DO NEGATIVE POLARITY ITEMS FACILITATE THE PROCESSING OF DECREASING INFERENCES?

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Negative polarity items occur within the immediate scope of operators that support decreasing inferences. It is natural to expect the presence of a licensed NPI to facilitate the processing of decreasing inferences based on the licensor. In joint work with L. Bott and B. McElree I conducted a series of experiments to test this. We found no facilitation in terms of either verification accuracy or processing speed; instead, the presence of an NPI slowed down the processing of valid inferences. The talk will report on the experiments and consider various theories of licensing as potential explanations.

1. Introduction

An operator is monotone decreasing iff it licenses inferences from sets to subsets. Negative polarity items are generally confined to the immediate scope of monotone decreasing operators. The correlation between the inferential property and NPI-acceptability is the cornerstone of the widely accepted scalar accounts of NPI-licensing (e.g. Kadmon & Landman 1993, Krifka 1995, Lahiri 1998, and Chierchia 2006). Glossing over their differences, the intuition is as follows. The NPI widens the domain of quantification and carries the requirement that the truth of the sentence as evaluated against the widened domain should entail its truth as evaluated against the normal domain that a plain indefinite would invoke. This requirement can only be satisfied in a decreasing context. Furthermore, Geurts & van der Slik 2005 showed that inference processing is sensitive to the monotonicity profiles of quantifiers, quite independently of matters of NPI-licensing. Therefore the following is a natural prediction of the scalar accounts:

> The presence of a licensed NPI highlights the monotone decreasing character of the licensor, and facilitates, in one way or another, the processing of decreasing inferences supported by the licensor.

In joint work with Lewis Bott and Brian McElree I conducted three experiments to test

this prediction. As regards the facilitation of processing, our hypothesis was that the presence of the NPI may make the verification of decreasing inferences more accurate or faster. Using the NPIs *ever* and *any* we conducted a direct inference verification experiment and two self-paced reading time experiments.

2.   Experiments

In the first experiment participants read vignettes and responded to a yes/no question. In the stimuli, S2 contained a decreasing or a non-decreasing quantifier with or without an NPI (all combinations). We used disjunction to ensure that encyclopedic knowledge and focus did not play a role in the inference. For example:

S1. Our camp is on Staten Island.
S2. Almost no/every camper has ever/∅ caught a cold or suffered bruises.
S3. Would it be reasonable to say that almost no/every camper has suffered bruises?

We found that participants discriminated between valid and invalid inferences: they accepted valid inferences much more often than invalid ones. On the other hand, and contrary to the prediction above, we found no facilitation whatsoever. The presence of an NPI in S2 did not induce participants to accept more valid inferences or to reject more invalid ones.

In the second and third experiments S3 was not a question but a declarative introduced by a *since*-clause. We presented the inference in a *since*-clause in an attempt to replicate the use of pronominal anaphora in eliciting naturalistic quantifier scope interpretations (Tunstall 1999, Szabolcsi 2007). Participants read the vignettes region by region, at their own pace, and reading times were measured. The reincarnation of the above stimuli would now be as follows. #'s indicate the division into regions:

S1. Our camp is on Staten Island. #
S2. Almost no/every camper # has ever/∅ # caught a cold # or suffered bruises. #
S3. Since # almost no/every camper # has ever/∅ # suffered bruises, # the parents
        are (un)happy, # and ... # ...

Again, we found that participants were sensitive both to the licensing of the NPI in S2 and to the validity of the inference in S3. When S2 contained an NPI, they read the NPI-region and/or the immediately following region significantly slower if the NPI was not licensed. When neither S2 nor S3 contained an NPI and thus only validity was at

stake, they read the inference region of S3 (*suffered bruises*) and/or the immediately following region significantly slower if the inference was invalid. However, the presence of a licensed NPI in S2 did not have a facilitation effect on the speed of the reading of S3. In fact, we observed the opposite effect. When reading valid inferences, participants significantly slowed down on the inference region if the previous sentence contained a licensed NPI, as compared to the case where S2 did not contain an NPI. This effect obtained irrespective of whether the NPI was repeated in S3.

In sum, the experiments were sensitive enough to detect facilitation if there had been one. But we did not find facilitation, in terms of either accuracy or speed.

3. Possible explanations for the lack of facilitation

The simplest explanation for the lack of facilitation is that the human processor does not recognize the connection between the abilities of certain operators to support decreasing inferences and to license NPIs, and therefore the presence of a licensed NPI does not specifically highlight the decreasing character of its licensor. This might be for two rather different reasons.

One possibility is that the scalar account of NPI-licensing is correct in the abstract, but in fact licensing is syntacticized. Suppose that NPIs carry a syntactic feature [-de] and the sentence is unacceptable unless [-de] is deleted in construction with an operator that carries a [+de] feature. Operators with [+de] may be coextensive with the monotone decreasing ones, but this is an extra-grammatical fact. If inferences are, in contrast, computed purely model theoretically, the processor has no reason to associate decreasingness and NPIs.

