

Phrase Length and Prosody in PP Attachment

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RESEARCH ISSUE

There is clear evidence that Intonation Phrase (IPh) boundaries can cue syntactic clause boundaries. But do intermediate phrase (ip) boundaries cue syntactic phrase boundaries?

Mixed results from previous studies. Allbritton et al. (1996) vs Kraljic & Brennan (2005). More references in Millotte, Wales & Christophe (2007)

HYPOTHESIS: Inconsistent on-line results for ip boundaries may be due to inappropriate phrase lengths.

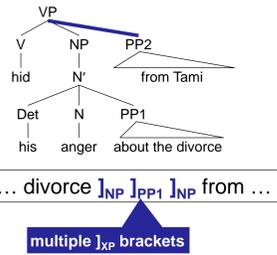
CONSTRUCTION: double-PP ambiguity, with long / short PP2 **LANGUAGE:** Hebrew

METHOD: Combined production-comprehension task to check preferred interpretation and preferred prosody.

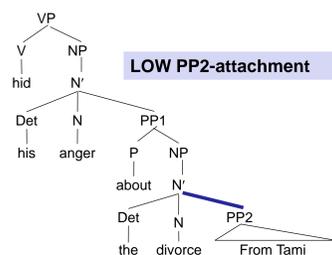
MATERIALS

PREAMBLE: Rafi doesn't like to expose his feelings **forced low** **ambiguous**
 TARGET: Subj Verb Object-NP PP1 PP2
 hu histir 'et ha-ka'as šelo al ha-gerušin mi-tami
 He hid ACC the-anger his about the-divorce from-Tami

HIGH PP2-attachment



LOW PP2-attachment



multiple J_{XP} brackets

no J_{XP} brackets

DOUBLE PP STRUCTURE OFFERS A SHARP STRUCTURAL CONTRAST:

- Multiple syntactic right edges for high attachment (sharp distinction).
- No right edges for low attachment.

LENGTH MANIPULATION OF PP2 DOESN'T ALTER SENTENCE MEANING:

- [Short PP2 mi-tami (מתמי)]
1 prosodic word from Tami
- [Long PP2 mi-tami toledano (מתמי טולדנו)]
2-3 prosodic words from-Tami Toledano

PROSODY-SYNTAX INTERFACE CONSTRAINTS

Align_R XP: The right edge of an XP in syntactic structure and of MaP in prosodic structure must align (Selkirk, 2000)

Wrap: "Each syntactic XP must be contained in a phonological phrase" (Truckenbrodt, 1995)

BinMin/Max: A major phrase must consist of at least/at most 2 minor phrases (Selkirk, 2000)

Uniformity: "A string is ideally parsed into same length units" (Ghini, 1993)

PREDICTED PROSODIC PHRASING

- [pron+Verb Obj-NP PP1] [LONG PP2] - Uniformity, BinMin
- [pron+Verb Obj-NP PP1 SHORT PP2] - Wrap
- [pron+Verb Obj-NP] [PP1 SHORT PP2] - Uniformity, BinMin/Max

PREDICTED AMBIGUITY RESOLUTION

- [PP2 prosodic break → high PP2 attachment (by R-alignment)]
- [PP1 prosodic break (which groups PP2 with PP1) → more low attachment]
- Indirectly predict: More high attachment of long PP2 than Short PP2

PROCEDURE

Participants:

- 40 naïve native Hebrew speakers, tested in Israel
- Performance criteria: < 15% comprehension errors on fillers, < 15 speech errors, < 3 missing recordings

Materials pre-test (4 expert judges):

- Both interpretations of each ambiguous target sentence were judged equally plausible.

Main experiment:

- Read aloud, then post-sentence comprehension choice.
- A *preamble* sentence mentioned the subject of the target sentence → the target sentence subject was a pronoun cliticized to the verb, not adding to the prosodic phrasing.

