SET COMPARISON IN CHILD LANGUAGE

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1. Introduction

In the past decades, research on the acquisition of quantification has focused on children's understanding of e.g. *all* and *every* and the sets they are quantifying over. However, there is only sparse data on children's understanding of the different ways quantifiers are known to relate these sets to each other (cf. the difference between intersective/weak and non-intersective/strong quantifiers, Milsark, 1979). Moreover, since context is known to affect this relation, Smits (in preparation) argues that a target-like understanding of quantifiers crucially involves combining information from different sources (syntax, semantics, pragmatics; cf. also Hendriks and De Hoop, 2001). From this perspective, this paper presents new data on children's understanding of the context-dependency of the quantifier *many*.

2. The many meanings of *many*

A quantifier relates two sets, the denotation of the NP and the denotation of the VP (its 'domain' and its 'nuclear scope' (Heim, 1982). However, quantifiers differ in the kind of relation(s) they establish between these two sets. For (1), this always concerns a subset relation; to be true, the set of parrots should be a subset of the set of tie-wearers.

(1) All parrots are wearing a tie
(2) Many parrots are wearing a tie

The quantifier *many,* however, allows (at least) three different kind of relations. For example, to determine the truth-value of (2), one only needs

to inspect the intersection of the set of parrots and the set of 'tie-wearers'. If there are more than a certain number of parrots wearing a tie, (2) is true. In this respect, the quantifier *many* in this reading is called intersective and quantifiers like *all* non-intersective (Barwise and Cooper, 1981).

Note, however, that what counts as *many* in (2) is context-dependent. Since parrots do not wear ties in real life, one might judge (2) true if one sees three parrots wearing a tie. However, (3) might be judged false if only three of all the men present at a wedding are wearing a tie.

(3) Many men are wearing a tie at the wedding.

In a different way, *many* is context-dependent in (4) (from Westerståhl, 1984):

(4) Many Scandinavians have won the Nobel price in literature

It is not a context-dependent number in (4) what determines what counts as *many*, but rather the ratio of Scandinavians that have won the Nobel Prize in literature as compared to the number of Nobel Prize winners from other countries.

We label the three readings of *many* exemplified in (2), (3) and (4) respectively the cardinal, proportional and Westerståhl reading of *many*. Since determining which reading is at issue clearly involves taking into account the discourse context, children's understanding of *many* will be addressed in a similar way in the experiment presented below.

3. Children's understanding of *many* and *many of*

An experiment was conducted to answer the question whether children use the discourse context and the type of the quantifier (intersective versus non-intersective) to determine the meaning of *many* and *many of*.

3.1 Method

3.1.1 Subjects

We tested 22 children between the ages of 4;1 and 7;3 (mean age 6;0). All children were recruited at preschools in the area of Amherst, Massachusetts (USA).

3.1.2 Procedure

The children were tested using a Truth Value Judgment Task. Instead of a puppet uttering the test sentences, we used a laptop with prerecorded test items. The test items were either presented in a context about the quantifier's domain or about its nuclear scope (see materials). The child was instructed to check whether the pictures matched the sentences or not. This instruction was given to prevent children from answering in terms of world-knowledge (e.g. "parrots do not wear hats in the real world, so the picture is not right"). This setup crucially allowed the child to explain her answer (being either 'yes' or 'no'), either in terms of cardinality, proportions or ratio's (cf. the Westerståhl reading).

3.1.3 Design

The pictures displayed the set of individuals denoted by the noun phrase and the verb phrase next to the alternative set of the first argument set and the alternative set of the second argument set (cf. the figure below for the test item *Many parrots are wearing hats*). The same kind of pictures were shown for sentences with *many* and m*any of*.

