Only the (informationally) stronger survive: A probe recognition study with scale-mates and antonyms

Background: Most theoretical accounts assume that scalar implicatures involve alternatives, but it is an open question which kinds of alternatives listeners reason about (see Chemla & Singh, 2014, and Gotzner & Romoli, 2022 for an overview). The standard view following Horn (1972) is that only stronger scale-mates should play a role in the inferential process. For example, when hearing a sentence like *Zack's carpet was dirty,* listeners should activate and negate the scale-mate *filthy*. Recent psycholinguistic studies have used lexical priming paradigms to show that listeners indeed activate alternatives within pragmatic processing (de Carvahlo et al., 2016; Ronai & Xiang, 2023). Interestingly, some studies indicated that non-entailed alternatives such as antonyms (*clean*) also play a role in the inferential process, contrary to the standard view (e.g., Peloquin & Frank, 2016; Lacina et al., 2023). This is consistent with the Alternative Activation Account (Gotzner, 2017), which proposes a two-stage process: First, all semantically associated meanings are activated (e.g., *filthy* and *clean*) and second, grammatical and contextual restrictions select those alternatives that are relevant for implicature computation (*filthy*). This view predicts that only the strong scalars should survive in the representation of the final product of pragmatic processing. Here, we test this prediction in experiments using the probe recognition task, which taps into eventual discourse representations (Gernsbacher & Jescheniak, 1995) and has been used to test relevant alternatives in focus processing (Gotzner et al., 2016). We hypothesised that only stronger scalars (*filthy*) should be included in the final discourse representation while antonyms (*clean*) should no longer be represented since they are not part of the relevant set of alternatives for scalar implicature computation.

Method: Our native English speakers were exposed to sentences in the RSVP mode such as *Zack's carpet was…* The prime words ending the sentence were either related (*dirty* or *clean*) or unrelated (*patterned*) to the same target words (*filthy*). In Exp 1, the related probe word was the weak scalar (*dirty*) and in Exp 2, the antonym (*clean*). The unrelated primes were the same in both experiments and they served as a control that is irrelevant for pragmatic processing and associative priming. Participants were asked to read the sentences and then indicate whether a probe word, which appeared 2000ms after the stimulus, was present in the previous sentence. We used the same sentence frames as Ronai & Xiang (2023) and Lacina et al. (2023).

Results: For both experiments, we ran linear mixed effects models on the log-RT data of correct probe rejections with the fixed effect of relatedness. In Exp 1 (N = 74, Items = 60), target words were rejected slower when they followed weak scalars compared to unrelated words (β = 0.0337, SE = 0.0099, df = 52.11, t = 3.416, p = 0.00124**). This was not the case in Exp 2 (N = 78, Items = 60), where antonymic primes did not significantly differ from unrelated primes: β = 0.0087, SE = 0.0076, df = 75.78, t = 1.144, p = 0.256. A combined analysis of both experiments showed that the interaction of prime type (weak scalar or antonym experiment) and relatedness was significant: β = 0.0245, SE = 0.0109, df = 146.3, t = 2.260, p = 0.0253*.

Discussion: Our data from Exp 1 showed an interference effect in the probe recognition task with strong scalars—weak scalar primes made the recognition of the strong scale-mate slower. This result is reminiscent of the findings regarding unmentioned focus alternatives (e.g., Gotzner et al., 2016) and show that strong scalar terms are being represented by comprehenders in the

mental model of the discourse during comprehension. What this suggests is that at a point in processing where both the sentence and any of its pragmatic inferences have presumably been dealt with, the stronger term is present in the minds of comprehenders, arguably as a part of the finished enriched meaning of the sentence with its associated scalar implicature.