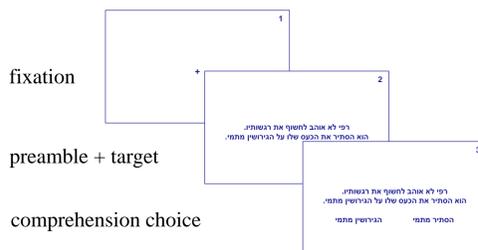
PREAMBLE: Rafi doesn't like to expose his feelings.
TARGET: He hid his anger about the divorce from Tami.

Design:

- 24 ambiguous targets, in 2 versions (short / long PP2)
- 48 unambiguous fillers of varied construction

We are indebted to Dr. Gabriel Liberman for his expert assistance with the statistical analyses.

PRESENTATION



RESULTS

Statistical analyses: Multilevel Multinomial Cross-Classified Logistic Regression Models (Baayen et al. 2008)

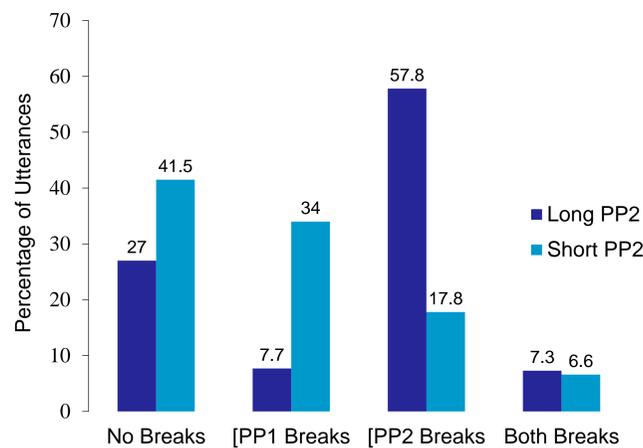
EFFECTS OF PP2 LENGTH ON PROSODY

Long-PP2 targets were most often produced with a [PP2 break.

[PP2 Break > No Breaks b=-0.83, p<.001
 No Breaks > [PP1 Break b=-1.34, p<.001

Short-PP2 targets were most often produced with no breaks or a [PP1 break.

No Breaks = [PP1 Break b=-2.18, p=.24
 [PP1 Break > [PP2 Break b=.70, p=.03



Prosodic Analyses:

- Location of prosodic breaks was determined by 2 trained judges.
- Acoustic analyses (Speech Analyzer/SIL International, 2007) results were consistent with these ear judgments.

Statistical analysis: Effect of PP2 length on prosodic breaks

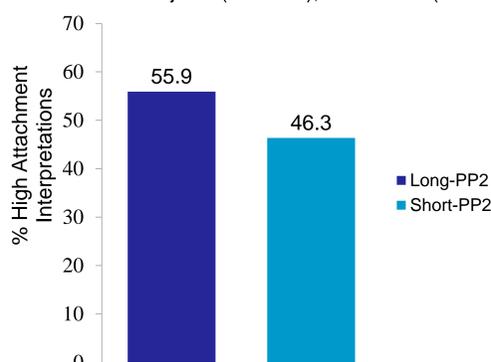
- **Fixed effects:** PP2 length
- **Random effects:** Subject (ICC: 19%), Sentence (ICC: 17%)

PP2 length → prosodic phrasing patterns

- In long vs short sentences:
 [PP2 break > No-Break (b = -1.80, p < .001)
 [PP2 break > [PP1 break (b = -3.02, p < .001)

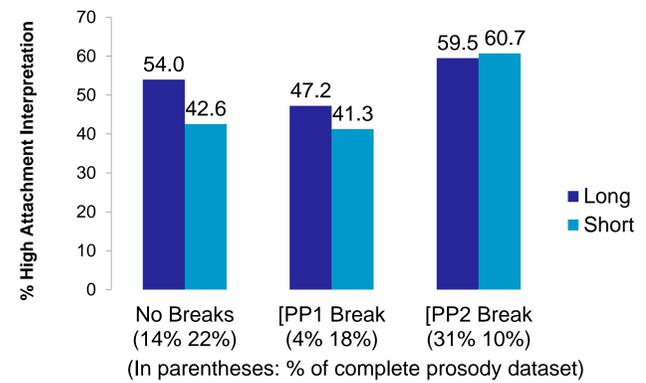
EFFECTS OF PP2 LENGTH ON AMBIGUITY RESOLUTION

