An implicature account of Homogeneity and Non-maximality

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Overview. We argue for an implicature account of Homogeneity with definite plurals, in analogy with Free Choice disjunction. Non-maximality is taken to be the result of the context-sensitivity of implicature calculation. Unlike previous accounts, ours correctly predicts assymetries between positive and negative sentences with respect to those phenomena.

The puzzle of Homogeneity. Homogeneity is the fact that in out of the blue contexts, we infer (1b) from (1a) and (1d) from (1c). This doesn't follow from a standard universal semantics for (1a), e.g., assuming a universal distributivity operator (Link 1987; Schwarzschild 1996); (1c) is expected to receive a weaker meaning, i.e., the negation of (1b) (Schwarzschild 1994; Krifka 1996; Löbner 2000; Križ 2016, a.o.). ($\mathcal{P}art(X) = \{x : x \sqsubseteq X \wedge Atom(x)\}$. The restriction to atomic parts and the focus on distributive predicates is for expository reasons. The system we present here can be modified to apply to collective predicates.)

(1) a. The kids laughed. ≈b. $\forall x \in \mathcal{P}art(⟦\text{the kids}⟧)[x \text{ laughed}]$

c. The kids didn't laugh. ≈d. $\neg\exists x \in \mathcal{P}art(⟦\text{the kids}⟧)[x \text{ laughed}]$

Non-maximality. Another property of definite plurals is their susceptibility to exceptions, called Non-maximality (=NM). In contexts where it doesn't matter whether most or all of the kids laughed, we judge (1a) true as long as most of them did (see, e.g., Malamud 2012).

Asymmetry. Not much attention, however, was given to the fact that for some speakers the negative sentence in (1c) requires a maximal reading in which no kid laughs even in a context where it doesn't matter whether most or all of the kids didn't laugh. Intuitions are clearer once the scope of the definite plural is fixed below negation using a bound variable, (2). Here the most salient readings are non-maximal for (2a) (=(2b)), but maximal for (2c) (=(2d)).

(2) Context: the kids are required to take at least 2 of the 4 vitamins I gave each of them.

a. All of the kids took their vitamins. ≈b. Every kid took at least 2 vitamins.

c. None of the kids took their vitamins. ≈d. No kid took any vitamin.

Further evidence for asymmetry between positive and negative sentences comes from acquisition: while some children have a weak (existential) reading for definite plurals in positive sentences, no child has a weak (universal) reading in negative sentences (Tieu *et al.* 2015). Most current solutions to Homogeneity and NM, which rely on trivalent semantics (Križ 2015, 2016) or ambiguity (Križ and Spector 2017), don't predict such asymmetries. While the implicature account of Homogeneity in Magri (2014) is asymmetric in nature, it doesn't naturally extend to NM (and by relying on *some-but-not-all* implicatures it faces problems explaining children's behavior, see Tieu *et al.* 2015). Our goal is to provide an account of Homogeneity and NM that predicts asymmetries (and avoids the *some-but-not-all* route).

Analogy with Free Choice. To motivate an implicature account we point out that the puzzle of Free Choice (=FC), illustrated in (3), is analogous to that of Homogeneity. In both cases, we observe a universal/conjunctive meaning in positive sentences and existential/disjunctive meaning in negative ones. Kratzer and Shimoyama 2002; Alonso-Ovalle 2005; Fox 2007 argue that (3c) reflects the basic existential meaning, which is strengthened into a universal one in (3a). We propose here a parallel analysis for the puzzle of Homogeneity.

(3) a. You are allowed to sing or dance. ≈b. $\forall p \in \{⟦\text{you sing}⟧, ⟦\text{you dance}⟧\}[\Diamond p]$

c. You aren't allowed to sing or dance. ≈d. $\neg\exists p \in \{⟦\text{you sing}⟧, ⟦\text{you dance}⟧\}[\Diamond p]$

Proposal: Homogeneity. We propose that (1a) has a basic existential meaning, (4b). This basic meaning is brought about by defining the distributivity operator as existential rather than universal, as in (4a); ∃-DIST takes a syntactically realized domain variable (subscripted). (In a sense we follow Schwarzschild (1994); Gajewski (2005) in blaming the distributivity operator for Homogeneity.) This yields the correct meaning for (1c), in (4c):

(4) a. $[\![\exists\text{-DIST}_D]\!] = \lambda P_{et}.\lambda x_e.\exists y \in (\mathcal{P}art(x) \cap D)[P(y)]$

b. $[\![$the kids $[\exists\text{-DIST}_D$ laughed$]]\!] = 1$ *iff* $\exists x \in (\mathcal{P}art([\![$the kids$]\!]) \cap D)[x$ laughed$]$

c. $[\![$NEG the kids $[\exists\text{-DIST}_D$ laughed$]]\!] = 1$ *iff* $\neg\exists x \in (\mathcal{P}art([\![$the kids$]\!]) \cap D)[x$ laughed$]$

The universal interpretation of (1a), we assume, is derived by strengthening. ∃-DIST invokes subdomain alternatives, along the lines of Chierchia (2013)'s analysis of NPIs and FCIs:

(5) $Alt(\exists\text{-DIST}_D) = \{\exists\text{-DIST}_{D'} : D' \subseteq D\}$

Suppose $[\![$the kids$]\!] = a + b + c$, $[\![$laughed$]\!] = L$. Given (4b), (1a) is true *iff* the underlined disjunction in (6) is true. The subdomain alternatives end up as its disjuncts, i.e., we derive the set C in (6) as Alt(1a) (cf. Križ and Spector's $Cand_x$). See figure 1 for a graphic depiction.

