**Inclusive and exclusive plurals reconciled**

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## 1. Introduction

In this paper we work out a novel approach to the semantics/pragmatics of nominal number in languages such as English, which distinguish morphologically plural forms from singular ones. In Section 2 we discuss two fundamental challenges any account must meet, after which we turn, in Section 3, to proposing a solution that resolves both. In Section 4 we discuss some consequences and comparisons with previous approaches.

## 2. Two challenges

### 2.1. The parallelism between formal and semantic markedness of number

Typically, in languages that have a singular/plural contrast in nominals, the plural is morphologically marked, i.e., it is encoded in a special morpheme, while the singular is not, i.e., there is no special morpheme signalling singular number (Greenberg 1966, Corbett 2000). Semantically, however, the plural seems to be the *less* marked member of the pair. Thus, assuming the terminology in Link (1983), we see in (1)-(3) that a singular form is interpreted as having atomic reference only, but the plural has two interpretations: (i) an *exclusive* interpretation, referring to sums only (and excluding atoms) and (ii) an *inclusive* interpretation, referring to both atoms and sums:

(1)  Mary saw *a horse*. (atom)
(2)  Mary saw *horses*. (sum; exclusive plural)
(3)  Do you have *children*? Yes, I have one/two/… (atom + sum; inclusive plural)
(4)  If you have *children,* you may come to our party. (atom + sum; inclusive plural)
(5)  Mary didn't solve *problems from this list*. (atom + sum; inclusive plural)

A fundamental question is then how to reconcile the morphology and the semantics of

number given the tendency of language to pair up morphologically unmarked forms with unmarked meanings (*Horn's division of pragmatic labor*, Horn 2001: 155).

• *The Horn pattern for number*: the singular form is semantically and morphologically unmarked; the marked plural form is semantically marked.

Farkas and de Swart (2003) and Farkas (2006) propose an analysis that respects the Horn pattern based on the assumption that atomic reference is assigned by default. Unfortunately, this account does not extend to languages like Chinese, which lack number morphology, and where unmarked NPs are number neutral rather than atomic in reference. The proposal developed here conforms to the Horn pattern while at the same time capturing Chinese.

## 2.2.      When is the inclusive interpretation of the plural available?

The inclusive interpretation is available in questions, conditionals and negation (3-5) but unavailable in upward entailing, episodic contexts (2). Even in questions and conditionals, the naturalness of the plural form varies (Farkas 2006, Spector 2005):

(6)   Do you have *an MA degree/MA degrees*?
(7)   Does Sam have *#Roman noses/a Roman nose*?
(8)   Does a worm have *#an eye/eyes*?

The plural in (6) is less neutral than in (3); the contrast is exacerbated in (7), and in (8) we prefer a singular over a plural form. Obviously, the generalization that noses come in singleton sets and eyes in pairs has something to do with the matter. We seek an analysis that not only predicts when inclusive interpretations are possible, but also sheds light on the principles that guide the choice of nominal form.

## 3.    The semantics of singular and plural morphology

## 3.1.      The plural is semantically marked

The morpho-syntax of number, we assume, involves the existence of a single privative feature [pl] realized in an inflectional projection we call NumP. Singular nominals involve neither a singular feature nor a NumP projection. The feature [pl] is assigned the family of interpretations in (9):

(9)  a.  $[[pl]] = \lambda x.\ x \in Sum$            (exclusive interpretation of plural)
     b.  $[[pl]] = \lambda x.\ x \in Sum \cup Atom$       (inclusive interpretation of plural)

Sums are always within the denotation space of the relevant variable; the difference concerns the question of whether atoms are excluded or not. The two meanings are ordered by (truth-conditional) strength: (9a) asymmetrically entails (9b). This relationship is crucial in determining the choice between interpretations in context.

### 3.2. Constraints on the use of number morphology

We rely on O(ptimality) T(heory) to account for the presence or absence of nominal number morphology (NNM) in a language. Following Hendriks et al. (2007, Ch. 7), we take NNM in a language to hinge on the interaction between the constraints in (10):

(10)  a.  *FunctN: Avoid functional structure in the nominal domain.
      b.  FPl: reference to sums is parsed by an expression in NumP.

The first constraint is a member of the *Struc family, penalizing use of structure. The second is a faithfulness constraint requiring reference to sums to be morphologically marked. A nominal associated with a variable $x$ is taken to involve 'reference to sums' iff sums are among the intended values of $x$, i.e., if relative to some verifying situation $s$ in the model, the set of values that $x$ is assigned in $s$ includes sums. Chinese ranks *FunctN over FP, which blocks overt NNM. In the absence of a morphological contrast between marked and unmarked nominals, unmarked forms are interpreted as number neutral. A language like English, which has a plural marker, has the ranking FPl >> *FunctN, and therefore in English reference to sums is overtly marked by the presence of [pl]. The fact that it is sums reference rather than atom reference that requires marking is, we hypothesize, connected to the cognitive primacy of atomic reference. Atomic reference is thus considered the unmarked interpretation.

