Adults are not always faster than children

An eye-tracking study on the online comprehension of Indirect Scalar Implicatures

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Introduction

(1) The captain did **not** dance with **all** the mermaids.

semantics: ¬∀; alternatives: {¬∀, ¬∃} Horn scale with a stronger alternative

¬∀: the captain didn't dance with all the mermaids

¬∃: the captain didn't dance with any mermaid

indirect scalar implicature (ISI)

pragmatically enriched reading: ¬∀ ∧ ∃

→ it is not the case that the captain didn't dance with any mermaid

= the captain didn't dance with all the mermaids but he danced with some

Previous Studies

Musolino & Lidz 2006: children tolerated violation of ISI ("the frog didn't eat all the flies") but adults did not

Bill et al. (2016): ISIs boost comprehension in children

Cremers & Chemla (2014), Exp. 1: clues that ISIs boost reaction times compared to direct SIs

Lohiniva & Panizza (2016); Panizza, Lohiniva & Foppolo (submitted): access to inverse scope with sentences including subject-quantifier in 4-5 year olds, without supporting intonation

ISIs facilitate comprehension of scope inversion but slowed down offline target identification

→ pragmatic boost hypothesis: the derivation of a SI, when supported by the context, is able to boost the comprehension of complex sentences that are interpretatively ambiguous

→ dissociation between online processing and offline interpretation

Research Questions

Q1: Do adults and children understand sentences like (1) uttered with unbiased intonation?

Q2: Do ISIs enhance comprehension and processing compared to non-enriched readings/ pragmatic violations? (Any evidence for the pragmatic boost hypothesis?)

Q3: How does age affect the comprehension and processing of sentences like (1)? Does comprehension of ISIs improve with age? Does tolerance for ISI violations decrease with age as is the case with SI violations (Katsos & Bishop 2011)?

Experimental Design

Participants: — **Exp.1:** 4-5 y/o (35), 6-10 y/o (48), adults (48); **Exp.2:** 48 adults

Methodology: Semantic Choice Task (Picture Selection Task with eye movement recording, cf. Lohiniva & Panizza 2016); videos of pirate adventures shown on a computer screen

Task: choose the group of pirates (see Conditions) that performed better or reject both

(i) offline data (picture selection):
- — **ACCESS** to a specific interpretation and
- — **PREFERENCE** for a scenario supporting one reading

(ii) eye-tracking data:
- — **WHEN** online disambiguation takes place and
- — **HOW** different readings are processed

Stimuli

Exp. 1: Sentences with universally quantified object and negation, recorded with **unbiased intonation, and slow pace** (5 to 6 seconds each)

(2) Der Kapitän hat nicht mit allen Meerjungfrauen getanzt.
The captain has ¬ with ∀ mermaids danced
"The captain did not dance with all the mermaids."

Exp. 2: Same sentence material, with **ISI biasing intonation and normal pace** (3 to 4 seconds each)

(3) Der Kapitän hat nicht mit allen Meerjungfrauen getanzt.

Conditions

Cond. 1:
ACCESS to non-ISI: false vs. *not all* ¬∀

Cond. 2:
ACCESS to ISI: false vs. *not all but some* ¬∀ + ∃

Cond. 3:
PREFERENCE:
not all ¬∀ vs. *not all but some* ¬∀ + ∃

Predictions

Q1: based on previous results (L&P, 2016) every group of participants should understand (1) regardless of the unbiased intonation

Q2: if ISIs boost comprehension and processing:
- NALL contexts are judged more accurately than NONE contexts and preferred
- NALL contexts are disambiguated more rapidly

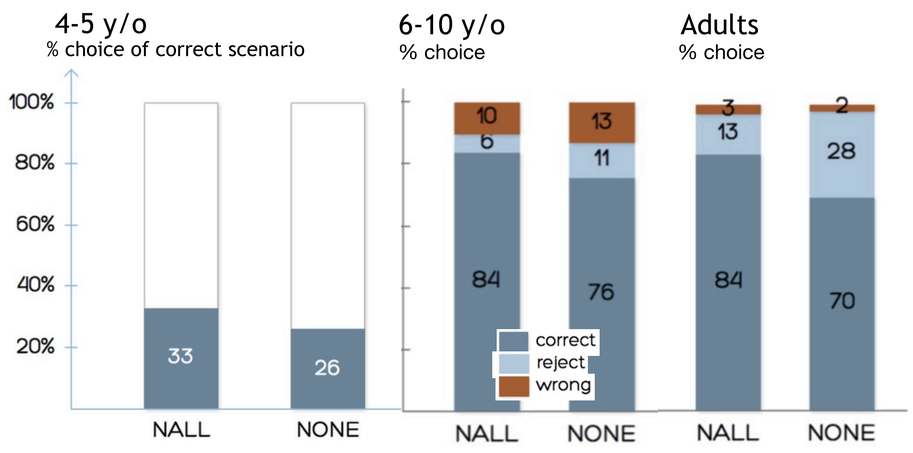
Q3: if ISI = SI:
- comprehension of ISIs (NALL) increases with age
- tolerance of ISI violations decreases (NONE) with age

