

What number marking on indefinites means:
conceivability presuppositions and sensitivity to
probabilities

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Number marking on indefinites

- (1) a. There are blue circles on the card.
 $\rightsquigarrow |\{x : x \text{ is a blue circle on the card}\}| \geq 2$
- b. There is a blue circle on the card.
 $\rightsquigarrow |\{x : x \text{ is a blue circle on the card}\}| = 1$
- (2) a. There are no blue circles on the card.
b. There is no blue circle on the card.
 $\rightsquigarrow |\{x : x \text{ is a blue circle on the card}\}| = 0$

Common conclusion: the inferences related to number marking on indefinites are derived through pragmatic mechanisms.

The scalar implicature account

Rough sketch of Spector 2007 (see also Zweig 2009, Ivlieva 2013):

- (3a) triggers an “exactly one” inference due to competition with something like (3b).

- (3) a. There is a blue circle on the card.
 b. There are several blue circles on the card.

- (4) triggers an “more than one” inference due to *second-order* competition with (3a).

- (4) There are blue circles on the card.

Number marking on negative indefinites

- (5) a. There are no blue circles on the card.
b. There is no blue circle on the card.

In general, scalar implicatures are suppressed in downward-entailing environments (and in questions). We predict (5a) and (5b) to be equivalent.

In this talk: what is the actual contribution of number marking in (5)?

The conceivability presupposition

- (6) a. This book has no table of contents.
b. #This book has no tables of contents.
- (7) a. #This book has no chapter.
b. This book has no chapters.
- (8) **Generalization:** a singular- (resp. plural-)marked indefinite presupposes that it *could have had* exactly one (resp. more than one) witness.

(See earlier discussion of the plural presupposition in Spector 2007, sec. V, and of the full paradigm in Farkas and de Swart 2010, sec. 3.3.)

Number pragmatics in the middle

What governs the choice of number feature when both possibilities are conceivable?

A generalization due to Farkas and de Swart (2010): singular is used when *prototypical* witnesses are atomic.

- (9)
- a. Do you have children?
 - b. Do you have a child on our baseball team?
- (Farkas and de Swart 2010)

Sketching a first account of the middle

In a suitable dynamic theory (among other options):

- Singular indefinites introduce atomic witnesses
- Plural indefinites introduce atomic and non-atomic witnesses (cf. Sauerland 2003, Sudo 2012 a.o.)
- Pragmatic principle: *maximize referents* (dynamic reflex of the *maximize presupposition*)
- Possibility of defeasible accommodation of a prototypical situation
- *Maximize referents* means that you should always use plural indefinites if non-atomic witnesses are conceivable
- Hence singular indefinites presuppose uniqueness of witnesses (but there can be defeasible accommodation)
- Plural indefinites presuppose conceivability due to competition with the singular (which is preferred per Manner and per *maximize presupposition*)

Towards an experiment

Intuition: the choice of number varies smoothly with the distribution of witness numbers.

Do we predict this? If accommodation is suppressed, we might expect only plurals to surface when both sorts of witnesses are conceivable.

To get to the bottom of this, we can run a production experiment.

The task

- Participants see a series of cards with symbols and have to learn a certain condition through trial and error.
- The rule is always that the card has no blue circles.
- Participants can always see all earlier cards.
- After 20 trials, they are asked to provide a description of the rule.

The number of each symbol on each card is random, and the distribution depends on the conditions; each condition determines the chance of having several symbols of a kind, conditional on the kind being present:

- Conditions are Sg (0% chance), SgPI (10%), Mix (50%), PISg (90%), PI (100%).

Example trial

Previous valid cards

◆ × ■	■ × ◆	■ ◆ ×
◆ ■		

New card

■

●

Previous invalid cards

◆ ●	● ×	■ ● ×
◆ ●	● ◆	× ◆ ●

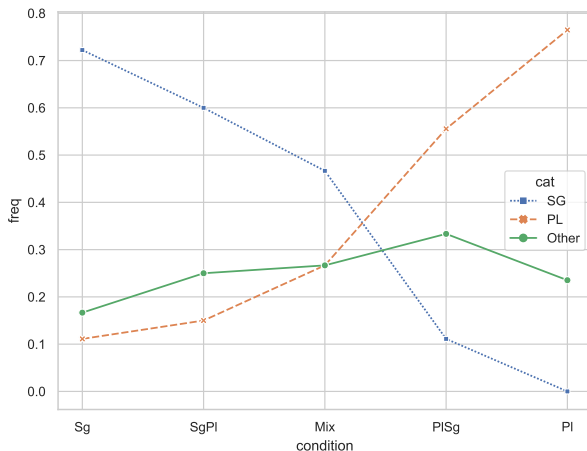
What do you think: is this card valid or invalid?

