

The investigation of quantity implicatures during typical development: a systematic review

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During the last two decades, many experimental studies have concentrated on the investigation of quantity implicatures, and in particular of scalar implicatures, which are generated through the use of lexical items that belong on a scale of informativeness. From a developmental point of view, experimental data suggest that children find these implicatures difficult to process (Guasti et al., 2005; Katsos & Bishop, 2011; Noveck, 2001; Papafragou & Musolino, 2003; Pouscoulous et al., 2007). There is however no straightforward indication of the exact age at which children start deriving this type of implicature, as the available data on the acquisition of scalar implicatures during typical development is varied and sometimes appears contradictory (Eiteljoerge et al. 2018; Sullivan et al., 2019). Furthermore, there are different hypotheses regarding the underlying mechanism of the derivation of these implicatures, and the reasons for the difficulties that children seem to have in deriving them (Foppolo et al. 2012; Katsos & Bishop, 2011; Pouscoulous et al., 2007).

The present work is part of a bigger review project on the acquisition of conversational implicatures in typically developing children, and it is meant to concentrate on quantity implicature in an attempt not only to shed light on what theory amongst the most accredited within experimental pragmatics is most supported by the data, but also on methodological issues regarding the investigation of this type of implicature. The references for this review were selected through the PRISMA method. The criteria for eligibility were that the articles should be peer-reviewed, published articles written in English, they should contain empirical data on the comprehension of quantity implicatures in first language acquisition during typical development, and there needed to be a classification of what type of implicature was being tested and in what way, with examples. Furthermore, the authors needed to have performed a replicable statistical analysis on the data and there needed to be indication of the age range and mean age of the participants. In order to make the data more easily comparable, the last criterion was that the articles should all present their results in term of percentage of success in implicature derivation (or a measure that could be converted to this).

In the end, 39 papers were deemed eligible for this study, all published between years 2001 and 2021. Within these, a total of 141 different findings in terms of percentage of success was obtained, summing up the different experiments, implicature types, tasks and groups tested within these 39 references. The minimum age tested was 2 years old and the maximum age tested was 13 years and 4 months old. Information on how many findings were found for each age group can be found in Table 1.

Quantity implicatures taken into consideration could be those derived via the use of a scalar lexical terms or those derived via a contextually given ad-hoc scale. There is therefore a distinction made between scalar implicatures, which count 111 findings, and ad-hoc implicatures, which count 30.

| Mean age in years | Findings per age group |
|-------------------|------------------------|
| 2 | 2 |
| 3 | 11 |
| 4 | 36 |
| 5 | 43 |
| 6 | 8 |
| 7 | 20 |
| 8 | 3 |
| 9 | 6 |
| 10 | 8 |
| 11 | 4 |

The experiments were run in eight different languages, namely *Table 1* Dutch, English, French, Greek, Italian, Japanese, Mandarin Chinese and Spanish. The results are generalizable beyond the scope of just one language, as there is no detectable difference in percentage of success among the eight languages; in fact, while a MANOVA shows significant effect of language on performance ($F = 2.772$, $p < 0.05$), a subsequent Tukey test reveals that there is no statistically significant difference between any two languages.

Among the 39 papers, six different types of task were used to test scalar implicatures, with four possible types of output variables (binary, ternary, quaternary or performative). A summary of the tasks used and how many findings were collected with each can be seen in Table 2.

| Task type | Findings per task type |
|----------------------------------|------------------------|
| Action based | 10 |
| Communicative context assessment | 2 |
| Felicity judgment | 30 |
| Referent selection | 50 |
| Speaker selection | 9 |
| Truth value judgment | 40 |

Table 2

An exploratory analysis of the data done through simple linear regressions suggests that, as expected, performance improves overall with age, which is demonstrated by a positive correlation between the mean age in months and the percentage of success in implicature derivation ($R^2 = 0.078$, $p < 0.001$). This improvement is however more evident for certain tasks than it is

for others: in particular, a comparison between the Referent selection task and the Truth value judgment task, which are the two methodologies that count more than 30 findings each, shows that while age does not seem to predict a better performance in the latter case ($R^2 = 0.049$, $p = 0.168$), it does in the former ($R^2 = 0.283$, $p < 0.001$).

The data also suggest that ad-hoc implicatures are easier to derive for children as compared to scalar implicatures, as Fig.1 shows. A t-test confirmed that the difference in percentage of success between the two implicature types is in fact significant ($t = 5.376$, $p < 0.001$).

The data will be analyzed further, through statistical methods, in order to account for interactions among factors. However, it will also be analyzed qualitatively, by grouping the main conclusions drawn by the authors of each paper and the modifications made to the methodologies. Aside from age, task, implicature type and output variable type, other potential predictors of better performance will be taken into consideration in this review, such as presence of pre-training, number of participants and trials, age span of the participants and other linguistic, cognitive and socio-economic factors that were studied within the 39 references.

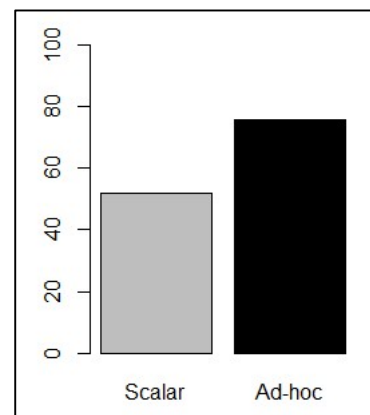


Figure 1: mean percentage of success per implicature type

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