Scalar Implicatures: not all are derived from lexical alternatives

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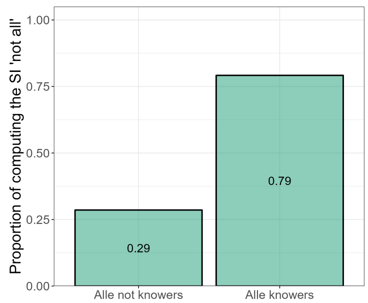
Introduction. Some meanings arise from expressions competing with alternative expressions: the utterance 'some of the kids cried' implies the meaning 'not all of the kids cried', because the speaker did not say the alternative 'all of the kids cried'. More recently, Buccola et al. (2021) put forward arguments for the existence of *conceptual alternatives*, which are meanings that can act as alternatives but that do not necessarily correspond to utterable expressions. In this work, we test the conceptual alternative hypothesis by looking at language acquisition. If conceptual alternatives exist in adult language, we might also expect to find them in children going through a stage where they already compute inferences based on alternative concepts, before they have acquired the corresponding linguistic expressions. For example, when hearing *some*, a child may compute the scalar implicatures (SIs) 'not all' and 'not most' before they learn the meanings of the words *all* and *most* which act as competitors to *some*. At the same time, we should not expect that the eventual lexicalization of these concepts has no effect on SI computation: when children are exposed to the usage of *all* and *most* in conversation, they will be more likely to identify them as relevant competitors to *some*, an important step in the acquisition of implicatures.

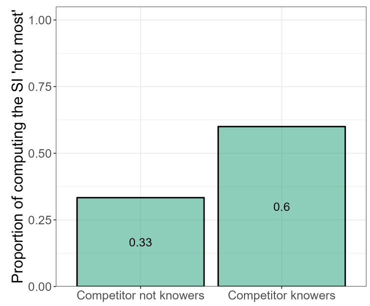
Current study. We investigate whether (i) SIs can be computed before lexicalization of the competitor, and (ii) whether the computation of SIs is boosted by lexicalization of the competitor. We focus on German children's comprehension of the SIs 'not most' and 'not all' of *ein paar* 'some', which may arise through competition with *viele/die meisten* 'lots'/'most' and *alle* 'all,' respectively. We tested two hypotheses: (H1) there are children who compute the implicature but do not have knowledge of the competitor; (H2) the probability of computing the implicature is higher if the competitor is known lexically.

Methods. 67 typically-developing German-speaking children (4;1–7;3, *M*=5;6) participated in this study. We used a picture selection task to test the two hypotheses above. Participants were presented with two images and asked to choose the one that best represented a sentence containing *ein paar, alle, die meisten* or *viele* (e.g., *Ein paar der Katzen tragen einen Hut.* 'Some of the cats are wearing a hat.'). All target images consisted of 9 characters, a subset of which was associated with a given property that 3/9, 7/9, 9/9, or 0/9 of the characters have (e.g., 3/9 cats wear a hat). The image pairs aimed at testing knowledge of each meaning: *ein paar* – 0/9 (false) vs 3/9 (true); *alle* – 7/9 vs 9/9; *die meisten/viele* – 3/9 vs 7/9; SI 'not all' – 3/9 vs 9/9; SI 'not most' – 3/9 vs 7/9. We controlled for whether a participant selected a higher/lower numerosity strategy when faced with a not-yet acquired word meaning: we had a condition with the nonce quantifier *tume* presented with the image pair 3/9 vs 7/9. An 'I don't know' button was given as an option to use if they did not understand the meaning of a word or did not have a preference for either image. There were 5 items per condition. We counted a child as knowing the meaning of a word if they picked the correct picture at least 4 times and did not have a higher numerosity strategy (determined by whether they picked the 7/9 at least 4 times when hearing the nonce word *tume*). Similarly, we counted a child as drawing an SI if they picked the correct image at least 4 times and did not choose the lower numerosity strategy. The experimental phase was divided into two blocks, so as to introduce the competitors only after SI computation was tested. The items were randomized within each block.