Technical details

- 100 English-speaking participants recruited on Prolific and assigned randomly to one of the 5 conditions
- 88 of them guessed the rule and are included in analysis
- Productions manually sorted into three categories:
 - ▶ SG: negated or negative singular indefinite
 - ▶ PL: negated or negative plural indefinite
 - ▶ Other: most commonly, referring to the color blue (e.g. “there is no blue”)

The graph

Share of participants using a negated singular indefinite (SG), a negated plural indefinite (PL), or another strategy (Other), as a function of condition:



Qualitative results

- Both numbers are used in all mixed situations (hence no strong presupposition in either case).
- Plural can be used even when it was never observed, unlike singular: supports the established view (though perhaps participants have the domain of symbols of all kind in mind).
- Clear gradient effect: *participants are sensitive to the stimuli distribution.*

Sensitivity to probabilities

- Some models of pragmatics (e.g. RSA (Bergen et al. 2016, a.o.), IBR (Franke 2011)) predict ubiquitous sensitivity of production and comprehension to prior probabilities.
- Argued by Fox and Katzir (2020) to be excessive.
- Enguehard and Spector (2021) provide a clear example of sensitivity, but do not demonstrate a gradient effect.
- Here we have a clear gradient effect.

Problem (possibly): formal pragmatics theories do not incorporate probabilities.

(See also Denic 2020 and Bar-Lev and Fox 2023 for interesting complications.)

Towards a probabilistic account

Idea: speakers try to make *continuing* the conversation easy (forward-looking maxim of manner).

In particular, they try to set up useful discourse referents.

When the crucial facts are beyond the knowledge of the speaker, they make their best guess, based on probabilistic knowledge.

Reference to negative indefinites

Observation #1: negated / negative indefinites introduce referents.

- Double negation

(10) It's not true that the card doesn't have a circle. It's just hard to see.

- So-called *bathroom*-pronouns

(11) Either the card does not have a circle, or it is hard to see.

- Retractions / denials

(12) A: The card does not have blue circles.
B: Yes it does! They're just hard to see.

- Related: indefinites in questions

(13) Q: Does the card have blue circles?
A: Yes, but they're hard to see.

Bilateral dynamic semantics

The facts in the previous slides can be accounted for in a bilateral dynamic system (cf. Krahmer and Muskens 1995, Elliott 2020 a.o.).

- (14) a. Classical dynamic propositional type: $s \rightarrow i \rightarrow \{i\}$
b. Bilateral dynamic propositional type: $s \rightarrow i \rightarrow \{(i; t)\}$
(i : assignments / $\{\cdot\}$: sets / $(\cdot; \cdot)$: pairs)

Truth is divorced from dynamic output: we can end up with “inactive” referents.

- (15) a. $\llbracket \text{there is a}^x \text{ horse} \rrbracket (w, g) =$
$$\begin{cases} \{(g[x/a]; 1) : \text{horse}(a) \wedge |a| = 1\} & \text{if there are horses} \\ \{(g; 0)\} & \text{otherwise} \end{cases}$$

b. $\llbracket \text{there is no}^x \text{ horse} \rrbracket (w, g) =$
$$\{(h; \neg b) : (h; b) \in \llbracket \text{there is a}^x \text{ horse} \rrbracket (w, g)\}$$

Anaphora to negative indefinites

Observation #2: pronouns have to match indefinites in number.

Observation #3: pronouns (but not indefinites on their own!) trigger an inference equivalent to the number inference from a definite.

- (16) It's not true that the card doesn't have a circle.
- It's just hard to see. \rightsquigarrow There is exactly one circle.
 - *They're just hard to see.
 - There are several but they're just hard to see.
- (17) It's not true that the card doesn't have any circles.
- They're just hard to see. \rightsquigarrow There are several circles.
 - *It's just hard to see.
 - There is one but it's just hard to see.

Anaphora to negative indefinites: the analysis

To account for the previous facts:

- Indices have number features, both indefinites and pronouns have to agree in number with their indices (as in Sudo 2012)
- These features are interpreted on pronouns (which are essentially definites)
- Pronouns are always maximal (cf. discussion in Sudo 2023, sec. 3.3)

Dynamic competition

Pragmatic principle: *provide useful referents*.

- (18) a. A: There is no blue circle.
(i) B: Actually it's just hard to see.
(ii) B: Actually *(there are several but) they're just hard to see.
- b. There are no blue circles.
(i) B: Actually *(there is one but) it's just hard to see.
(ii) B: Actually they're just hard to see.

- If the maximal witness is atomic, we *have to* use a singular indefinite (or risk ineffability).
- If the maximal witness is non-atomic, we *have to* use a plural indefinite.
- If the speaker does not know (and speakers using negative indefinies believe there is no witness at all!), they fall back to prior expectations.

Application to other environments

- (19) Situation: *there are several blue circles on the card.*
Q: Is there a blue circle on the card?
- a. A: Yes, *(there are several,) but they're hard to see.
 - b. #A: Yes, but it's hard to see.

With a suitable bilateral dynamic theory of questions (see Enguehard 2021 for preliminary work), this account extends immediately to questions (and perhaps other environments).