### 3.3. Choice of interpretation

The polysemous semantics proposed in (9) permits both inclusive and exclusive readings of the plural. We use the independently motivated S(trong) M(eaning) H(ypothesis) to account for how the choice of interpretation is done in particular contexts (Dalrymple et al.1998, Winter 2001, Zwarts 2003). Our hypothesis is formulated as SMH_PL:

- SMH_PL: *the Strongest Meaning Hypothesis for plurals*:  prefer the stronger interpretation of [pl] over the weaker one, unless the former conflicts with the context.

In neutral cases, such as the upward entailing environments exemplified in (2), the SMH_PL favors the exclusive interpretation over the inclusive one, because the exclusive interpretation is stronger in these contexts.  In downward entailing contexts and questions, the SMH_PL leads to the inclusive interpretation, because of scale reversal under monotonicity reversal (Fauconnier 1976, Sauerland 2003). The weaker, inclusive reading of the plural in such contexts leads to a stronger claim for the sentence as a whole. We predict that, other things being equal, a plural is interpreted inclusively in downward entailing contexts and exclusively in upward entailing ones.

The SMH_PL is a pragmatic principle, which can be overridden by contextual information. The fact that eyes always come in pairs is sufficient to weaken the interpretation of  (8) to an exclusive plural interpretation. However, there are limits to the influence of context. We cannot normally weaken (2) to an inclusive interpretation. These restrictions arise from the competition between singular and plural.

### 3.4. Competition between singular and plural forms

In languages with morphological number, speakers have a choice between the use of a singular or a plural form. As we see in (5)-(7), this choice is not always free. In order to account for the distribution of forms and meanings, we need to set up a bidirectional OT analysis. We use here the format of the bias constraints proposed by Mattausch (2006). Bias constraints block particular combinations of unmarked (u) and marked forms (m) with common, unmarked meanings ($\alpha$) and infrequent, marked meanings ($\beta$). With the bidirectional learning algorithm, the ranking $\{*u,\beta; *m,\alpha\} >> *Struct >> \{*m,\beta; *u,\alpha\}$ emerges as an evolutionary stable pattern. This models the emergence of  Horn's division of pragmatic labor as the optimal communication strategy that arises under evolutionary pressure. If we exploit FPl and the semantics of [pl] in (9) to instantiate the bias constraints for NNM, we obtain the bidirectional tableau 1, where forms are paired with their domain of interpretation in the lattice. Under this constraint ranking, intended sum reference calls for the use of a plural form, and plural forms have exclusive or inclusive sum reference. The tableau also shows that we assign the (unmarked) singular form the (unmarked) meaning of atomic reference under strong bidirectional optimization.

|  | *sg,sum/ at ∪ sum | *pl,at | *FunctN | *pl, sum/ at ∪ sum | *sg, at |
|---|---|---|---|---|---|
| <sg, atom>  ☞ |  |  |  |  | * |
| <sg, at ∪ sum> | * |  |  |  |  |
| <sg, sum> | * |  |  |  |  |
| <pl, atom> |  | * | * |  |  |
| <pl, at ∪ sum>  ☞ |  |  | * | * |  |
| <pl, sum>  ☞ |  |  | * | * |  |

Tableau 1: bidirectional optimization over singular/plural forms and meanings

We make two further predictions. Under the assumption that the speaker knows what Mary saw (namely one horse, or more than one horse), we can explain why (2) cannot be weakened to an inclusive interpretation: intended atomic reference calls for a singular form. Intended atomic reference is also at stake in (7). The problem for a unidirectional account is that the inclusive semantics in (9b) is not falsified by a situation in which the only contextually relevant alternatives involve atoms (as with Roman noses). Under the bidirectional analysis, we see that in this case not only the pair <pl, atom ∪ sum> is relevant, but also the pair <pl, atom>. But <pl, atom> is a suboptimal pair, because of the high ranked constraint *pl,atom. The use of the plural in sentences like (7) is thus blocked by the preference for a singular form in a context in which sum values are pragmatically excluded. We also predict the contrast between (3) and (6): the use of the plural in (6) signals that sum values are relevant, a situation that is culturally more striking in the case of MA degrees than in the case of children.

## 4. Results and comparisons

The analysis presented meets the challenges raised in Section 2, without special stipulations for languages with or without NNM (English vs. Chinese). Its advantage over Sauerland et al. (2005) is that it conforms to Horn's division of pragmatic labor Unlike Spector (2005), we do not rely on a special higher order implicature mechanism, and we predict the possibility of inclusive plurals with indefinites as well as definites:

(11) If *the children in a divorced family* stay with the mother they are well fed.

We differ from Zweig (2006) in that we provide an explicit account of the interpretation of singulars and we explain why in (2) sum interpretation is not cancelable.

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