What's behind some (but not all) implicatures

Francesca Foppolo[a], Greta Mazzaggio[b], Francesca Panzeri[a], Luca Surian[b]

[a] Department of Psychology, University of Milan-Bicocca
[b] Department of Psychology and Cognitive Science, University of Trento

Several studies investigated children's derivation of pragmatic inferences by testing different items in different languages, populations and tasks (Skordos & Papafragou, 2016). In general, pre-schoolers have difficulties in the computation of the scalar implicature (SI) related to some, while a better performance has been documented in the case of non scalar or ad hoc implicatures (AIs), even in younger kids (Horowitz, Schneider and Frank, 2017; Katsos & Bishop, 2011; Stiller, Goodman & Frank, 2015). Children's difficulty has been accounted for by different hypotheses: children are more tolerant of pragmatic violations than adults ('tolerance account', Katsos & Bishop, 2011); children do not (always) recognize what is conversationally relevant ('relevance account', Skordos & Papafragou, 2016); children have difficulties in lexicalizing the scale and/or retrieving the lexical alternatives ('lexicalist account', Barner et al., 2011; Foppolo et al., 2012; Tieu et al., 2015). Yet, the source and nature of children's difficulty is still unknown, as well as the interplay of different factors and their impact on different inference types.

Different theoretical accounts make different predictions for SIs and AIs. In principle, no difference is expected between implicature types within a pragmatic approach (like the tolerance or the relevance accounts), provided that children's non adult-like behavior relies in a principle of pragmatic tolerance or in a failure in accessing or recognizing relevant alternatives, that would equally affect all kinds of implicature. Under lexicalist approaches, on the other hand, a difference between AIs and SIs is expected: while in the case of AIs the alternatives depend solely on context, in SIs the set of alternatives is a feature of the language that relies on the lexical representation of scales. The crucial difference is in the access to the alternatives, which depends on a linguistic representation and a lexical retrieval mechanism in the case of scalar quantifiers, while it is purely contextually determined in the case of ad hoc scales.

In our study, we compared AIs and SIs by means of a Picture Selection Task modelled after Surian & Job (1987) and Stiller, Goodman & Frank (2015). Participants had to find the target (among 4 pictures) by following instructions. For example, they had to find the target bed in Figure 1A by deriving the AI in (1), or the target cake in Figure 1B by deriving the SI in (2):

(1) Guess which one is my bed, I give you a cue: on my bed there is a teddy bear.
(2) Guess which one is my cake, I give you a cue: on my birthday cake, some of the candles are burning.

The tasks included 4 implicatures of each type, interspersed with control sentences. To understand the developmental factors beyond children's performance, children were also administered tests of cognitive and linguistic development (Raven's Progressive Matrices; BVL for lexicon and morphosyntax; the first four tasks of Wellman & Liu 2004 to test for Theory of Mind, ToM: Diverse Desires-Diverse Beliefs-Knowledge Access-Content False Belief).

We tested 141 children aged 3 to 9 (75 in kindergarten: 3;10-6;0, M = 61 months; 66 in primary school: 6;10-9;2, M=90 months). Children's accuracy on controls was above 94%; overall, the rate of derivation of AIs was higher than SIs (86.3%-73.9%), and this gap is more evident in the younger group (78%-57%, Figure 2).

We ran a logistic regression analysis considering accuracy as the dependent variable, including Age, Implicature-Type and the scores on the other tasks as predictors. The model that best fits our data reveals a significant effect of Implicature-Type (Est= -1.53), Age (Est=.053) and Morpho-Syntax (Est=.08), all ps<.05. Since performance was almost at ceiling on controls and in primary school, we decided to focus only in kindergarten children for further analysis on predictors. A logistic regression analysis considering accuracy on AIs and SIs as the dependent variable revealed a significant effect of: type of implicature (accuracy was lower in SIs than AIs; Est=-1.47, SE=.64, p=.02); morpho-syntactic competence (Est=.07, SE=.02, p<.0001); ToM (Est=.45, SE=.198, p=.02). An interaction between Implicature-Type and ToM was also found (Est=.74, SE=.26, p=.005) in which ToM predicts performance on SIs but not AIs. To further understand the role of ToM in the derivation of SI, we ran a separate analysis in which the 4 tasks for ToM were entered as separate predictors in a logistic regression. We found a significant effect of Knowledge Access (KA) in the derivation of both kind of implicatures (Est=1.42, SE=.51, p= .005), and a significant interaction between Implicature-Type and Diverse Beliefs (DB), that reveals an effect of this component in the derivation of SIs but not AIs.

Our findings add an additional piece to the understanding of children's failure and success with scalar inferencing. In particular, we show that younger children succeed with AIs but have difficulties with SIs. We also found a significant role of linguistic (i.e., morpho-syntactic) abilities for both type of implicatures and a contribution of ToM: KA predicts implicatures derivation, and DB seems to play a role in SIs.