Another possibility is that decreasingness is not the key property in NPI-licensing, even if it is factually correct that most NPI-licensors are decreasing. Giannakidou 1998 proposes such an account. According to this, non-veridicality and anti-veridicality are the key properties. Some version of this account might be correct for *ever* and *any*. Alternatively, there is a family of theories that identify interpreted or uninterpreted negatives as the key players. Ladusaw 1992 assimilates Romance negative concord to NPI-licensing, arguing that n-words as well as verbal negation in Romance languages are NPIs, and their licensor is an overt or silent anti-additive item. De Swart and Sag 2002 recast this analysis, with n-words interpreted as anti-additive quantifiers that are absorbed into a single polyadic quantifier. Postal 2005 and Szabolcsi 2004 propose the flip-side account and assimilate NPI-licensing to negative concord. More precisely, according to Postal NPIs are not lexical items in need of licensing. Instead, surface forms like *no one* and *anyone* are alternative morphologies

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that spell out the combination of an underlying indefinite and one or more negations. The choice between them depends on whether the negations are left alone or cancelled by other negations in the sentence. (One of Postal's strong descriptive arguments for the claim that *any*-forms contain a lexical negation comes from the phenomenon known as "secondary triggering".) Szabolcsi recasts Postal's proposal along the lines of de Swart and Sag: both the NPI and the licensor have a negation component in their lexical semantics; these negations are factored out to form a polyadic negative quantifier. Given that all decreasing operators are either negations or can be decomposed into a negation plus an increasing operator, this analysis is fully compatible with the correlation between NPI-licensing and decreasingness. But the processor will have no particular reason to recognize that correlation.

4. Possible explanations for (the lack of facilitation and) the slowdown

Recall that the experiments did not simply fail to detect a facilitatory effect; they detected a slowdown on the inference region when the preceding sentence contained a licensed NPI. What explains the combined findings? The semantics or pragmatics of the NPI may incur a significant processing cost, which has not yet been taken into account. It may play a role in predicting the observed effects in two different ways.

> No facilitation plus somewhat costly NPI processing: NPI presence does not improve either the accuracy or the speed of inference processing. On the other hand it incurs some cost that is manifested in longer reading times.

> Some facilitation plus very costly NPI processing: NPI presence does facilitate inference processing in some way and to some extent, but it also incurs a cost that is large enough both to wipe out all facilitatory effects and to additionally lengthen reading times.

How would the extra cost arise? On the Ladusaw-de Swart & Sag-Postal-Szabolcsi account the factoring out of the negative component of the NPI's lexical representation and the formation of a polyadic quantifier with the negation component of the licensor may well be costly. On the Kadmon & Ladman-Krifka-Lahiri-Chierchia account, the NPI itself carries scalar implicatures. Chierchia (2006: 554-560) follows Krifka and Lahiri in attributing an *even*-like flavor to the base meaning of the NPI *any*. This activates a set of domain-alternatives and carries the implicature that even the broadest choice of the domain of quantification will make the sentence with *any* true. Departing

from Grice, implicatures are added and strengthened meanings are calculated recursively, at every step of the sentences's composition. Domain widening and implicature calculation are plausibly costly.

The upshot is that both kinds of theoretical account might be able to explain the findings (no observable facilitation of accuracy, some slowdown in reading times). What our findings clearly rule out is an account that predicts that NPIs should have a squarely facilitatory effect. Further work is needed to assess the magnitude of the effects and determine whether one of the models is favored by the processing data.

As one issue of interest, notice that while stressed NPIs undeniably have an *even*-flavored meaning, not all NPIs do. Some examples of NPIs without domain widening are n-words interpreted as NPIs (Chierchia 2006), occurrences of unstressed *any* applied to unambiguously defined domains (*The empty set does not have any proper subsets* – does not mean `even a marginal proper subset', Krifka 1995), and items like the adverb *anymore* (*He doesn't live here anymore* `He lived here and that has changed'), the auxiliary *need* (*He need not come early*), and others (van der Wal, 1999). The existence of such NPIs is one reason why some accounts maintain that the phenomenon of NPI-licensing *per se* is not a scalar matter. On the other hand, the non-scalar accounts may freely acknowledge that some NPIs do have an *even*-flavor that has to be taken into account in the full description of their distribution and meaning (Szabolcsi 2004, and especially Giannakidou 2007). If so, they predict that the processing of an NPI is more costly when the NPI carries tangible scalar implicatures.

Chierchia's account accommodates the existence of NPIs without tangible domain widening in the following way. In contrast to items like *some* and *many*, whose scalar alternatives can be deactivated and thus their implicatures (`but not all') suspended in appropriate contexts, he assumes that *any* is grammaticized to always activate a set of domain-alternatives. But Chierchia requires the proposition with the widest possible domain of quantification only to entail its counterparts with particular domains; that is, it has to be either stronger than or equivalent to them. "Domain widening, as implemented here, is a *potential* for domain widening" (2006:559, emphasis in the original). In this way his account does not distort interpretations. However, the combined effect of the grammaticized activation of domain-alternatives and the recursive computation of scalar implicatures is that NPIs will incur the same processing cost regardless whether they actually involve domain widening (*The campers have not suffered ANY bruises*) or not (*The empty set does not have any proper subsets*). This prediction contrasts with that of the non-scalar accounts, see above.

Further work should be able to determine which prediction is borne out by processing. Bott & Noveck 2004 showed that interpreting *Some of the children are in the classroom* with an implicature to mean `Some [but not all] of the children are in the

classroom' is more costly than the same sentence interpreted without the implicature, as in `Some [and possibly all] of the children are in the classroom'.

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