched as in (69a): LEFT and RIGHT asymmetrically entail disjunction and are asymmetrically entailed by (focused and unfocused) conjunction. Following Sauerland (2004), I assume that disjunction as well as focused and unfocused conjunction include the two atomic clauses LEFT and RIGHT among their scalar alternatives, as in (69b).[15] Once again, I assume that focused conjunction AND_{F} and unfocused conjunction AND_{unF} are alternatives of each other. And that they only differ because focused conjunction AND_{F} has also disjunction OR among its alternatives, contrary to unfocused conjunction AND_{unF}.[16]

(69) a.


b.


The presence of the two new alternatives LEFT and RIGHT is well known to require a more careful definition of excludable alternatives (Sauerland 2004). In the rest

15 It does not matter for what follows whether the two atomic clauses LEFT and RIGHT are alternatives of each other. For simplicity, I omit drawing a dotted line between them in (69b), but nothing rests on this choice.

16 According to (69b), I am postulating the following asymmetry: while the two atomic clauses LEFT and RIGHT count as alternatives of both focused and unfocused conjunction, disjunction only counts as an alternative of focused conjunction, not of unfocused conjunction. The underlying intuition can be metaphorically stated as follows. Because of its reduced phonological status, unfocused conjunction has a harder time "activating" its alternatives. The two atomic clauses are activated more easily than the corresponding conjunction. Unfocused conjunction thus ends up with only the two atomic clauses as alternatives, but not disjunction. Building on Katzir (2007), Singh, Wexler, Astle, Kamawar & Fox (2013) suggest a way to formalize the intuition that the two atomic clauses are easier to activate as alternatives of conjunction than disjunction: the atomic clauses can be retrieved from disjunction by simple pruning while retrieving conjunction requires access to the lexicon.

of this Appendix, I will assume that the set $Excl(\varphi)$ of excludable alternatives is defined as in (70), after Fox (2007).

(70) a. A set $X = \{\psi_1, \psi_2, \dots\} \subseteq Alt(\varphi)$ of alternatives of a prejacent φ is called *consistently excludable* relative to φ provided the conjunction of φ with the negation of all the alternatives $\psi_1, \psi_2, \dots$ in the set is not a contradiction (namely $\varphi \wedge \neg\psi_1 \wedge \neg\psi_2 \wedge \dots \neq \emptyset$).

b. A consistently excludable set $X \subseteq Alt(\varphi)$ of alternatives of a prejacent φ is called *maximal* provided there exists no set $Y \subseteq Alt(\varphi)$ of alternatives of φ which is consistently excludable as well and is furthermore a superset of X.

c. The set $Excl(\varphi)$ of *excludable* alternatives relative to the prejacent φ is the intersection of all maximal consistently excludable sets of alternatives of φ.

Let's now compute the predictions of the new, enriched pragma-semantic assumptions (69)-(70) for the homogeneity effects triggered by unfocused conjunction in environments of different monotonicity.

Let's start with the case of embedding in DE environments, such as the scope of negation. To start, I apply the exhaustivity operator once, obtaining the identities in (71). These computations crucially rely on the definition (70) of excludable alternatives.

(71) a. $\text{EXH}\big(\textit{not}\,\text{AND}_{\text{F}}\big) = \textit{not}\,\text{AND} \wedge \neg\textit{not}\,\text{OR}$

b. $\text{EXH}\big(\textit{not}\,\text{AND}_{\text{unF}}\big) = \textit{not}\,\text{AND}$

c. $\text{EXH}\big(\textit{not}\,\text{LEFT}\big) = \textit{not}\,\text{LEFT} \wedge \neg\textit{not}\,\text{OR}$

d. $\text{EXH}\big(\textit{not}\,\text{RIGHT}\big) = \textit{not}\,\text{RIGHT} \wedge \neg\textit{not}\,\text{OR}$

The strengthened meaning of the sentence $\textit{not}\,\text{AND}_{\text{unF}}$ obtained by embedding unfocused conjunction in the scope of negation can thus be computed as in (72). The crucial step in the computation is (*), where I have used the identities (71c) and (71d) to conclude that the negation of the alternatives $\text{EXH}(\textit{not}\,\text{LEFT})$ and $\text{EXH}(\textit{not}\,\text{RIGHT})$ is already entailed by $\textit{not}\,\text{OR}$ and can therefore be dropped.