The overall picture is rather puzzling: focusing on pre-schoolers, their ability to derive both types of implicatures seems to depend on common mechanisms, such as morpho-syntactic skills and the ability to recognize that another person can know something only if she has access to relevant information. Nevertheless, by controlling for task effects, we confirmed that SIs are harder than AIs. This finding is not easily explained within a pragmatic approach: if children were, in general, more logical or more tolerant than adults, they would be equally so with any kind of implicature; at the same time, if they were not sensitive to informativeness or unable to recognize relevance, they would fail with all pragmatic inferences. A lexical account instead predicts that, beyond general mechanisms common to SIs and AIs, the derivation of SIs requires one further step, that takes time to be acquired or automatized, namely: the lexicalization of the relevant scales. This might be the real source of the observed difference between these types of inferences, although further research is needed to fully capture its impact on children's performance.

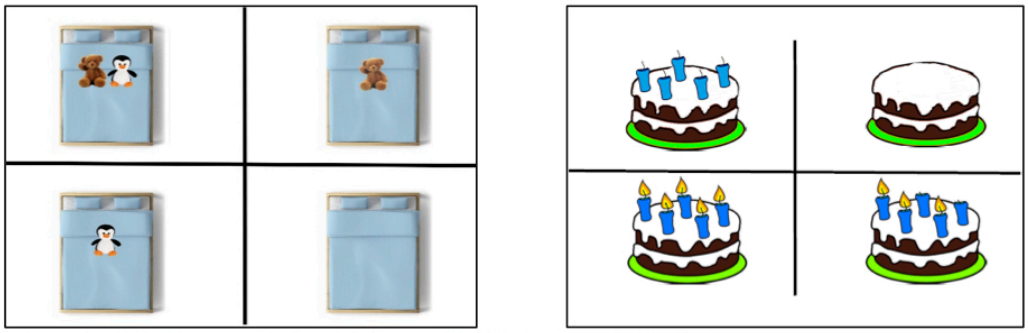

Figure 1. A-left: scenario for AI items; B-right: scenario for SI items.

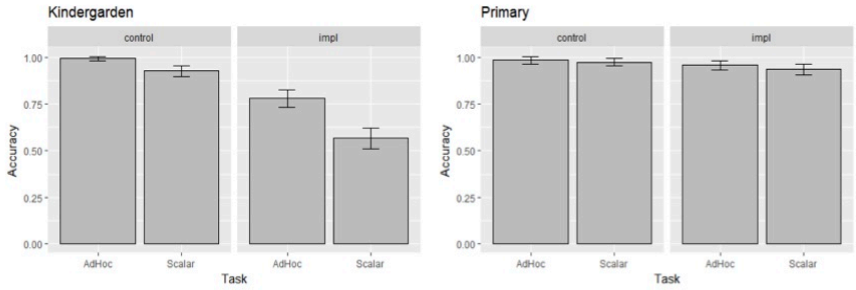

Figure 2. Accuracy on control and implicatures items in the two tasks (for AI and SI) divided by age group (for descriptive purposes).

References

Barner, D., Brooks, N., & Bale, A. (2011). Accessing the unsaid: The role of scalar alternatives in children's pragmatic inference. *Cognition*, 118(1), 84-93.
Belacchi, C., Scalisi, T. G., Cannoni, E., & Cornoldi, C. (2008). *CPM coloured progressive matrices: standardizzazione italiana: manuale*. Firenze: Giunti OS.
Foppolo, F., Guasti, M. T., & Chierchia, G. (2012). Scalar implicatures in child language: Give children a chance. *Language learning and development*, 8(4), 365-394.
Horowitz, A. C., Schneider, R. M., & Frank, M. C. (2017). The Trouble With Quantifiers: Exploring Children's Deficits in Scalar Implicature. *Child Development*.
Katsos, N., & Bishop, D. V. (2011). Pragmatic tolerance: Implications for the acquisition of informativeness and implicature. *Cognition*, 120(1), 67-81.
Marini, A., Marotta, L., Bulgheroni, S., & Fabbro, F. (2015). *Batteria per la Valutazione del Linguaggio in Bambini dai 4 ai 12 anni (BVL_4-12)*. Firenze: Giunti OS.
Skordos, D., & Papafragou, A. (2016). Children's derivation of scalar implicatures: Alternatives and relevance. *Cognition*, 153, 6-18.
Stiller, A. J., Goodman, N. D., & Frank, M. C. (2015). Ad-hoc implicature in preschool children. *Language Learning and Development*, 11(2), 176-190.
Sullivan, K., Zaitchik, D., & Tager-Flusberg, H. (1994). Preschoolers can attribute second-order beliefs. *Developmental Psychology, 30*(3), 395.
Surian, L., & Job, R. (1987). Children's use of conversational rules in a referential communication task. *Journal of Psycholinguistic Research*, 16(4), 369-382.
Tieu, L., Romoli, J., Zhou, P., & Crain, S. (2015). Children's knowledge of free choice inferences and scalar implicatures. *Journal of Semantics*.
Wellman, H. M., & Liu, D. (2004). Scaling of theory-of-mind tasks. *Child Development*, *75*(2), 523-541.