Q2: if there is no facilitation associated with ISIs:
- ISIs incur processing costs
- NALL are judged less accurately
- NONE contexts are disambiguated faster (cf. L&P 2016)

Results

Experiment 1:

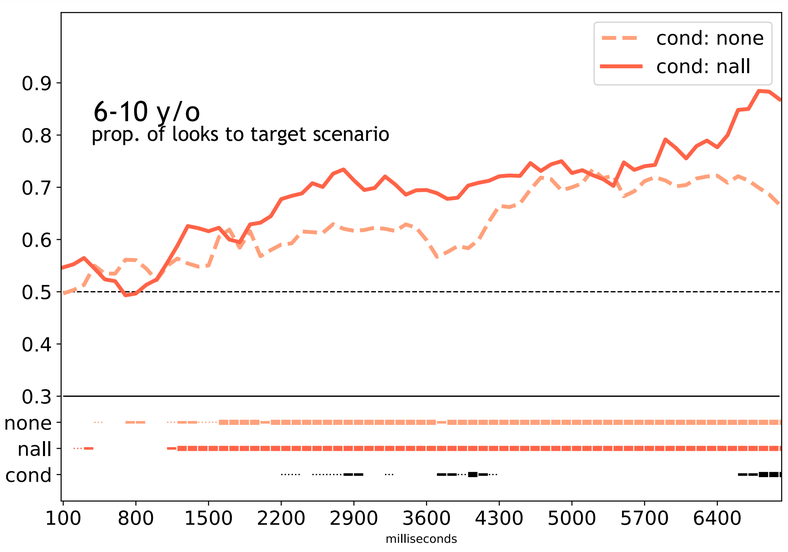
ACCESS:

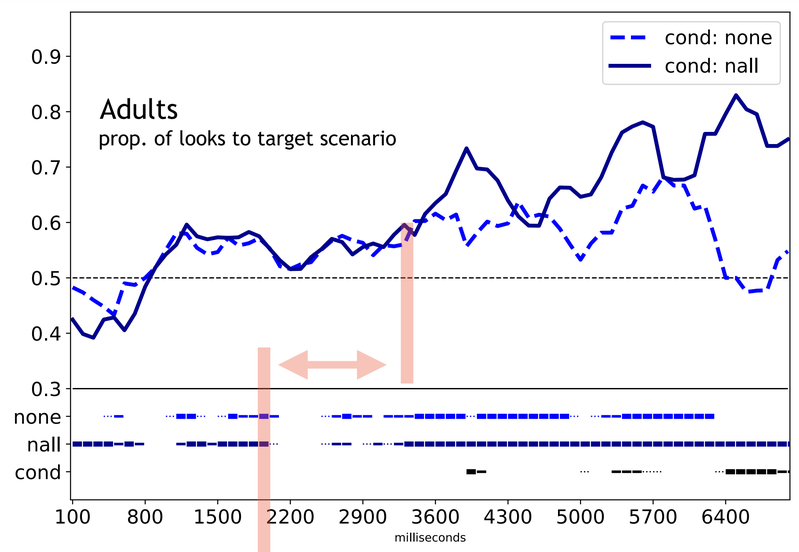


Q1: only 4–5 y/o failed to grasp experimental sentences: they ignore negation, despite always repeating the sentence correctly

Q2: NALL scenarios judged more felicitously than NONE scenarios in all groups (*sensitivity to ISI*)

Q3: — overall comprehension increases with age but not specific to ISIs
— tolerance decreases with age (cf. direct scalar implicatures)



