On-Line Perception of Topic-Change Intonation

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Sound to Sense Project 8: Prosodic Structure and Fine Phonetic Detail

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Background: Topic

- 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?

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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)

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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

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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

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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)

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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

***match* or *mismatch* w/ intonation**

1. Pause detection

2. Sentence rating

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

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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

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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

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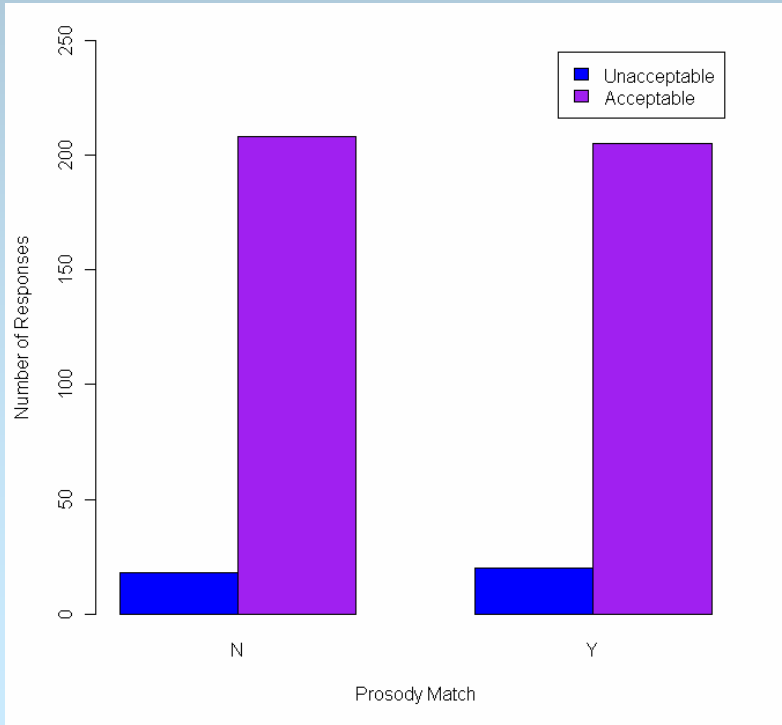
Main Results (sentence ratings)

- Distribution of "acceptable" versus "unacceptable" apparently unrelated to prosody match



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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

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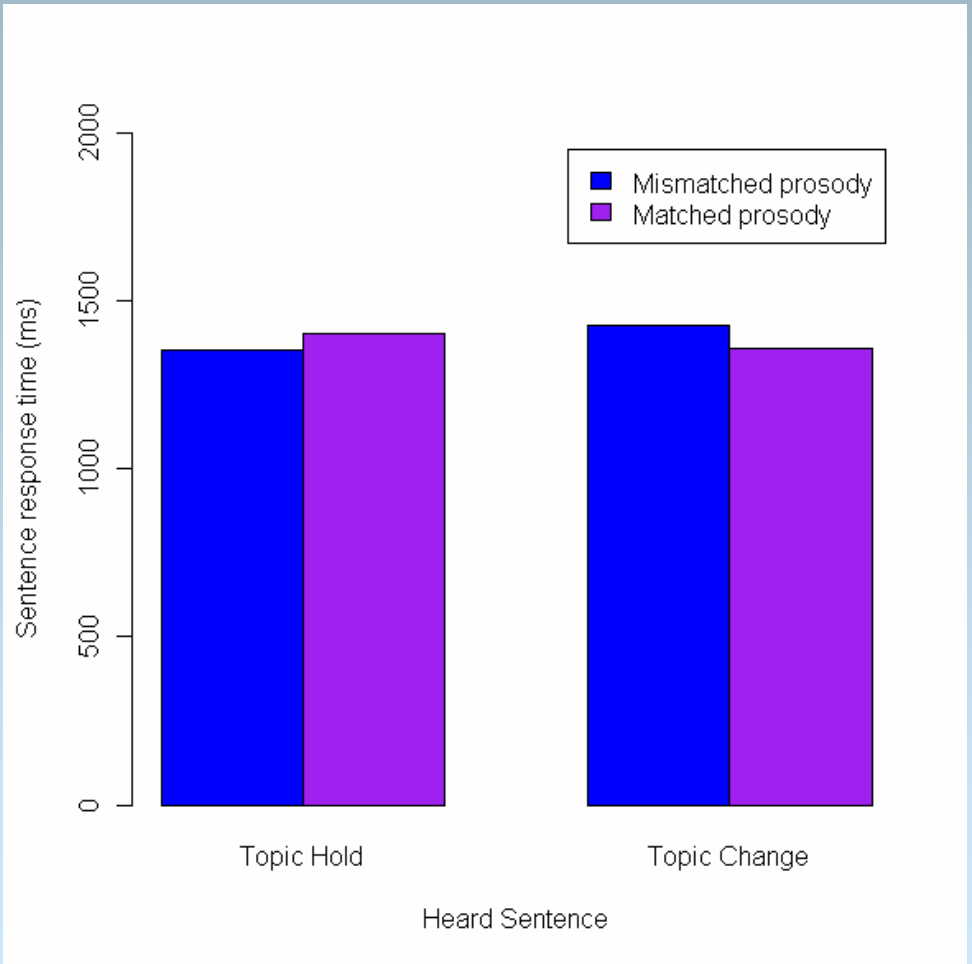
Main Results (III)