- **Fixed effects:** Order of presentation of answers (high attachment left/right), PP2 length (long/short), Prosodic phrasing ((No Breaks/PP1 Breaks/PP2 Breaks)
- **Random effects:** Subjects (ICC: 5%), Sentences (ICC: 21%)



→ a significant effect of phrase length on interpretation:
More high attachment when PP2 is long vs short (b=0.56, p<.001)

EFFECTS OF PROSODY ON AMBIGUITY RESOLUTION



Probability of High Attachment:

- [PP2 Break > No Break (b = -0.55, p < .01)
- [PP2 Break > [PP1 Break (b = -0.65, p < .01)
- [PP1 Break ≈ No Break (b = -0.2, p = .65)

Why no significant effect of [PP1 Break?

- Sparse data for [PP1 Break.
- Syntactic Late Closure may prevail in No Breaks condition (Kjelgaard & Speer 1999; Dinçtopal & Fodor, 2013).

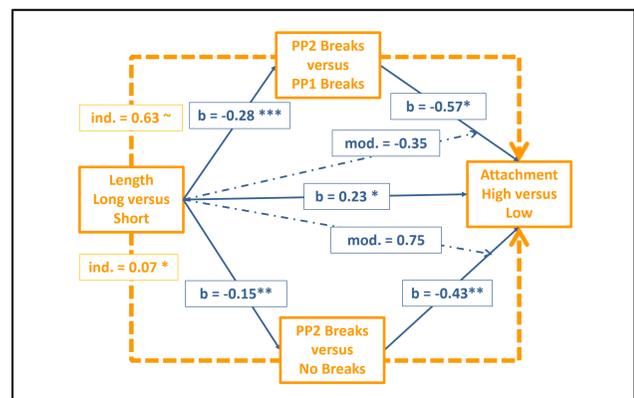
PP2 length → PP2 attachment preference

HYPOTHESIS: INDIRECT CAUSATION

PP2 length → prosody → attachment preference

Direct & indirect effects on attachment can be statistically distinguished

Multi-Level Structural Equation Model Analysis:
Random effects: sentence (ICC: 21%)



THIS ANALYSIS CONFIRMS: The effect of PP2 length on PP2 attachment was in part indirect, mediated by the effect of PP2 length on prosodic phrasing.

- Break locations mediated the effect of PP2 length on attachment (indirect = 0.63, p = 0.06; indirect = 0.07, p < .05; for [PP1 Break and No Break respectively).
- There was also a direct effect of length on attachment (b = 0.23, p < .05), but the prosodic break location effect was significantly stronger than the phrase length effect (Wald's Chi-Squared, one-tailed=3.26, p=.035).

NOVEL CONTRIBUTIONS

- WHICH INFLUENCES WHICH IN READING – preferred meaning or preferred prosody?
 - This study of Hebrew double-PP constructions supports a causal effect of the preferred prosodic phrasing on the preferred syntactic height of attachment – in reading, where there's no overt prosody in the input.
 - This has been proposed in the 'implicit prosody' literature on silent reading (Fodor 2002). But until now it has been difficult to demonstrate.
 - Our statistical analysis, more powerful than traditional analyses, can distinguish between direct and indirect effects of factors.
- ARE ip BOUNDARIES UNRELIABLE AS CUES TO SYNTACTIC STRUCTURE?
 - Our behavioral data support linguistic theory claims concerning the relevance of phrase lengths in modulating syntax-prosody alignment.
 - Unlike IPh, ip's are governed by the interplay of syntax/semantics with eurhythmic (purely phonological) constraints.