

N-words are not slower than existential and universal quantifiers in 5-year-olds. A comparison of processing times using the visual world paradigm and its implications for Early Negative Concord.

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Background: Recent studies in language acquisition have shown that young children and adults differ in their understanding of sentences with more than one negative element. Looking at sentences as in (1), Thornton et al. (2016) made two important observations: the first is that English-speaking children at age 5, contrary to adults, fail to access the Double Negation (DN) reading (1a) in favour of the alternative NC reading (1b). The second is that children do not unselectively merge together two negative elements under a single operator if there is a clause-boundary in between, as in (2):

- (1) The girl [who skip the rope] didn't buy nothing
a. the girl bought something (DN reading <- adults)
b. * the girl bought nothing (NC reading <- children)
- (2) The girl [who didn't skip the rope] bought nothing (same reading in children and adults)

Taken together, the lack of DN readings in (1) and the locality constraint in (2) support the view that children may initially adopt a *Neg-Concord* grammar. We label this explanation as the "*Neg-Concord Hypothesis*".

A second route to take for explaining the contrast in (1) is instead that 5-year-olds have troubles to process negation on the quantifier, in line with Katsos et al. (2016)'s proposal that Negative Quantifiers (NQs) and N-words are challenging for children. Therefore, the absence of the DN reading in (1) (for similar results with N-words in pre-verbal position see also Moscati, in press) could be reduced to a processing constraint that would single out NQs and N-words from other quantifiers (eg. *nothing* vs *everything/something*). We call this alternative path the "*Processing Hypothesis*".

A way to adjudicate between the two hypotheses would be to compare the processing time of negative and positive quantifiers and determine if there is evidence supporting a different processing load. To do this, we designed a novel eye-tracking experiment.

The experiment. Materials. We investigate children and adult processing of sentences in three different experimental conditions, each of them with a diverse quantificational expression. Examples of the Italian sentences used in the study are provided below:

(3) *look at the drawing in which...*

- (a) *Nessun treno è giallo* "no train is yellow" (Condition 1: N-word).
(b) *Tutti i treni sono gialli* "all trains are yellow" (Condition 2: Universal)
(c) *Alcuni treni sono gialli* "some trains are yellow" (Condition 3: Existential)

After a brief warm up, a sequence of 15 experimental trials began, with 5 trials per condition. Figure 1 illustrates the trial structure: after a fixation cross, an object appeared on screen and a voice described it introducing a relevant property *p* (e.g. *being yellow*). Then a new image appeared, with similar objects grouped together in three different Areas Of Interest (AOI):

- AOI1: NONE of the object had property *p*
- AOI2: ALL of the objects had property *p*
- AOI3: SOME of the objects had property *p*

Fixations were recorded at 60Hz, using a Tobii X2-60 remote eye-tracker. **Participants.** 43 Italian-speaking children (mean 5;5) and 27 adults took part to experiment. **Results.** Figure 2 descriptively reports children's proportion of fixations to each AOI in the 3 conditions, from the onset of the quantifier. In Condition 1 (N-word), children looked more at AOI1 (Fig2, left); in Condition 2 (Universal) more at AOI2 (Fig2, middle); in Condition 3 (Existential) more at AOI3¹ (Fig2, right). This patten was the same found in adults.

In order to determine if children take longer to converge on the correct referent in Condition 1 (N-word) in comparison with Condition 2 (Universal), as predicted by the *Processing Hypothesis*, we

¹ With respect to Condition 3, notice that also the proportion to fixations to AOI2 stays high, probably indicating a failure to quickly compute the scalar implicature (i.e. some trains *but not all*, are yellow) (see Huang & Snedeker 2009). For this reason, we did not include Condition 3 as a term of comparison in the divergence analysis.

run two separate cluster-based divergence analyses (Maris & Oostenveld, 2007) in R. Results are reported in Table 1 for Condition 1 and in Table 2 for Condition 2. The analyses revealed similar reaction times, with fixations on target significantly growing from time-bin 105 in both Conditions 1 and 2.

Discussion. Eye movements reveal an overall adult-like pattern, with reaction times in Condition 1 (N-Word) not being any slower than in Condition 2 (Universal). This finding does not provide support to the "processing Hypothesis". The Grammatical Hypothesis will be discussed in relation to these data, the first coming from an on-line investigation of negative nominals in young children.

