On-Line Perception of Topic-Change Intonation

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Sound to Sense Project 8: Prosodic Structure and Fine Phonetic Detail
Discourse topic: a fuzzy concept from a structural point of view

- “What the unit of discourse is about”
- Could be an entity, a proposition, etc.
- Many theories exist but details don't affect this study (cf. Grosz & Sidner 1986; Wichmann 2000)

For today’s purposes: is the speaker still talking about the same thing or something different?
Background: Prosody & Topic

• Previously: production study of how speakers vary prosody in relation to topic organization of discourse – testing predictions of 2 models
  – F0 fall size (Zellers & Post, to appear)
  – Height of F0 peak? (Wichmann 2000 and others)
  – Choice of pitch accent? (Zellers et al. 2009)
Listening to Topic Prosody

• Many studies using listening paradigms to look for phonetic variation related to topic structure (e.g. Sluijter & Terken 1993, Swerts 1997)
  – Listeners identify topic boundaries fairly consistently (though never with 100% agreement); more consistent than people reading same text
  – So we know listeners are sensitive to phonetic cues correlated with topic
Psycholinguistic Approaches

• So far no on-line studies of topic structure prosody
  – What cues do listeners attend to?
  – What happens at moment listeners hear prosodic variation?

• A challenging task since many typical psycholinguistic paradigms would introduce confounds
Experimental Method

• Developing a novel method for testing processing of topic structure prosody (size of F0 falls) (cf. Zellers 2009; Zellers & Post, to appear)

• 3 tasks: different levels of processing
  – Pause detection: immediate on-line sensitivity to prosody (cf. Mattys & colleagues)
  – Sentence rating: on-line comprehension of prosody
  – Sentence memory: integration of prosodic information (cf. Almor & Eimas 2008)
Experimental Method

2x2 Latin square in two intonation conditions (high and low F0)

Listen to Context sentences

Listen to Target sentence: Topic Change Intonation

Listen to Target sentence: Topic Hold Intonation

Read sentence: Consistent w/ Topic Change

Read sentence: Consistent w/ Topic Hold

1. Pause detection

match or mismatch w/ intonation

2. Sentence rating

3. Memory task: read Target sentence, remember Read sentence
Hypotheses

**Sentence ratings** should be better with matched prosody

- Sentences with match to prosody should be easier to process
- They should therefore be accepted faster than sentences with mismatch to prosody
Pilot Results

• Initial sentence rating task on scale of 1 to 5: too hard
• No discernible difference in acceptability ratings, BUT for “acceptable” ratings (4 or 5 on scale), faster with matched prosody
Main Results (sentence ratings)

• Distribution of “acceptable” versus “unacceptable” apparently unrelated to prosody match
Main Results (II)

• Even if sentences are still ranked acceptable (in written form all were acceptable), perhaps mismatch of prosody influences how quickly this decision is made
  – i.e. easier to choose that it’s acceptable when it matches prosody
Main Results (III)

- Slight effect of match/mismatch when Topic Change sentence heard; only interaction significant
- No other categories significantly different (despite mismatch apparent in figure)
- Difference is small – in range of 30-70ms
Discussion

• Different results in pilot (less controlled) versus main experiment
  – Multiple prosodic cues to topic change were present in pilot (larger F0 movements, variations in speech rate and pausing)
  – More cues = more natural?
  – More cues = more certainty about what's being signalled?
Discussion (II)

- Time-course problem: for how long is prosodic information available?
  - Andruski et al. (1994): 250ms for segmental-phonetic info, so possibly decay by time of task
  - But scope of prosodic meaning is longer
- Perhaps measuring at different point in time course would yield different result
  - Referent resolution?
  - Eye-tracking experiment planned
Conclusion

• Appears to be a measurable effect of prosody, even if not where expected: listeners are sensitive to topic structure even when not asked about it explicitly.

• Difference between pilot and main experiment shows importance of using multiple cues.

Thank you!
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Results: F0 Peak Height

- Height in semitones (st) from speaker’s baseline pitch
- Significant main effect of **position in utterance group**
  1>2=4>5 (ANOVA: F(3, 370)=11.74, p<0.01; no main effect or interaction with topic)
F0 Fall Range

- Distance between H* and following L valley in semitones
- Significant main effect of topic structure T>A=E>C (ANOVA: F(3, 423), p<0.01; no interactions with position, but model improved by including individual speaker differences)
Topic Structure: Hierarchy

• Grosz & Sidner (1986)
  – Topic structure = simple hierarchy
  – Discourse Segments have Discourse Segment Purposes (DSPs)
  – DSPs contribute to overall Discourse Purpose
  – “Topic” would have to be mapped to one level in an arbitrary way; could be weakness or strength of this theory
Nakajima and Allen (1993)

4 levels:
Topic Shift, Topic Continuation, Elaboration, Speech Act

• Main difference: order of categories (due to source data?)

• Wichmann (2000)
  – 4 levels (slightly different to N&A)
    Topic, Continuation, Elaboration, Reformulation
## Sentence Acceptability: Statistics

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<th>Condition</th>
<th>Estimate</th>
<th>Standard Error</th>
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<td>(Intercept)</td>
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