Some related work

- Levy (2008): linguistic processing in general functions by reasoning about continuations.
- Krifka (2015, and subsequent): a model of pragmatics where potential continuations receive an explicit representation (for questions).
- Sudo (2023): proposes a competition over referents as an alternative to the implicature account of number inferences for positive indefinites (but sets aside negation, and he proposes *minimize referents*).

Conclusion

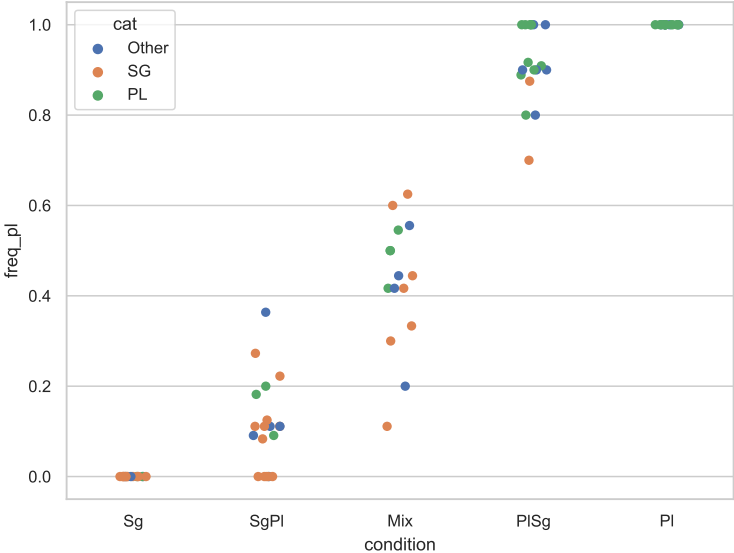
- Indefinites presuppose that they *could have* a witness whose atomicity fits the number feature.
- The choice of number feature for indefinites in non-veridical environments depends on expectations in a gradient way.
And: gradient patterns of context-sensitivity exist.
- This can be analyzed by extending pragmatic competition to referents / continuations and not just truth conditions.

Thank you!

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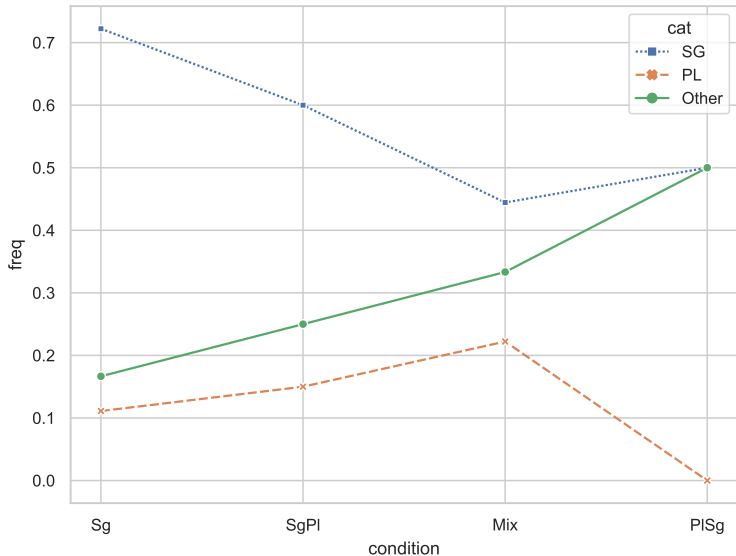
Bonus data I

Actual frequencies of there being multiple witnesses:



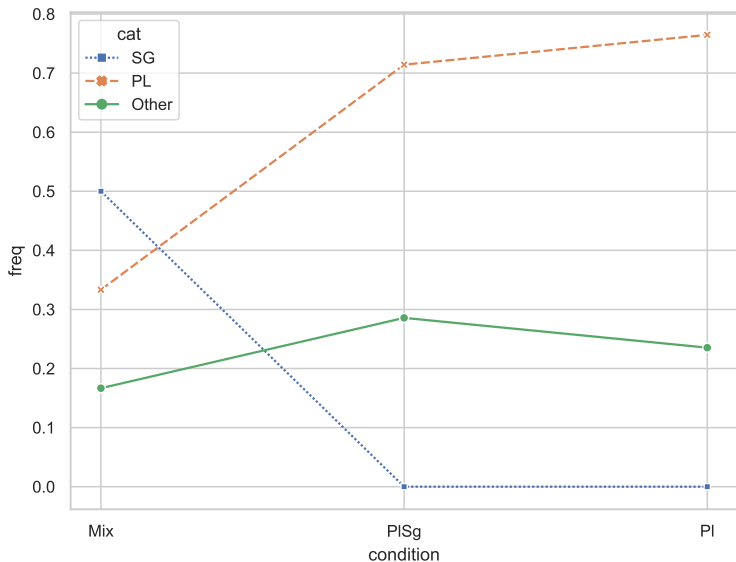
Bonus data II

Conditioning on the last relevant stimulus having a unique symbol:



Bonus data III

Conditioning on the last relevant stimulus having multiple symbols:



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