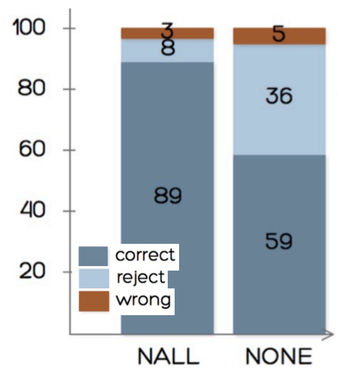


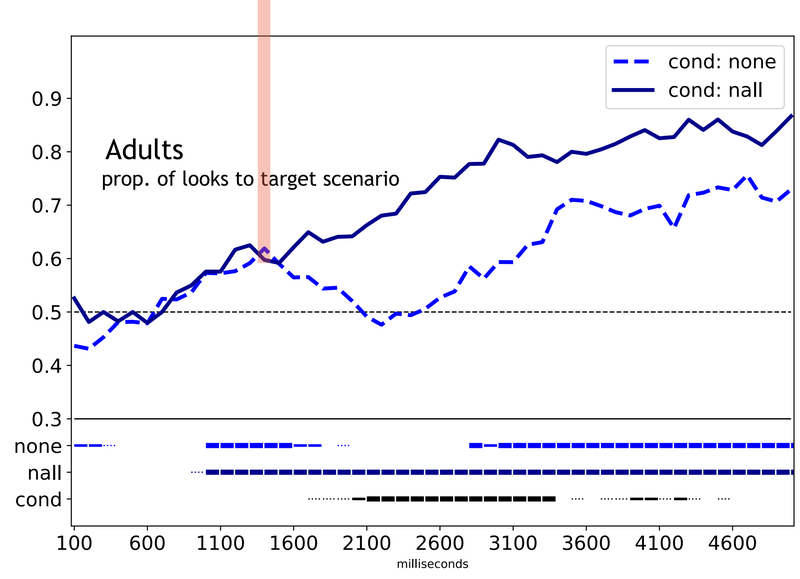
PREFERENCE:
- younger children do not have a strong preference
- with age, preference for SI support increases

PREFERENCE:
- slight increase (5%) from Exp.1 to Exp.2 for adults

Experiment 2:

ACCESS:
less tolerance towards ISI violation with more natural prosodic profile: +8% rejection, -11% acceptance





References: **Chierchia, G. (2004)**: Scalar implicatures, polarity phenomena and the syntax/pragmatics interface. **Muolino, J & Lidz, J. (2006)**: Why children aren't universally successful with quantification. **Bill, C. & Romoli, J. & Schwarz, F. & Crain, S. (2016)**: Scalar Implicatures vs. Presuppositions – The view from Acquisition. **Cremers, A. & Chemla, E. (2016)**: Direct and Indirect Scalar Implicatures Share the Same Processing Signature. **Lohiniva, K. & Panizza, D. (2016)**: When Pragmatics Helps Syntax: An Eye Tracking Study on Scope Ambiguity Resolution in 4- to 5-Year-Old Children. **Panizza, D. & Lohiniva, K. & Foppolo, F. (*submitted*)**: On the interpretation and processing of scope ambiguity in children and adults. The case of subject-universal quantifier and negation. **Katsos, N. & Bishop D. (2011)**: Pragmatic tolerance: Implications for the acquisition of informativeness and implicature.

Discussion

- stronger difference between NALL and NONE condition with **natural prosody** (slight for offline choices; greater in online disambiguation)
- when ISI is violated, target looks decrease, indexing increasing amounts of uncertainty
  - possibly an **effect of implicature cancellation**
- adults' online data in second experiment approach children's from first experiment
- prosody might trigger operations at semantics-pragmatics interface that adults appear to rely on; e.g. topicalization/focus, and implicatures
  - seems to affect the activation of as well as the differentiation between multiple meanings

Conclusions

Q1: 4–5 y/o children fail to understand sentences like (1) ignoring negation (contra Lohiniva & Panizza 2016); possibly also related to prosody effect observed in adults

Q2: 6–10 y/o children and adults judge NALL contexts supporting ISIs more favorably and identify those contexts more rapidly compared to the NONE (violating ISIs) and NEG contexts

→ evidence for **frequent and relatively effortless ISI derivation** vs. struggle with ISI violations

Q3: children are tolerant (NONE scenarios), while ISI violations are less acceptable to older participants. Adults are inhibited by unnatural intonation