- 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



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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?

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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

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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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Acknowledgements

Thank you to…

Sven Mattys
John Williams
Catherine Kitsis
Hannah Goodman
S2S researchers

This research was supported by the EC Marie Curie Research Training Network/Sound to Sense/(MRTN-CT-2006-035561).

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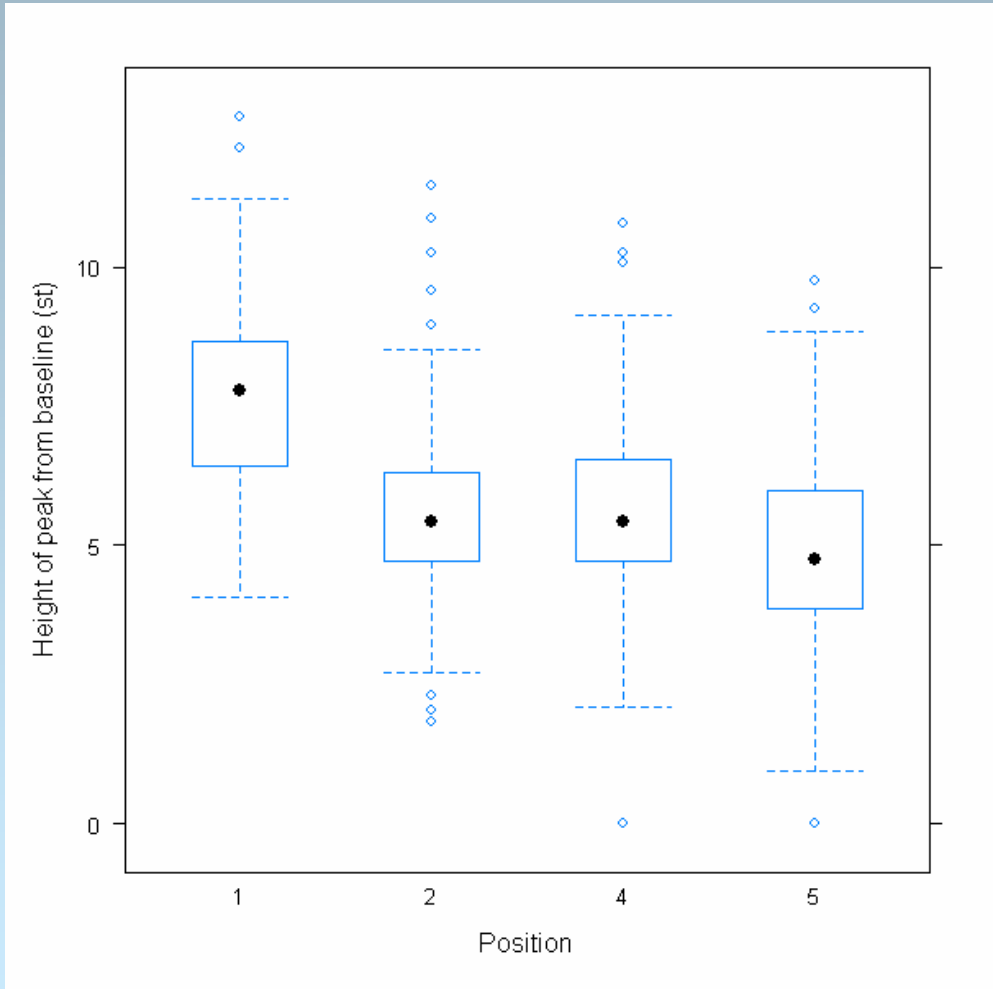
Results: F0 Peak Height

