Even more evidence for the emptiness of plurality: An experimental investigation of plural interpretation as a species of scalar implicature.

Manizeh Khan, Hazel Pearson & Jesse Snedeker ~ Harvard University
khan@wjh.harvard.edu; hpearson@fas.harvard.edu; snedeker@wjh.harvard.edu

Research issue. Semanticists have long been puzzled by the fact that plural nominals can sometimes include atoms in their denotations [1,2,3,4,5,6]. If Professor Brown has exactly one book on her desk, then she cannot truthfully utter (1a), should lock her office according to (1b-c), and should answer 'yes' to (1d).

1a. There are no books on my desk.
1b. If there are books on your desk, please lock the office door when you leave.
1c. Every professor who has books on her desk should lock her office door when she leaves.
1d. Are there books on your desk?

Various researchers [1,2] have responded to the challenge presented by these data by assuming a 'weak' semantics for plural morphology. That is, if the set of cookies in a model M is {a, b, c}, then we have the following denotations.

2a. $[\![\text{cookie-SG}]\!]^M = \{a, b, c\}$ 2b. $[\![\text{cookie-PL}]\!]^M = \{a, b, c, a + b, a + c, b + c, a + b + c\}$

Theories of this type face the challenge of explaining why a noun bearing plural morphology is typically false of singularities; that is, why (3) is false in the context we described.

3. Professor Brown has books on her desk.

Sauerland [4,5] argues that the 'more than one' meaning component of the plural is a scalar implicature (SI). Adopting a presuppositional treatment of number features, he proposes that whereas a number feature valued 'singular' (SG) is defined only for atoms, the plural value (PL) is always defined (4). SG and PL therefore form a scale <PL, SG>, where whatever is at the rightmost edge of the scale carries the most presuppositions. Given Maximize Presupposition [7], it is predicted that use of PL should implicate that the atomicity presupposition of SG is not satisfied.

4a. $[\![\text{SG}]\!] = \lambda x \in D_e: \text{ATOM}(x).\ x$ 4b. $[\![\text{PL}]\!] = \lambda x \in D_e.\ x$

Some weight is lent to this proposal by the observation that the environments in which plural nominals can be true of atoms are those in which SIs are typically suspended [8]: downward entailing (DE) environments, as exemplified in (1). However, these facts could also be accounted for within a weak theory without appeal to SI. On any weak theory, a singular nominal's denotation is a subset of that of its plural counterpart, as in (2). Given that DE contexts license inferences from sets to subsets, it is unsurprising that, for example, there being no books on the desk entails that not even one book is on the desk. This is a case where linguistic data alone seem inadequate to adjudicate between competing theories, and it is worthwhile to conduct an experimental investigation.

Experiment. We tested Sauerland's theory using the 'covered box task' [9] to test for the presence of SIs by exploiting their cancelability. In this task, participants are given a choice between open boxes whose contents they can see, and a covered box, and hear a description that is compatible with one of the open boxes, but only if the scalar implicature is canceled. With the scale <some,all>, adults in this task were willing to cancel the implicature and choose the semantically compatible open box. We adapted this task to investigate whether the 'more than one' meaning of the plural is cancelable in a context where there is no plural match.

Method. We employed a variant of the covered box task using cards instead of boxes, each depicting Big Bird with various items; one card was placed face down and two face up on each trial. Thirteen adult participants were tested in a 2 condition between subjects design, manipulating the singular/plural marking of the description and the visible matches of the cards. A familiarization phase trained participants on the idea that when there was no visible match for the description, the

intended card must be the one that was face down. Instructions of the form 'Give me the card where Big Bird only has kites/a kite?'[1] were given with mismatching visible card options: (1) for the plural description - one card with one kite, one card with no objects), face down card; (2) for the singular description - one card with two/three kites, one card with no objects, face down card. Sauerland's theory predicts that in the condition where a plural noun is used but does not match the visible options, the 'more than one' meaning of the plural should be canceled, and participants should choose the singular match.

Results. We analyzed participants' responses on the first trial in this task, reasoning that any changes in response patterns after this trial might reflect metalinguistic reasoning exploiting speakers' explicit knowledge about the meaning of plural morphology. All participants consistently chose the face down card in trials where the description was singular but only a plural match was visible. In contrast, participants in the plural noun condition were equally likely to choose or reject the visible card depicting a single kite. These participants were significantly less likely to reject the visible, numerically mismatched option, than those in the singular condition (Wilcoxon Signed Rank Test, Z=-2.05, $p < .05$).

Discussion. We take these results as evidence in favor of Sauerland's theory. Given a context that facilitates implicature cancellation, participants were willing to accept a single object as the target of a plural description. Note, moreover, that this cannot be accounted for by simple flexibility in responses in this task, as participants did not accept multiple objects when given singular number marking. Let's assume a presuppositional semantics for *only* [10], where 'Big Bird only has kites' presupposes that Big Bird has kites and asserts that Big Bird has nothing that is not a kite. What we found is that participants are willing to cancel the SI in the presence of a card satisfying the asserted component of the description. That is, Sauerland's theory predicts a choice between a strengthened presupposition, 'Big Bird has more than one kite', and a weaker one with no SI, 'Big Bird has at least one kite'; a card that satisifies the asserted component and the weaker presupposition is deemed an adequate match. The SI of the plural is clearly difficult to cancel [11], but it seems that occurrence within a presupposition facilitates cancellation. Precedents to the idea that SIs within presupposed material are less robust exist in the literature: Russell [12] notes that (5) is equally felicitous regardless of whether it is presupposed that some of George's advisors are crooks, or all are.

5. George knows that some of his advisors are crooks.

If Russell is right that speakers can go either way in deciding between a weak or strengthened presupposition, this would sit particularly well with our finding that participants were 50/50 as to whether they cancelled the implicature or chose the covered card. In sum, our findings not only support implicature-based theories of the plural, but they may also have implications for our understanding of the interaction of presuppositions and implicatures – an issue that in turn bears on the debate over whether SIs are computed pragmatically or within the grammar. Whether participants' willingness to trade off the implicature of the plural against some other requirement imposed by another aspect of the sentence's meaning is confined to implicatures within the presuppositional component is a question that we are currently investigating with a control condition involving instructions of form 'Big Bird has a cookie/cookies and nothing else'.

References [1] Krifka 1989 [2] Schwarzschild 1996 [3] Chierchia 1998 [4] Sauerland 2003 [5] Sauerland et al 2005 [6] Spector 2007 [7] Heim 1991 [8] Chierchia 2004 [9] Huang et al submitted [10] Horn 1969 [11] Chierchia et al 2008 [12] Russell 2006

[1] We used 'only' in the instruction to prevent participants from taking the description to apply to a subset of the items on the card, as this would allow 'a kite' to be consistent with a card with multiple kites on it, thereby obscuring any possible effects of a scalar implicature on the plural.