(72) $[\![\textit{not}\,\text{AND}_{\text{unF}}]\!]$

$$
\begin{aligned}
&= \text{EXH}\big(\text{EXH}(\textit{not}\,\text{AND}_{\text{unF}})\big) \\
&= \text{EXH}(\textit{not}\,\text{AND}_{\text{unF}}) \wedge \neg\text{EXH}(\textit{not}\,\text{AND}_{\text{F}}) \;\wedge\; \neg\text{EXH}(\textit{not}\,\text{LEFT}) \wedge \neg\text{EXH}(\textit{not}\,\text{RIGHT}) \\
&= \textit{not}\,\text{AND} \wedge \neg\big(\textit{not}\,\text{AND} \wedge \neg\textit{not}\,\text{OR}\big) \;\wedge\; \neg\text{EXH}(\textit{not}\,\text{LEFT}) \wedge \neg\text{EXH}(\textit{not}\,\text{RIGHT}) \\
&= \textit{not}\,\text{OR} \;\wedge\; \neg\text{EXH}(\textit{not}\,\text{LEFT}) \wedge \neg\text{EXH}(\textit{not}\,\text{RIGHT}) \\
&\overset{(*)}{=} \textit{not}\,\text{OR}
\end{aligned}
$$

In other words, the two additional alternatives LEFT and RIGHT play no role in the computation of the doubly strengthened meaning of unfocused conjunction embedded in DE environment. Indeed, the right hand side of the computation (72) is useless, as shown at step (*); and the left hand side is identical to the original computation (61). In conclusion, adding the two alternatives LEFT and RIGHT has no consequences for embedding in DE environments and the original account for the homogeneity effect triggered by unfocused conjunction is thus unharmed.

The case where the two additional alternatives LEFT and RIGHT do make a difference is that of embedding in non-monotonic environments. Let $\exists!$LEFT and $\exists!$RIGHT be the result of embedding the two atomic conjuncts LEFT and RIGHT underneath the non-monotonic operator *exactly one girl*, thus enriching the paradigm (65) into (73).

(73) a. $\exists!\text{AND}_{\text{unF}}$ = Exactly one girl saw Adam and$_{\text{unF}}$ Bill.
b. $\exists!\text{AND}_{\text{F}}$ = Exactly one girl saw Adam and$_{\text{F}}$ Bill / both Adam and Bill.
c. $\exists!$OR = Exactly one girl saw Adam or Bill.
d. $\exists!$LEFT = Exactly one girl saw Adam.
e. $\exists!$RIGHT = Exactly one girl saw Bill.

Let's apply the exhaustivity operator once, starting with the case of unfocused conjunction. Of course, the alternative $\exists!\text{AND}_{\text{F}}$ is not excludable relative to the prejacent $\exists!\text{AND}_{\text{unF}}$, because they have the same plain meaning. The two alternatives $\exists!$LEFT and $\exists!$RIGHT are instead excludable relative to the prejacent $\exists!\text{AND}_{\text{unF}}$, yielding step (*) in the computation (74a); the remaining two steps hold by logical equivalence.

(74) $\text{EXH}(\exists!\text{AND}_{\text{unF}}) =$

$$\begin{aligned}
&\overset{(*)}{=} \exists!\text{AND} && \wedge \neg\exists!\text{LEFT} && \wedge \neg\exists!\text{RIGHT} \\
&= \left[\exists_1\text{AND} \wedge \nexists_2\text{AND}\right] && \wedge \neg\left[\exists_1\text{LEFT} \wedge \nexists_2\text{LEFT}\right] && \wedge \neg\left[\exists_1\text{RIGHT} \wedge \nexists_2\text{RIGHT}\right] \\
&= \left[\exists_1\text{AND} \wedge \nexists_2\text{AND}\right] && \wedge \quad \exists_2\text{LEFT} && \wedge \quad \exists_2\text{RIGHT}
\end{aligned}$$

Let's now turn to the case of focused conjunction. In this case, we need to also consider the alternative $\exists!$OR, yielding step (*) in the computation (75) — this alternative was of course absent in step (*) of the computation (74), because OR is by stipulation not an alternative of unfocused conjunction AND_{unF}. Yet, the negation of the two alternatives $\exists!$LEFT and $\exists!$RIGHT already entails (given the prejacent $\exists!$AND) the negation of this additional alternative $\exists!$OR. The negation of the latter alternative has thus been dropped by logical equivalence in the step (**) of the computation (75). In other words, once the two extra alternatives $\exists!$LEFT and $\exists!$RIGHT are in place, the alternative $\exists!$OR plays no role anymore. The net results derived at the end of the computations (74) and (75) therefore coincide.

