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Present to the eye, away from the mind

Dissociating online comprehension and offline judgments of indirect scalar inferences

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Introduction

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

Horn scale with a stronger alternative

semantics: $\neg\forall$; alternatives: $\{\neg\forall, \neg\exists\}$

$\neg\forall$: the captain didn't dance with all the mermaids
$\neg\exists$: the captain didn't dance with any mermaid

pragmatically enriched reading: $\neg\forall \wedge \exists$

→ 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

indirect scalar implicature (ISI)

interesting theoretical issues:

- **indirect scalar implicatures** (ISI) (Chierchia 2004) present a **challenge to lexicalist theories** of scalar implicature: no lexical trigger, but a sentential one (only in negative environments)
- possible influence of scope ambiguity but not in German
- standard intonation for (1) requires main focal stress on **alle ('all')** and/ or on **nicht ('not')**

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-*alle* ("All the pirates did not go to the ship") in 4-5 year olds, without supporting intonation
  - ISIs facilitate comprehension of scope inversion but slowed down 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**

conflicting results!

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)?

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.

Experiment Design

Participants: 4-5 y/o (35), 6-10 y/o (48), adults (48); German native speakers
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 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

Sentences with universally quantified object and negation, recorded with unbiased intonation

(2) Der Kapitän hat **nicht** mit **allen** Meerjungfrauen getanzt.
The captain has $\neg$ with $\forall$ mermaids danced
"The captain did not dance with all the mermaids."

Conditions

Cond. 1: **ACCESS** to non-ISI: false vs. *not all* $\neg\forall$

vs

Cond. 2: **ACCESS** to ISI: false vs. *not all but some* $\neg\forall + \exists$

vs

Cond. 3: **PREFERENCE**: *not all* $\neg\forall$ vs. *not all but some* $\neg\forall + \exists$

vs

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

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)

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

Results

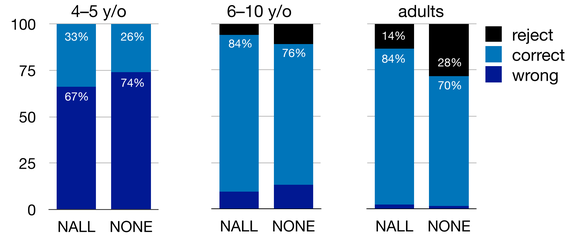
Q1
- only 4—5 y/o failed to comprehend experimental sentences: they ignore negation, despite always repeating the sentence correctly

Q2
- NALL scenarios judged more felicitously than NONE scenarios in all groups (*sensitivity to ISI*)
- small facilitation effect of NALL scenarios in 4—5 y/o (*pragmatic boost*)

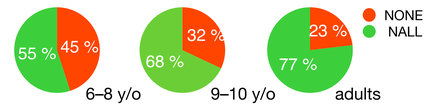
Q3
- overall comprehension of (1) increases with age but not specific to ISIs
- tolerance decreases with age just like with SIs

Offline Data

ACCESS



PREFERENCE



Online Data

Q2
- faster response times for NALL (5.6s) than NONE (6s) and NEG (6.1s) scenarios in children
- faster response times for NALL (5.9s) than NONE (6.1s) and NEG (6s) scenarios in adults
- earlier target scenario disambiguation for NALL than NONE in children, significant in the last three regions ("… Meerjungfrauen getanzt"), see Fig. 1
- earlier target scenario disambiguation for NALL than NONE in adults, significant after the end of the sentence (Spillover), see Fig. 2
- 6—10 y/o children are overall faster than adults, see table below and Fig. 3

	adults		children				
Region	NONE	NALL	NONE	NALL	β (coeff.)	t	p-value
Der Kapitän	0.47	0.45	0.49	0.54	0.0812	1.903	0.084
hat nicht	0.51	0.47	0.52	0.54	0.0631	1.389	0.21
mit allen	0.57	0.55	0.57	0.60	0.0444	0.907	0.5198
Meerjungfrauen	0.52	0.59	0.59	0.67	0.08	1.907	**0.0171**
getanzt	0.62	0.65	0.61	0.70	0.0558	1.314	0.3767
Spillover	0.62	0.73	0.73	0.78	0.0558	1.467	**0.0057**

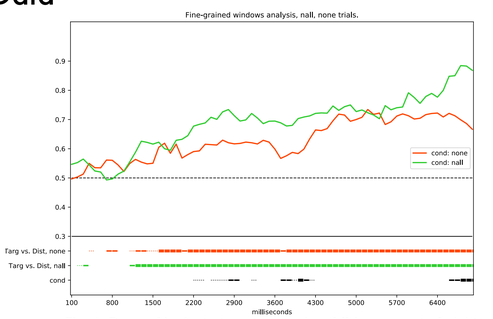


Fig. 1: Prop. of looks to target scenario: **children**, onset of *nicht*

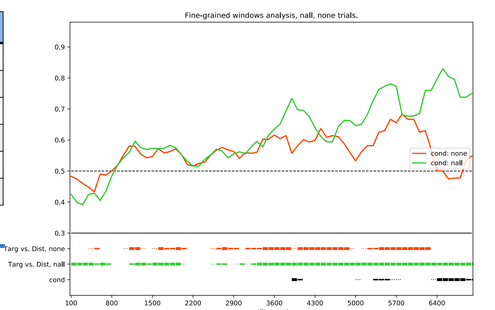


Fig. 2: Prop. of looks to target scenario: **adults**; onset of *nicht*

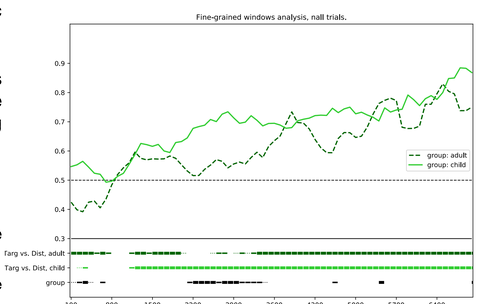


Fig. 3: prop. of looks to target in **NALL** condition, adults vs children

Conclusions

Q1
- 4—5 y/o children fail to understand sentences like (1) ignoring negation (contra Lohiniva & Panizza 2016)
- Possible explanations: unnatural prosody (but are young children sensitive to prosody?), PP increased syntactic complexity or object-*alle* requires QR crossing negation

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

unexpected results: children disambiguate sentences like (1) more rapidly than adults and display comparable response times
possible explanation: children rely on intonation to a lesser extent than adults; adults are inhibited by unnatural intonation
→ future studies: same experiment with sentences presented with natural intonation (main accent on quantifier and negation), should improve adults' performance