(6) $C = \{\underline{L(a) \vee L(b) \vee L(c)}, L(a) \vee L(b), L(a) \vee L(c), L(b) \vee L(c), L(a), L(b), L(c)\}$

An exhaustivity operator EXH then applies (obligatorily, cf. Magri 2009). Following Bar-Lev and Fox (2017)'s proposal based on considerations of FC phenomena, EXH negates Innocently Excludable (=IE) alternatives and asserts Innocently Includable (=II) alternatives. All of the alternatives in C are non-IE and thus can't be negated; they are rather all II and are thus asserted, yielding the desired interpretation in (7) which is equivalent to $L(a) \wedge L(b) \wedge L(c)$.

(7) $[\![\text{EXH}_C$ [the kids $[\exists\text{-DIST}_D$ laughed$]]]\!] = 1$ *iff* $\forall x \in (\mathcal{P}art([\![$the kids$]\!]) \cap D)[x$ laughed$]$

Proposal: Non-maximality. A natural way to think about NM in this framework is as following from the context-sensitivity of implicature calculation (Horn 1972, recently Katzir 2014). In order for such an account to work, we have to decide how relevance considerations get into the definition of EXH. We propose the following implementation, intended to replace current views of how some alternatives come to be ignored sometimes, known as 'pruning':

(8) EXH asserts every *conjunction* of negations of IE alternatives *which is relevant*, and every *conjunction* of II alternatives *which is relevant*.

The novelty here is by letting EXH output only relevant *inferences*, instead of considering relevance for each *alternative* in isolation. With this notion of exhaustification in mind, we can turn to non-maximality. Following Križ (2016); Križ and Spector (2017), we use the notion of relevance relative to an *Issue*, a similar notion to QUD. An issue that allows for a non-maximal reading given that there are 3 kids would be the partition I in (9):

(9) $I = \{i_1 =$ at most one of the kids laughed$, i_2 =$ at least two of the kids laughed$\}$

This kind of Issue facilitates an NM reading for (1a) where it means *at least two of the kids laughed*, i.e., it identifies cell i_2. (It's in fact difficult to get such readings for small sets; we stick to a context with 3 kids for simplicity.) Crucially, the conjunction $L(a) \wedge L(b) \wedge L(c)$ is irrelevant to I (it's only relevant to issues in which 3 kids laughing is a union of cells). Since given (8) EXH only asserts *relevant* conjunctions of II alternatives, it won't yield this result given I. The strongest conjunction of alternatives in C that's relevant to I is the one in (10). This conjunction indeed identifies cell i_2, so this would be the output of EXH (see figure 1):

(10) $(L(a) \vee L(b)) \wedge (L(a) \vee L(c)) \wedge (L(b) \vee L(c)) \Leftrightarrow$ at least two of the kids laughed

Predicting asymmetries. Importantly, our analysis predicts asymmetries between positive and negative sentences. Since NM is dependent on implicature calculation and implicatures aren't generally derived under negation, we expect a non-maximal reading for (1c) and (2c) to be dispreferred. As for the acquisition data, the existential reading some children have for definite plurals in positive sentences results from not deriving the Homogeneity implicature.

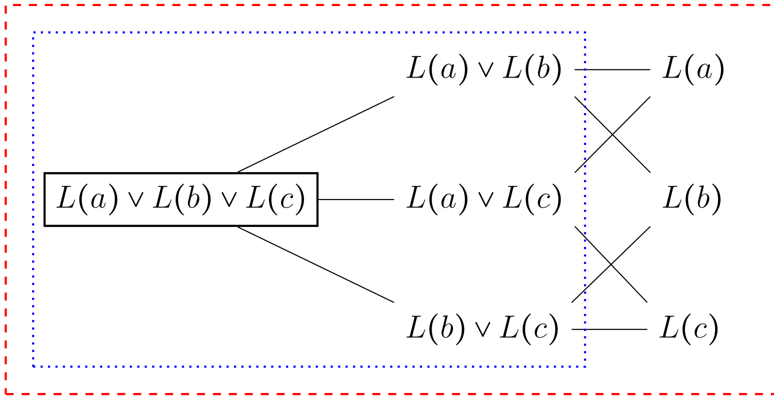

Figure 1: Entailment relations between the alternatives in C, represented by lines from right to left. The basic meaning of (1a) is marked with a solid-line black box. The II alternatives are in a dashed-line red box; exhaustification yields their conjunction when $L(a) \wedge L(b) \wedge L(c)$ is relevant, (7). The conjunction of the alternatives in the dotted-line blue box, equivalent to (10), is the result given issue I in (9).

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