$$
\begin{aligned}
(75)\ \textsc{exh}(\exists!\textsc{and}_{\textsc{f}}) &= \\
&\overset{(*)}{=} \exists!\textsc{and} \wedge \neg\exists!\textsc{lft} \wedge \neg\exists!\textsc{rgt} \wedge \neg\exists!\textsc{or} \\
&\overset{(**)}{=} \exists!\textsc{and} \wedge \neg\exists!\textsc{lft} \wedge \neg\exists!\textsc{rgt} \\
&= \left[\exists_1\textsc{and} \wedge \nexists_2\textsc{and}\right] \wedge \neg\left[\exists_1\textsc{lft} \wedge \nexists_2\textsc{lft}\right] \wedge \neg\left[\exists_1\textsc{rgt} \wedge \nexists_2\textsc{rgt}\right] \\
&= \left[\exists_1\textsc{and} \wedge \nexists_2\textsc{and}\right] \wedge \exists_2\textsc{lft} \wedge \exists_2\textsc{rgt}
\end{aligned}
$$

Further application of the exhaustivity operator is vacuous, as shown below in Subsection A.3. The strengthened meaning of the two sentences $\exists!\textsc{and}_{\textsc{unf}}$ and $\exists!\textsc{and}_{\textsc{f}}$ is thus obtained by applying the exhaustivity operator only once, and can therefore be stated as in (76), based on the two computations (74) and (75).

$$
(76)\qquad \left.\begin{array}{r} [\![\exists!\textsc{and}_{\textsc{unf}}]\!] \\ [\![\exists!\textsc{and}_{\textsc{f}}]\!] \end{array}\right\} = \exists_1\textsc{and} \wedge \nexists_2\textsc{and} \wedge \exists_2\textsc{left} \wedge \exists_2\textsc{right}
$$

The meaning thus derived says that there is a girl who saw both of the boys ($\exists_1\textsc{and}$), that no other girl saw both of the boys ($\nexists_2\textsc{and}$), that there is at least another girl who saw only Adam ($\exists_2\textsc{left}$) and at least another girl who saw only Bill ($\exists_2\textsc{right}$). The meaning thus derived comes very close to an interpretation of the embedded conjunction without homogeneity effect.

Let me take stock. Focused and unfocused conjunction differ because only the latter triggers homogeneity effects, at least when embedded in DE environments. The proposal developed in section 5 for this observation rests on two core assumptions. The first assumption is that the relevant difference between focused and unfocused conjunction is that only the former admits disjunction as an alternative. The second assumption is that the strengthened meaning is defined through double rather than simple strengthening, thus making the pragma-semantics sensitive to the different alternatives of focused and unfocused conjunction. In the case of embedding in DE environments, the effect of these two assumptions is not hampered by the presence of the two additional alternatives LEFT and RIGHT, as shown by the computation in (72). In the case of embedding in non-monotonic environments instead, the effect of these two assumptions is completely neutralized by the presence of the two additional alternatives LEFT and RIGHT (under the assumption that they are shared by focused and unfocused conjunction). In fact, the assumption that the strengthened meaning is obtained through double rather simple strengthening has no bite in this case, as the second round of exhaustification is vacuous. Furthermore, the assumption that focused and unfocused conjunction differ in whether they admit disjunction as an alternative has no bite either, given that they both admit the alternatives LEFT and RIGHT which in turn render the alternative OR superfluous, making the two computations (74) and (75) completely parallel. As my two assumptions (concerning double strengthening and Horn-mateness with disjunction) have no bite in the case of non-monotonic environments, I get the same meaning for focused and

unfocused conjunction. This is the meaning predicted by the standard semantics for the strengthened meaning, without any additional assumptions. And this predicted meaning comes close to an interpretation without homogeneity effect. The fact that unfocused conjunction triggers a homogeneity effect only in DE environments but not in non-monotonic environments is thus ascribed to the different effect that the two additional alternatives LEFT and RIGHT have for embedding in those two different environments.

