Are logical representations quantifier-specific?
Evidence from priming for a non-quantifier-specific representation of scope

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Scopally ambiguous sentences (e.g., *Every bear approached a tent*) allow two scopal configurations: a *universal-wide* (wide scope *every*: every bear approached a different tent) and an *existential-wide* configuration (wide scope *a*: every bear approached the same tent). The assignment of scope is mentally represented as logical representations. A key question about logical representations is whether scope is represented following quantifier-specific scope-taking operations or following more general scope operations. This question is relevant, because quantifiers differ from each other in their scope-taking biases (e.g., *each* is more likely to take wide scope than *all*, Ioup, 1975). Feiman and Snedeker (2016; henceforth F&S) previously tested this question using the structural priming paradigm in comprehension. They observed that logical representations are only susceptible to priming if prime and target contained the same quantifiers. This finding indicates that logical representations are differentiated according to quantifier-specific scope-taking mechanisms. We replicated F&S's study in Dutch. Dutch quantifier words are slightly different than English quantifier words. More specifically, the Dutch distributive quantifiers *iedere* and *elke* are closer in meaning than their rough English translation equivalents *each* and *every*. Our original aim was therefore to test whether priming emerged between *elke* and *iedere*. However, the outcome of Exp. 1 led us to re-examine F&S's hypothesis that logical representations are quantifier-specific.

We used sentence-picture matching tasks to elicit priming of logical representations in language comprehension (similar to F&S; Fig. 1). Prime sentences either had the form *elke...een* ('every...a'), *iedere...een* ('every...a') or *alle...een* ('all...a'). Target sentences were always *elke...een*. In Exp. 1 (*n* = 188), we manipulated Prime Quantifier (*elke*, *iedere*, *alle*) between participants (following F&S). The results of Exp. 1 revealed priming from *elke* to *elke*, but also between the different quantifiers *alle* and *elke*. There was no priming between *iedere* and *elke* (Fig. 2). Given these inconclusive results, we ran a replication (Exp. 2; *n* = 180) in which Prime Quantifier was manipulated within participants. Exp. 2 showed priming in all conditions (with no differences in the magnitude of the effect; Fig. 3). This finding contrasts with F&S's hypothesis. Rather, people seem to generalise in scope assignment across different quantifier words if they are exposed to similar interpretations of different quantifier words. Note that the contrasts between F&S's findings and our findings is likely not due to the difference in language tested in both studies (Dutch vs English). Like English quantifiers, Dutch quantifiers differ from each other in scope-taking behaviour (*elke* and *iedere* are more likely to take wide scope than *all*; e.g., Dik, 1975). Therefore, it is more likely that these differences are due to differences in experimental design.

Some structural priming studies in language production showed that abstract priming sometimes requires presence of a lexical overlap condition in the same experiment (Muylle, Bernolet, & Hartsuiker, in press). This may also explain our results: In Exp. 1, within-quantifier and between-quantifiers were never both presented to the participants, whereas this was the case in Exp. 2. We tested this hypothesis in Exp. 3 (*n* = 260), in which the presence of the within-quantifier condition (*elke-elke*) was manipulated between blocks. Exp. 3 showed that priming emerged between quantifiers in the absence of a within-quantifier condition (Fig. 4). This suggests that people generalise across different quantifier words as long as they are exposed to both possible readings of multiple quantifier words (i.e., also if they are exposed to multiple between-quantifier conditions). Altogether, our results therefore suggest that the absence of between-quantifier priming does not denote a quantifier-specific representation of scope assignment. Rather, people seem to generalise across the scope-taking behaviour of different quantifiers if they are exposed to the scope-taking behaviour of multiple quantifiers. Therefore, we conclude that logical representations do not involve a quantifier-specific representation of scope assignment: Quantifiers bias us towards the construction of a particular logical representation, but logical representations themselves do not specify quantifier-specific scope-taking mechanisms.

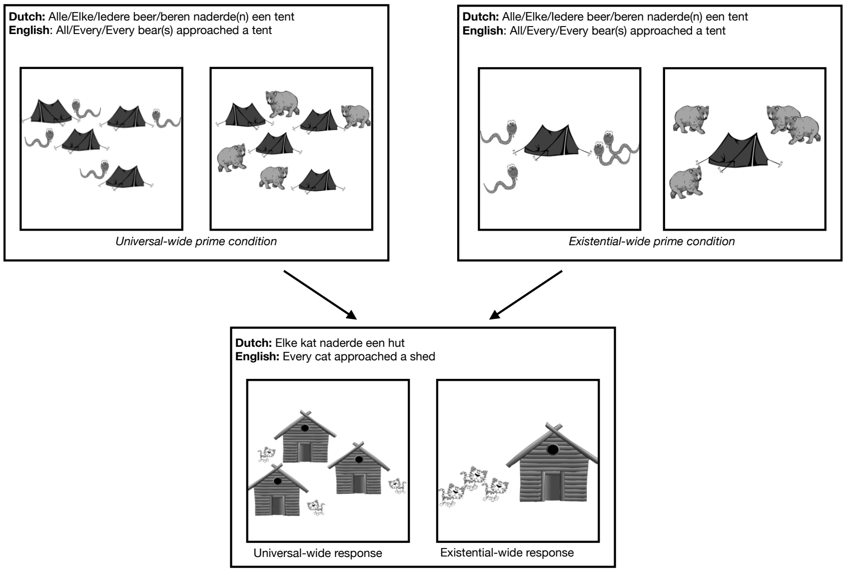

Fig. 1. Example of a prime-target trial of the sentence-picture matching tasks used in Experiments 1-3. Participants matched the sentence with one out of the two pictures. In the primes, they were forced to select one interpretation, in the targets, they could choose between both interpretations.

