Superlative Quantifiers as Speech Act Modifiers: Experimental Evidence from Hebrew

Introduction: We provide experimental support for Cohen & Krifka's (to appear) account of superlative quantifiers (henceforth SQs), according to which they are speech act modifiers.

Traditionally (Keenan & Stavi 1986), superlative quantifiers are treated in the same way as comparative quantifiers (*more than* and *fewer than*), so that (1) is assumed to be equivalent to (2).

(1) Mary petted at least three rabbits
(2) Mary petted more than two rabbits.

More recently, however, Geurts & Nouwen (2007) have demonstrated that this account is inadequate, and proposed an alternative, according to which,SQsexpress epistemic modal statements; specifically, (1) is claimed to mean (3).

(3) It is epistemically necessary that Mary petted three rabbits, and it is epistemically possible that she petted more.

Alternative theories are proposed by Büring (2007) and Cummins & Katsos (2010) who argue that (1) means the disjunction in (4).

(4) Mary petted exactly three rabbits or Mary petted more than three rabbits.

Cohen & Krifka (to appear) propose a different theory, according to whichSQs are illocutionary operators. Specifically, (1) is interpreted as (5).

(5) For all $n<3$, the speaker denies that Mary petted exactly n rabbits.

Note that a crucial element of this theory is that speech acts can be under the scope of logical operators and contribute to the truth conditions of the sentence. For example, suppose Mary petted exactly two rabbits, and John utters (1). Now, according to (5), John is denying three statements (for n=0,1,2), one of which is true (for n=2), hence asserting a falsehood, and (1) is false, as desired.

Turning from falsity to truth, suppose Mary petted exactly four rabbits. It follows from (5), by way of conversational implicature, that the speaker refrains from denying that Mary petted exactly n rabbits for $n\geq3$. Since one of the options entertained by the speaker is, in fact, true (for n=4), (1) is true, as desired.

Importantly, then, the falsity of (1) follows semantically, whereas its truth follows pragmatically, through conversational implicature. Cohen & Krifka argue for this claim on linguistic grounds; in this paper we provide experimental support for Cohen and Krifka's proposal.

Processing: All three theories (epistemic, disjunction, and illocutionary) predict that the processing of SQs will take longer than that of comparative quantifiers, and indeed this prediction has been confirmed experimentally (Geurts *et al* 2010; Cummins and Katsos 2010). However, Cohen & Krifka's illocutionary theory makes a further prediction: since only judgments of truth, but not judgments of falsity, require an implicature; and since implicatures require additional time to process (e.g. Bott & Noveck 2004), it follows that judgments of true SQ sentences will take longer than judgments of false ones. Importantly, this prediction does not follow from any of the competing theories, which assume that both truth and falsity are evaluated semantically, with no need for implicature. We conducted two online experiments, using the sentence verification task to test this prediction.

Experiment A - methods: Reaction times were recorded as participants judged sentences of the form *I see Q N Xs*, where Q is a quantifier (superlative or comparative); N is a number (3, 4 or 5); and X is one of two everyday objects, e.g., "I see at least 4 glasses".The stimuli sentences were in

Hebrew, which allowed us to control for frequency effects: in English, *at least* is much more frequent than *at most*, a fact that could conceivably affect behavior, resulting in a frequency confound. In contrast, Hebrew has two forms (*lexol hapaxot* 'at least' and *lexol hayoter* 'at most') with roughly the same (low) frequency. For completeness, we also added the much more frequent form *lefaxot* 'at least'.

There were five experimental conditions, corresponding to three superlative quantifiers and two comparative ones, each consisting of 12 trials. Each trial included a written sentence presentation on a computer screen, which was simultaneously accompanied by a picture. All stimuli were counterbalanced and randomly distributed. We tested 28 Hebrew speaking adults.

Experiment A - results and discussion: Findings from previous studies demonstrating that SQs require substantially longer reaction times were replicated. More importantly, within superlative quantifiers, we observed a significant difference ($P<0.02$) between mean reaction time for judgments of truth (2613ms) and falsity (2360ms), as predicted by the illocutionary theory. The interaction between quantifier (*lexol hapaxot*, *lexol hayoter,* or *lefaxot*) and truth judgment (true or false) was not significant, indicating that all three SQs demonstrate a similar effect. No effect was observed for comparative quantifiers. These findings support the illocutionary theory.

One might conceivably claim, however, that our results could also be made compatible with the epistemic or disjunction theory, if it could somehow be demonstrated that the judgment of the logical form assumed by the theory requires more time for truth than for falsity. In order to rule out this possibility, we carried out a second experiment, in which we gave subjects sufficient time to process the sentence, including its implicature, before presenting them with the picture. The illocutionary theory now predicts that the effect will disapear, since the computation of the implicature can be carried out prior to the (truth) judgment itself. In contrast, the competing theories, even with the added assumption made above, would predict the effect to remain essentially unchanged.

Experiment B - methods: The same materials and procedure were used, with the exception that the sentence preceded the corresponding picture by 2 seconds. 27 Hebrew speaking adults were tested in this experiment.

Experiment B – results and discussion: A small difference between mean reaction times for truth (1750ms) vs. falsity (1883ms) was recorded. This difference is not statistically significant ($P=0.38$), which provides further support for the illocutionary theory.

Conclusion: Cohen & Krifka's illocutionary theory predicts that reaction time to judgments of true SQ sentences will be longer than that of false SQ sentences, and that this difference will disappear if subjects are given sufficient time to compute the implicature prior to the judgment. These predictions are borne out by our experiments. Since Cohen & Krifka's proposal crucially involves speech act operators in the scope of quantifiers, our findings can be seen as further evidence for the thesis that speech acts are full-fledged participants in the semantic game.

Selected references

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