A.3 Why double strengthening is vacuous

This Subsection shows explicitly that the second round of strengthening is vacuous in the case of $\exists!\text{AND}_{\text{unF}}$ and $\exists!\text{AND}_{\text{F}}$, as stated in (76). To that end, let me start by applying the exhaustivity operator once to the various alternatives. The result of strengthening once the alternatives AND_{unF} and AND_{F} has already been computed in (74) and (75), and is repeated in (77a) and (77b). The application of the exhaustivity operator to $\exists!\text{OR}$ triggers the implicature that $\neg\exists!\text{AND}$, as stated in (77c). The application of the exhaustivity operator to $\exists!\text{LEFT}$ and $\exists!\text{RIGHT}$ is instead vacuous, as stated in (77d) and (77e).

(77)
a. $\text{EXH}(\exists!\text{AND}_{\text{unF}}) = \exists_1\text{AND} \wedge \nexists_2\text{AND} \wedge \exists_2\text{LEFT} \wedge \exists_2\text{RIGHT}$
b. $\text{EXH}(\exists!\text{AND}_{\text{F}}) = \exists_1\text{AND} \wedge \nexists_2\text{AND} \wedge \exists_2\text{LEFT} \wedge \exists_2\text{RIGHT}$
c. $\text{EXH}(\exists!\text{OR}) = \exists!\text{OR} \wedge \neg\exists!\text{AND}$
d. $\text{EXH}(\exists!\text{LEFT}) = \exists!\text{LEFT}$
e. $\text{EXH}(\exists!\text{RIGHT}) = \exists!\text{RIGHT}$

These computations are explained below, and then used to obtain the strengthened meaning, through double application of the exhaustivity operator.

Let me explain (77c). The prejacent $\exists!\text{OR}$ has three alternatives: $\exists!\text{LEFT}$, $\exists!\text{RIGHT}$, and $\exists!\text{AND}$. The pair of alternatives $\exists!\text{LEFT}$ and $\exists!\text{RIGHT}$ are not excludable relative to the prejacent $\exists!\text{OR}$, as shown in (78).

(78)
$$\begin{aligned} & \exists!\text{OR} && \wedge\neg\exists!\text{LEFT} && \wedge\neg\exists!\text{RIGHT} = \\ = & [\exists_1\text{OR} \wedge \nexists_2\text{OR}] && \wedge[\nexists_1\text{LEFT} \vee \exists_2\text{LEFT}] && \wedge[\nexists_1\text{RIGHT} \vee \exists_2\text{RIGHT}] \\ = & \emptyset \end{aligned}$$

The pair of alternatives $\exists!\text{LEFT}$ and $\exists!\text{AND}$ are instead excludable relative to the prejacent $\exists!\text{OR}$, as shown in (79). Analogously, the pair of alternatives $\exists!\text{RIGHT}$ and $\exists!\text{AND}$ are jointly excludable as well.

(79)
$$\begin{aligned} & \exists!\text{OR} && \wedge\neg\exists!\text{LEFT} && \wedge\neg\exists!\text{AND} = \\ = & [\exists_1\text{OR} \wedge \nexists_2\text{OR}] && \wedge[\nexists_1\text{LEFT} \vee \exists_2\text{LEFT}] && \wedge[\nexists_1\text{AND} \vee \exists_2\text{AND}] \\ = & [\exists_1\text{OR} \wedge \nexists_2\text{OR}] && \wedge \nexists_1\text{LEFT} && \wedge \nexists_1\text{AND} \\ \neq & \emptyset \end{aligned}$$

I thus conclude that the set of excludable alternatives computed according to Fox's (2007) condition (70) only consists of the alternative $\exists!\textsc{and}$, yielding (77c).

Let me now explain (77d); identical considerations hold for (77e). The prejacent $\exists!\textsc{left}$ has at most three alternatives: $\exists!\textsc{or}$ and $\exists!\textsc{and}$ plus possibly $\exists!\textsc{right}$, if the two atomic clauses LEFT and RIGHT are alternatives of each other (see footnote 15). The result of excluding any two of them is computed in (80).