Prime sentences always involved one universal quantifier (*elke*, *iedere* or *alle*). The *labels Universal-wide prime, Existential-wide prime, Universal-wide response* and *Existential-wide response* and the English translations are added to this figure for ease of illustration.

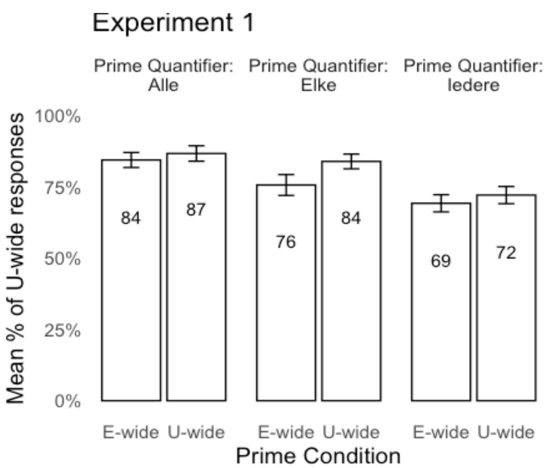

Fig. 2. Percentage of u-wide target choices per Prime Quantifier and Prime Condition configuration in Exp. 1. Logit mixed-effect models comparisons revealed a main effect of Prime Condition ($p < 0.001$), which was modulated by Prime Quantifier ($p = 0.013$; post-hoc comparisons: priming was stronger in *elke* compared to *iedere* ($p = 0.011$), but not compared to *alle* ($p = 0.127$).

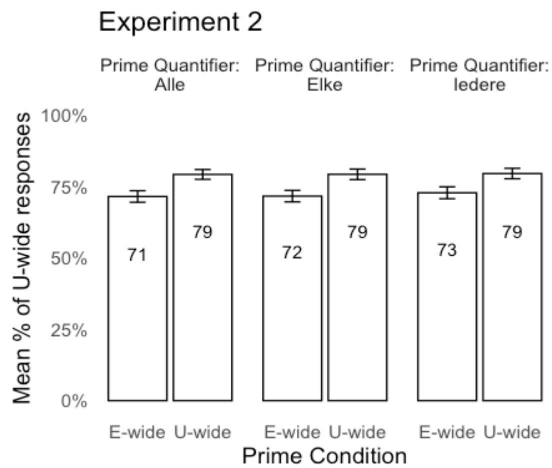

Fig. 3. Percentage of u-wide target choices per Prime Quantifier and Prime Condition configuration in Exp. 2. The statistical analyses revealed a main effect of Prime Condition ($p < 0.001$), which was not modulated by Prime Quantifier ($p = 0.935$)

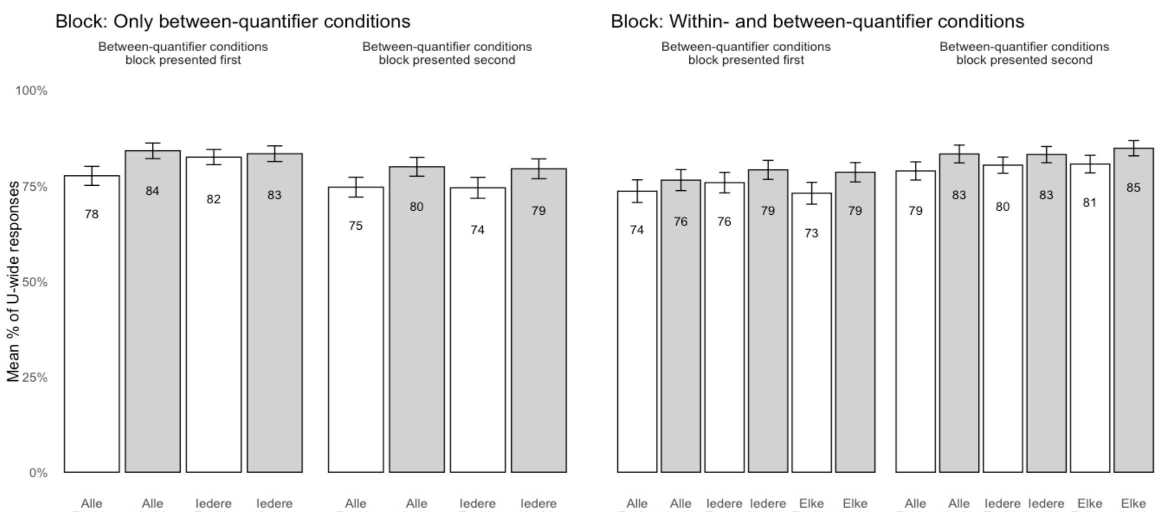

Fig. 4. Percentage of u-wide target choices per Prime Quantifier, Prime Condition, Block, and Block Order configuration in Exp. 3. The statistical analyses revealed a main effect of Prime Condition ($p < 0.001$) which was not modulated by the Prime Quantifier, Block, or Block Order conditions.

References: Feiman, R., & Snedeker, J. (2016). The logic in language: How all quantifiers are alike, but each quantifier is different. *Cognitive psychology*, 87, 29-52.; Ioup, G. (1975). Some universals for quantifier scope. In *Syntax and Semantics volume 4* (pp. 37-58).; Muylle, M., Bernolet, S., & Hartsuiker, R.J. (in press). On the limits of shared syntactic representations: When word order variation blocks priming between an artificial language and Dutch. *Journal of Experimental Psychology: Learning, Memory and Cognition.*