In contrast, Exp 2 showed that this was not the case when antonyms were presented as primes and a cross-experiment analysis revealed an interaction effect. Thus, strong scalars but not antonyms seem to be retained in the final discourse representation. Lacina et al. (2023) reported that in the earlier stages of processing, both weak scalars (*dirty*) and antonyms (*clean*) activated the targets (*filthy*). Taken together with the current results, we find support for the Alternative Activation Account: while all semantic associates might be activated in the process of implicature derivation, only the strong scalars are retained in the eventual representation, being the only relevant alternatives. The initial broad activation of all associates is a result of how the brain organises information in semantic networks across domains (e.g., Onifer & Swinney, 1981) while there has to be additional specialised mechanisms for the computation of scalar implicatures that identify relevant alternatives that are being negated.

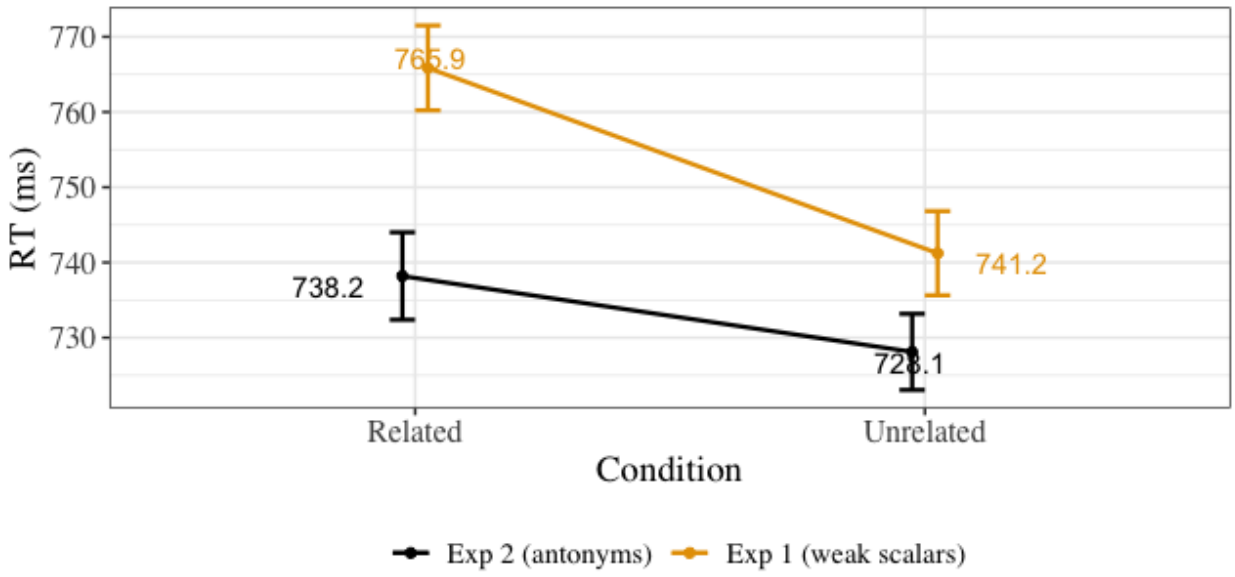

Figure 1: Mean response times of correct rejections by condition in Experiments 1 and 2 with associated standard errors.

Selected References: De Carvalho, A., Reboul, A. C., Van der Henst, J. B., Cheylus, A., & Nazir, T. (2016). Scalar implicatures: The psychological reality of scales. *Frontiers in psychology*, 7, 1500.; Gernsbacher, M. A., & Jescheniak, J. D. (1995). Cataphoric devices in spoken discourse. *Cognitive psychology*, 29(1), 24-58.; Gotzner, N. (2017). *Alternative sets in language processing: How focus alternatives are represented in the mind*. Springer.; Horn, L. (1972). *On the semantic properties of logical operators in English*. University of California, Los Angeles.; Lacina, R., Alexandropoulou, S., Ronai, E., & Gotzner, N. (2023). The Priming of Informationally Weaker Alternatives: Antonyms and Negation. Poster presented at the 10th Experimental Pragmatics conference, September 20 - 22 Paris, France.; Ronai, E., & Xiang, M. (2023). Tracking the activation of scalar alternatives with semantic priming. *Experiments in Linguistic Meaning*, 2, 229-240.