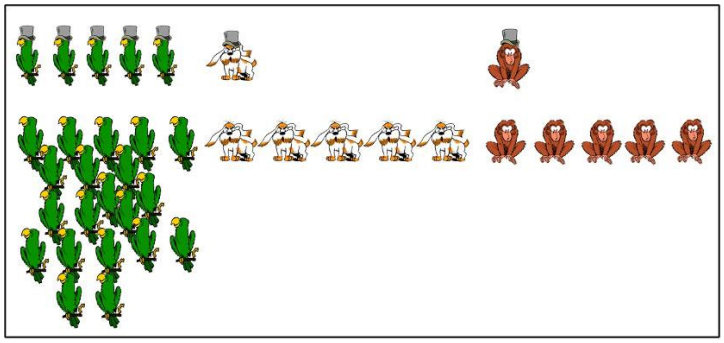

Figure 1: Many/Many of the parrots are wearing hats

These scenarios were used to test children's comprehension of sentences containing the different types of quantifiers: *many* (6 items) versus *many of* (6 items). As a control condition, children were asked to interpret sentences containing *all* with respect to a picture in which e.g. all boys were carrying a box and a doctor and a woman were not (6 items). Additionally, two control items with *many* and two with *all* were tested. In the control items, a sentence with *many* and *all* was used in combination with a picture in which respectively e.g. one parrot was wearing a hat (triggering a 'no' answer) or e.g. four parrots were all wearing a hat (triggering a 'yes' answer). The total number of items was 22.

In addition to the effect of Quantifier Type, the effect of Discourse Context was tested by varying the introduction to each picture. The description was either about the quantifier's domain or the quantifier's nuclear scope. Additionally, the experimenter pointed out the set under discussion. This gesturing was used to achieve joint attention.

Adults are expected to either give a cardinal or proportional answer in the case of a discourse context about the quantifier's domain in the case of a figure like the one above and a sentence like *Many parrots are wearing hats*. Conversely, adults are expected to give a Westerståhl reading in the case of a discourse context about the quantifier's nuclear scope.

3.2 Results

Children answered target-like on the control condition with *all*. For both *many* and *many of*, children gave more cardinal interpretations than proportinal, Westerståhl and 'other' interpretations (t-tests $p < 0.001$) (cf. figure 2 below). Each child showed the four readings in their answers.

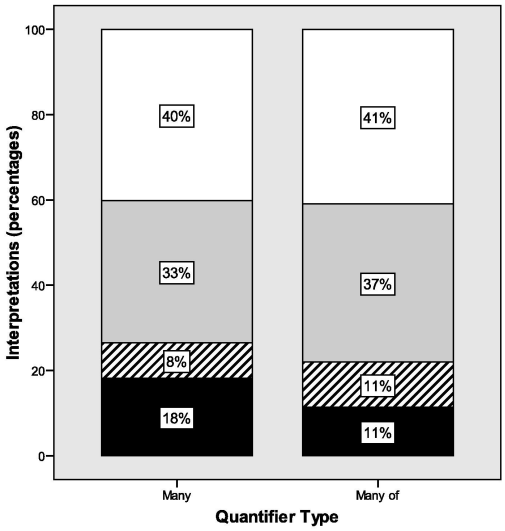

Figure 2: Children's cardinal (white), proportional (grey), Westerståhl (dashed) and other (black) interpretations of *many* and *many of*

Does the child uses the difference between intersective and non-intersective quantifiers as a clue to determine the meaning of a quantified sentence. However, no statistically significant associations were found between the child answer (cardinal, proportional, Westerståhl or other) and the type of the quantifier ($\chi^2(3) = 0.739$, $p = 0.864$).

Recall that the discourse varied in the introductory description. But do children use this kind of discourse information? No statistically significant difference was found between the distribution of answers in the discourse A context (χ^2 (3) = 0.868, $p = 0.833$) nor in the discourse B context ($\chi^2(3) = 2.152$, $p = 0.542$).

4. Conclusion

In this paper, we took the different readings of *many* versus *many of* to address children's usage of discourse context and the type of the quantifiers (intersective or non-intersective) to interpret a quantifier domain. The results show that children accept all three readings of *many*, but crucially do not use the discourse context or the type of the quantifier to determine the intended reading. Smits (in preparation) argues that this shows that the acquisition of quantification crucially involves fine-tuning the interaction between syntax, semantics and pragmatics. Only by doing so, the child will be able to compare sets adult-like.

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References

Barwise, J. and Cooper, R. (1981). Generalized quantifiers and natural language. *Linguistics and Philosophy* 4 (2): 159–219.

Heim, I. (1982), *The Semantics of Definite and Indefinite Noun Phrases*. PhD dissertation, University of Massachusetts, Amherst.

Hendriks, P. and H. De Hoop (2001). Optimality theoretic semantics. *Linguistics and philosophy* 24 (1), 1–32.

Milsark, G. L. (1979). *Existential sentences in English.* New York: Garland Publications.

Smits, E.-J. (in preparation). *The acquisition of quantification. Children's use of semantics and pragmatics to constrain meaning*. PhD thesis. University of Groningen

Westerståhl, D. (1985). Logical constants in quantifier languages. *Linguistics and Philosophy* 8: 387–413.