Results. Data were preprocessed to identify (i) children who knew *ein paar*, (ii) children who did or did not know the competitors *alle*, *viele* and *die meisten*, and (iii) children who computed the relevant SIs. Hypothesis 1 was confirmed if we found children who (a) knew *ein paar*, did not know *alle*, yet computed the SI 'not all', and (b) knew *ein paar*, but not *viele* or *die meisten*, and still computed the SI 'not most'. We identified 31 *ein paar* knowers, of which 7 did not know *alle*;



(a) ‘not all’



(b) ‘not most’

Figure 1: Proportion of SI computation by quantifier knowledge

among these, 2 still computed the SI ‘not all’. In addition, 6 children did not know *die meisten* or *viele*, and of those 2 still computed the SI ‘not most’.

Hypothesis 2 was confirmed if among children who knew *ein paar*, the probability of computing the SI ‘not all’ was higher for those who knew *alle*, and the probability of computing the SI ‘not most’ was higher for those who knew *die meisten* or *viele*. To evaluate this, we conducted two logistic regression analyses. The first model examined *computing_notall* (1 = the child computes the SI ‘not all’, 0 otherwise) as the dependent variable, with *all_knower* (1 = the child knows the meaning of *alle*, 0 otherwise) as a fixed effect. This model revealed a significant effect of knowledge of *alle* ($\beta = 2.25, SE = 0.98, z = 2.31, p = 0.02$). The 24 children who knew *alle* were more likely to compute the SI than the 7 children who did not, as shown in Figure 1a. The second model examined *computing_notmost* (1 = the child computes the SI ‘not most’, 0 otherwise) with *competitor_knower* (1 = the child knows either *viele* or *die meisten*, 0 otherwise) as the fixed effect. This model did not reveal a statistically significant effect of competitor knowledge ($\beta = 1.10, SE = 0.96, z = 1.15, p = 0.25$), although the pattern was in the expected direction. The 25 children who knew at least one of the competitor computed the SI ‘not most’ on 60% of trials, whereas non-competitor-knowers (6 children) did so on 33% of trials (see Figure 1b). This null effect is likely attributable to limited statistical power, given the small sample size and the uneven distribution of children across the two subgroups. Finally, additional models including age as a predictor did not reveal any effect of age on the computation of either SI.

Discussion. Both hypotheses were confirmed. Our results indicate that some children pass through a stage in which they know the concepts *all* and *most/lots*, do not have words for them yet, and nevertheless can use them as alternatives to generate scalar implicatures to *ein paar*. This supports the idea that children can have representations for alternatives before learning the meaning of the corresponding words, and that those can be used to generate inferences. Furthermore, the confirmation of the second hypothesis suggests that knowledge of the lexical competitor boosts SI computation (we note a confound in the correlation of lexical knowledge and SI computation in the developmental trajectory, which is only partially controlled for by including age as a predictor). Prior work has shown that even when children know the meaning of a stronger competitor, they struggle with identifying it as a relevant alternative for generating implicatures (Skordos and Papafragou 2016). Our findings can be interpreted as showing that knowing the lexical item allows to more readily recognize it as an alternative, because of exposure to its usage. For children who do not know the lexical competitor, it nevertheless remains an open question whether those who failed to compute the SI behaved so because they haven’t yet acquired the concept for *all/most/many* or because they haven’t identified them as relevant alternatives.

References • Brian Buccola, Manuel Križ, and Emmanuel Chemla. Conceptual alternatives: Competition in language and beyond. *Linguistics and Philosophy*, 45(2):265–291, 2021. doi: 10.1007/s10988-021-09327-w. • Dimitrios Skordos and Anna Papafragou. Children's derivation of scalar implicatures: Alternatives and relevance. *Cognition*, 153:6–18, 2016.