(80) a.

$$\begin{aligned}
&\exists!\textsc{left} && \wedge \neg\exists!\textsc{right} && \wedge \neg\exists!\textsc{or} \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge [\nexists_1\textsc{right} \vee \exists_2\textsc{right}] && \wedge [\nexists_1\textsc{or} \vee \exists_2\textsc{or}] \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge [\nexists_1\textsc{right} \vee \exists_2\textsc{right}] && \wedge \quad \exists_2\textsc{or} \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge \quad \exists_2\textsc{right} && \wedge \quad \exists_2\textsc{or} \\
&= \exists_1\textsc{left} \wedge \nexists_2\textsc{left} && \wedge \quad \exists_2\textsc{right} &&
\end{aligned}$$

b.

$$\begin{aligned}
&\exists!\textsc{left} && \wedge \neg\exists!\textsc{right} && \wedge \neg\exists!\textsc{and} \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge [\nexists_1\textsc{right} \vee \exists_2\textsc{right}] && \wedge [\nexists_1\textsc{and} \vee \exists_2\textsc{and}] \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge [\nexists_1\textsc{right} \vee \exists_2\textsc{right}] && \wedge \quad \nexists_1\textsc{and} \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge \quad \nexists_1\textsc{right} && \wedge \quad \nexists_1\textsc{and} \\
&= \exists_1\textsc{left} \wedge \nexists_2\textsc{left} && \wedge \quad \nexists_1\textsc{right} &&
\end{aligned}$$

c.

$$\begin{aligned}
&\exists!\textsc{left} && \wedge \neg\exists!\textsc{or} && \wedge \neg\exists!\textsc{and} \\
&= [\exists_1\textsc{left} \wedge \nexists_2\textsc{left}] && \wedge [\nexists_1\textsc{or} \vee \exists_2\textsc{or}] && \wedge [\nexists_1\textsc{and} \vee \exists_2\textsc{and}] \\
&= \exists_1\textsc{left} \wedge \nexists_2\textsc{left} && \wedge \quad \exists_2\textsc{or} && \wedge \quad \nexists_1\textsc{and}
\end{aligned}$$

These computations in (80) show that any two alternatives are jointly excludable relative to the prejacent $\exists!\textsc{left}$. Furthermore, they show that all three alternatives are not excludable. Thus, the set of excludable alternatives computed according to Fox's (2007) condition (70) is empty and the application of the exhaustivity operator to $\exists!\textsc{left}$ is therefore trivial, as stated in (77b).

I am now ready to compute the doubly strengthened meaning of $\exists!\textsc{and}_{\text{unF}}$ and $\exists!\textsc{and}_{\text{F}}$. Starting with the former, I note that the prejacent $\textsc{exh}(\exists!\textsc{and}_{\text{unF}})$ has three alternatives: $\textsc{exh}(\exists!\textsc{left})$, $\textsc{exh}(\exists!\textsc{right}_{\text{unF}})$, and $\textsc{exh}(\exists!\textsc{and}_{\text{F}})$. As stated in (77a) and (77b), the alternative $\textsc{exh}(\exists!\textsc{and}_{\text{F}})$ is equivalent to the prejacent $\textsc{exh}(\exists!\textsc{and}_{\text{unF}})$, and therefore not excludable. Furthermore, the two alternatives $\textsc{exh}(\exists!\textsc{left})$ and $\textsc{exh}(\exists!\textsc{right})$ are equivalent to $\exists!\textsc{left}$ and $\exists!\textsc{right}$, by (77d) and (77e). Their negation is therefore already entailed by the prejacent $\textsc{exh}(\exists!\textsc{and}_{\text{unF}})$. In the end, second exhaustification is trivial in the case of embedded unfocused conjunction $\exists!\textsc{and}_{\text{unF}}$, namely $\textsc{exh}(\textsc{exh}(\exists!\textsc{and}_{\text{unF}})) = \textsc{exh}(\exists!\textsc{and}_{\text{unF}})$. The case of embedded focused conjunction is analogous. This prejacent $\textsc{exh}(\exists!\textsc{right}_{\text{F}})$ only has one extra alternative, namely $\textsc{exh}(\exists!\textsc{or})$. As stated in (77c), this alternative is equivalent to $\exists!\textsc{or} \wedge \neg\exists!\textsc{and}$. Its negation is thus entailed by the prejacent. In the end, second exhaustification is trivial also in the case of embedded focused conjunction $\exists!\textsc{and}_{\text{F}}$, namely $\textsc{exh}(\textsc{exh}(\exists!\textsc{and}_{\text{F}})) =$

$\text{EXH}(\exists!\text{AND}_{\text{F}})$.

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