Figure 1. Trial structure and the three Areas of Interests in the final display.

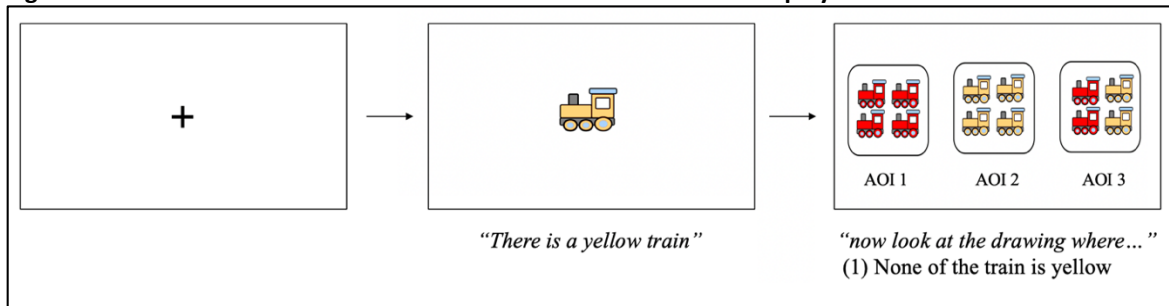


Figure 2. Children's data. Proportion of fixations to each AOI in the 3 experimental conditions

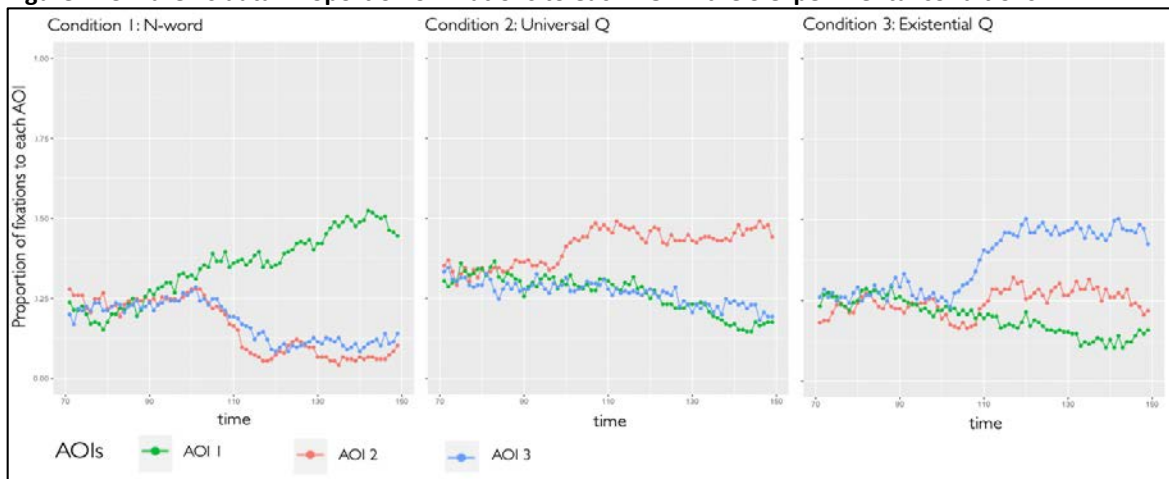


Table 1. Cluster-based divergence analysis for Children in Condition 1 (N-word). Significant divergence in time between the Target AOI1 and the distractors AOI2 and AOI3.

Target (AOI1) vs Distractors	time bins	Significance
AOI1 vs AOI2	105 - 150	p<.001
AOI1 vs AOI3	105-150	p<.001

Table 2. Cluster-based divergence analysis for Children in Condition 2 (Universal). Significant divergence in time between the Target AOI2 and the distractors AOI3 and AOI1.

Target (AOI2) vs Distractors	time bins	Significance
AOI2 vs AOI3	105-150	p<.001
AOI2 vs AOI1	105-150	p<.001

Selected references

- Huang, Y. T., & Snedeker, J. (2009). Semantic meaning and pragmatic interpretation in 5-year-olds: Evidence from real-time spoken language comprehension. *Developmental Psychology*, 45(6), 1723–1739.
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- Thornton, R., Notley, A., Moscati, V., & Crain, S. (2016). Two negations for the price of one. *Glossa: a journal of general linguistics*, 1(1), 45. 1-30.