Integrating Numerical Knowledge in the Exact Interpretation Numeral Quantifiers

What domains of cognition determine children's interpretations of numeral quantifiers? Semantics? Pragmatics? The number faculty itself? Linguistic studies of the exact interpretation of numeral quantifiers have proposed that these interpretations are lexically semantic (Kennedy & Syrett 2018) and, in contrast, that they are a product of a scalar implicature (Horn 1972; Papafragou & Musolino 2003). To date, there is no research to determine whether independent measures of numerical ability are predictive of children's numerical quantifier interpretations. Finally, we investigate whether we can find evidence of the role played by the number faculty itself, and in this way tell us something about the interaction of multiple mental faculties.

What might we expect to find, if number itself plays a role? A property of the human psychophysics of quantities is expressed by Fechner's Law, which states that magnitudes become increasingly difficult to discriminate as they increase, and that perception of stimuli will be a logarithmic function of them. The Logarithmic-to-Linear shift phenomenon (Siegler & Opfer 2003) has shown that before children learn to count, their estimates of numbers on a number-line are indeed a logarithmic function of the numbers they are given. In this sense, their estimates in the numerical domain are less exact than those of adults. Does this less exact numerical representation express itself as greater acceptance of non-exact numerical quantifier representations in the linguistic domain? Another aspect of children's numerical quantifier representations, which could reflect the influence of Fechner's Law, and hence the number faculty, is whether the set size of the objects over which children must make exactness judgments predicts their rate of acceptance. If less exact numerical representations are accepted as set size increases, it would reflect nothing about linguistics, but rather Fechner's Law, and the number faculty.

To test these predictions, 98 children (90.28 months, SD = 11.16 months) and 30 adult Spanish- speakers (369.2 months [30.75 years], SD = 68.3 months) were given a symbolic and a non- symbolic Number-Line Task (Siegler & Opfer 2003), as well as a Truth-Value-Judgment-Task (TVJT) (Crain & McKee 1985) of non-exact numerical quantifier interpretation. The TVJTs were video-recorded scenarios, based on Musolino (2004), in which participants answered yes or no to 8 questions such as "Does Peppa's mom have 16 rocks?", when she in fact has more. Participants were additionally given working memory, inhibition and attention measures to determine whether a pragmatic account is supported.

Results indicated that only children's acceptance of smaller quantifiers than the one presented in the TVJT was predicted by the cardinality of the quantifier presented (Figure 1- B=.016, SE=.003, p=.001). Further, children's, but not adults', number-line estimates predicted their acceptance of smaller quantifiers than the one presented (Figure 2- B =2.25, SE=.847, p=.008). There were no significant relationships between TVJT acceptance and any executive function measure. In sum, properties of the number faculty appear visible in children's developing use of numerically-sensitive elements of language. Furthermore, evidence from executive function measures is consistent with exact interpretations of numerals being encoded semantically rather than pragmatically.

Selected References

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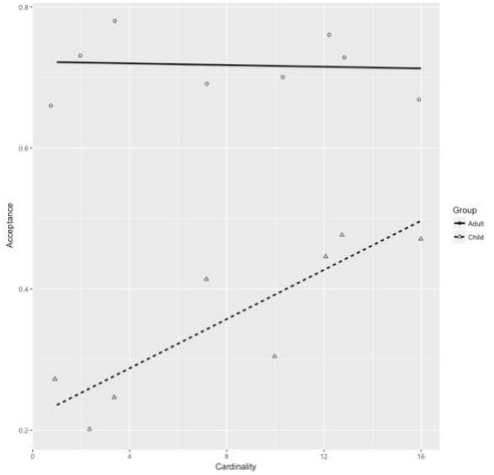
Figures

Figure 1(left): Set Size only predicts children's acceptance in the TVJT
Figure 2 (right): Number-line estimates only predicts children's acceptance in the TVJT



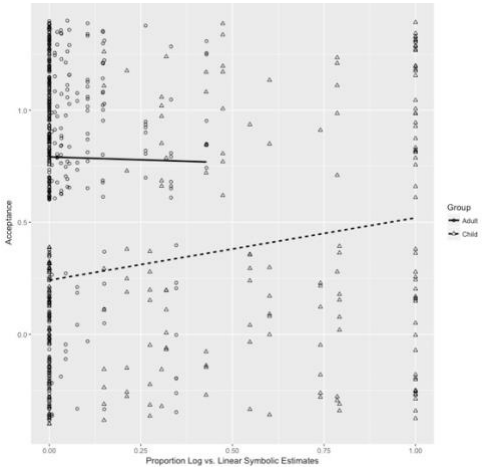


Figure 3: shows a scenario where Peppa needs 2 rocks and her mom has 4 rocks. We asked participants Does Peppa's mom have 2 rocks?

Figure 4: shows a scenario where Peppa needs 13 rocks and her mom has 15 rocks. We asked participants Does Peppa's mom have 13 rocks?