- 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)



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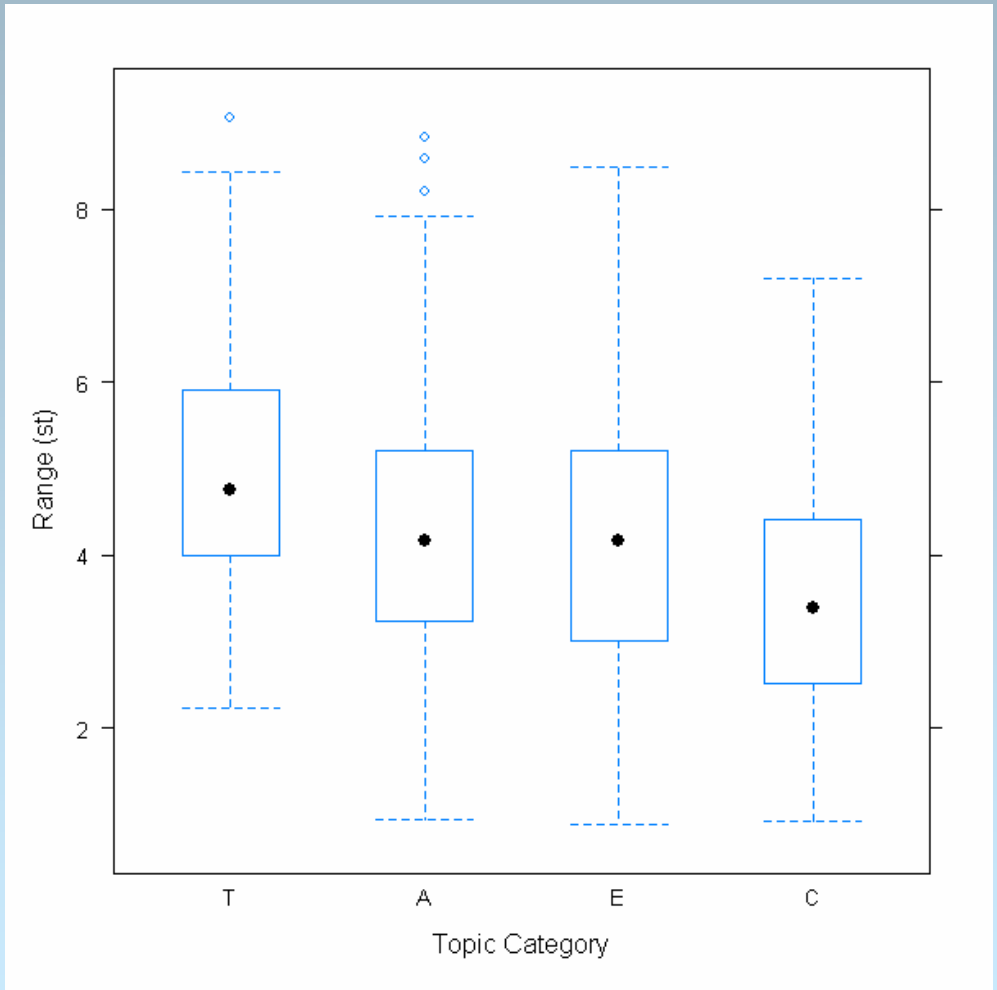
F0 Fall Range

- 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)



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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

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Topic Structure: Categories

Nakajima and Allen (1993)

4 levels:

Topic Shift,
Topic Continuation,
Elaboration,
Speech Act
Continuation

- Wichmann (2000)
  - 4 levels (slightly different to N&A)

Topic,
Continuation,
Elaboration,
Reformulation

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

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Sentence Acceptability: Statistics

Condition	Estimate	Standard Error	t-value (p-value)
(Intercept)	1403.72	41.13	34.13 (0.000)***
MatchY	47.83	31.02	1.54 (0.1236)
SoundTopT	54.57	31.06	1.76 (0.0794)
MatchY:SoundTopT	-109.40	44.14	-2.48135 (0.0)*

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