Number, Executive Function, Lexicon and Collective-Distributive Interpretations

Children's abilities to interpret distributive sentences such as *Each boy pushed a car.* vs. collective sentences such as *Some boys pushed a car.* are late to develop across a range of languages (e.g. Hanlon 1986, Brooks & Braine 1996, Brooks et al. 1998, Syrett & Musolino 2013, de Koster et al. 2016, 2017), culminating in adult-like interpretations only when children reach 10 or 11 years of age. The core question of our project is an attempt to understand why this development is so protracted. The intuition we pursue in our hypothesis is that the constructions are complex and depend on a range of cognitive abilities, in addition to language.

Recent work has shown that children's developing distributive interpretations are predictive of their collective interpretations (Pagliarini et al. 2012; Padilla-Reyes 2018). These authors argue that this relationship results from distributive and collective quantifiers falling on the same Collective-Distributive Pragmatic Scale, following Dotalačil (2010), in the same way that quantifiers fall on the classic Quantity Scale of Grice (1975) and Horn (1972). On this theory, the collective quantifiers, such as *some*, only come to have unambiguous collective meanings in opposition to the distributive quantifier *each.* While the collective quantifier *some* is inherently ambiguous between collective and distributive meanings, even in adults, the distributive entailment of *each* begins as ambiguous for children but eventually becomes unambiguous over development. The collective interpretation of *some* arises in parallel to the distributive *each* as the inference or conversational implicature that undergirds the collective meaning of *some* becomes easier to draw in contrast to the more informative, less ambiguous distributive entailment of *each*.

Grinstead, Oates, Padilla-Reyes & Nieves-Rivera (2018) show that inhibition, and Grinstead, Padilla-Reyes & Flores (2019) show that inhibition, attention and working memory; together with lexical development, predict children's collective interpretations, but not their distributive interpretations. Assuming that Dotlačil's hypothesis of a Collective-Distributive Scale is correct, these authors argue that children must use domain-general executive function abilities to choose among the potential collective-distributive quantifiers for particular pragmatic contexts, suppressing the potential distributive interpretation of *some*, as distributive *each* becomes increasingly less ambiguous.

How does the quantifier *each* come to have a clearer or stronger meaning over development? Among the dimensions of meaning expressed by natural language quantifiers, there is a core component that is quantitative and must therefore depend partially for their meaning on the non-species-specific number faculty. Nieves-Rivera & Grinstead (2019) show that children's number line estimates (Sieglar & Opfer 2003) are predictive of their exact numeral interpretations. In this study, we ask whether number line estimates, as a proxy for non-linguistic numerical ability, are predictive of children's collective implicature interpretations. Further, because we are concerned not only with number and collective implicatures, but also with executive function and lexical development, we model the interaction of these variables using Piecewise Path Analysis, a simple version of Structural Equation Modeling (e.g. Kline 1988, Shipley 2002).

49 monolingual, typically-developing Spanish-speaking children between the ages of 4 and 8 years-old (age range = 49-100 months, mean age = 82 months, SD = 14) were given a video-recorded Truth-Value Judgment Task to measure collective-distributive interpretations of the Spanish quantifiers *cada* (each) and *unos* (some). The children also took a standardized lexical test, *El Test de Vocabulario en Imágenes Peabody* (Dunn and Lugo 1984), executive function tests for attention (Set-Shifting), working memory (Dot Counting) and inhibition (Flanker) from the EXAMINER Battery (Kramer et al. 2014) and the Number Line tasks of Sieglar & Opfer (2003).

The specified Path Analysis, in Figure 1, shows a predictive relationship between judgments of *cada* (each) in collective contexts, putatively the product of an entailment, and judgments of *unos* (some) in distributive contexts, putatively the result of a conversational, scalar implicature, replicating past results. Also as in past results, executive function measures, including working memory, and the lexical measure predict judgments of *cada* in collective contexts. Finally, the Number Line tasks predicted lexical development, as one might expect given the role that the lexicon plays in mediating between numerical ability and judgments of *cada* in collective contexts.

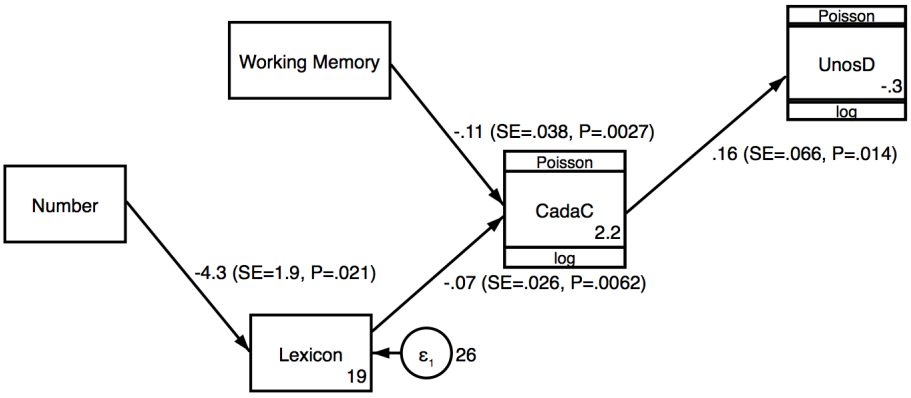

Figure 1 – Specified Path Analysis with Related Endogenous Variables Predicting the Pragmatic Implicature Associated with the Interpretation of Collective *unos* in Distributive Contexts

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