

More than words: What prosody can tell us about meaning

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- Language is typically viewed as conveying linguistic meaning through discrete, arbitrary symbols (Hockett, 1960).
- No inherent relation between meaning and form (Hockett, 1960; Saussure, 1959).



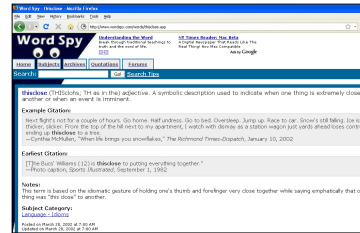
The role of prosody in comprehension

- Information about the message
 - Syntactic structure (Beach, 1991; Carlson, Clifton, & Frazier, 2001)
 - Discourse status: New/ Given (Birch & Clifton, 1995; Dahan et al., 2002)
- Information about the speaker
 - Emotion (Barnes & Scherer, 1996; Cosmides, 1983; Scherer et al., 1984)
 - Attitude (Bryant & Fox Tree, 2002; Rockwell, 2000)
 - Metacognitive state (Hirschberg & Pierrehumbert, 1986)

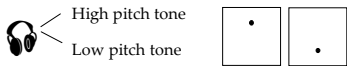
Prosody is not viewed as directly conveying information about external referents.

- Can acoustic properties of speech convey meaning?

Thisclose



Audio-visual cross-modal associations



(Bernstein & Edelman, 1971; Melara & O'Brien, 1987)

Other audio-visual associations:

- 👁️ : brightness, size
- 🔊 : pitch, loudness

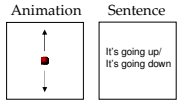
(Marks, 1989)

- Do speakers express information by manipulating acoustic properties of speech?
- Can acoustic properties of speech convey information that is not expressed in the propositional content of the utterance?
- Does this information serve a communicative function?

Experiment 1

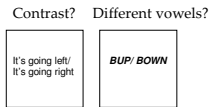
Test conditions:

It's going up
It's going down



Dependent measure: The fundamental frequency of speech (F0, the acoustic correlate of pitch) in *up* versus *down*

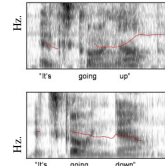
Control conditions:



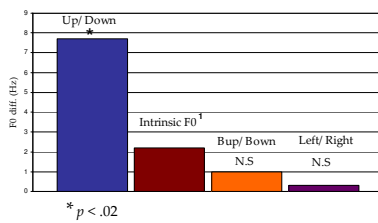
(Shintel, Okrent, & Nusbaum, 2006)

- Speakers varied the F0 of their speech analogically to the direction of motion they describe.
- No difference between the Animation and the Sentence conditions

Mean F0: *Up* 156.6 > *Down* 148.8 $p < .02$



F0 differences in each condition



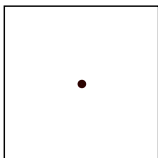
1. Based on Peterson & Barney 1952 and Peterson & Lehiste, 1960

Conclusions

- Speakers can express information through prosodic-acoustic properties of speech
- In contrast to linguistic symbols that are discrete and arbitrary, this signal is analog:
 - Continuous
 - Inherent relation between form and meaning
- Do speakers express information exclusively through prosodic-acoustic properties of speech?
- Is this signal communicative?

Experiment 2

Production



- 4 speakers
- Description task:
 - It's going left/ It's going right*
- 36 animations in random order

Comprehension

- 12 listeners
- Judgment: fast/ slow
- 144 utterances
- Sentences produced by each speaker were divided into three blocks.
- Within each block sentences were presented in the order in which they were produced.

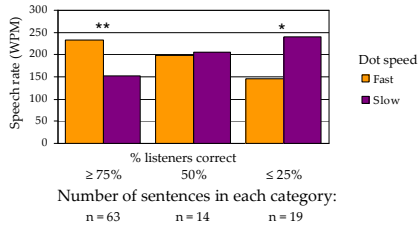
Results

It's going right 🗣️ 🗣️
It's going left 🗣️ 🗣️

- Participants talked faster when describing fast-moving dots (195.65 words per minute) than when describing slow-moving dots (171.92 WPM), $p = .005$
- Listeners' were 63% correct in identifying the dot's speed (greater than chance $p < .0001$).

(Shintel, Okrent, & Nusbaum, 2006)

Relation between speech rate and accuracy

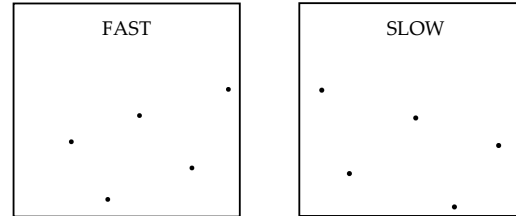


* p < .05
 ** p < .01

(Shintel, Okrent, & Nusbaum, 2006)

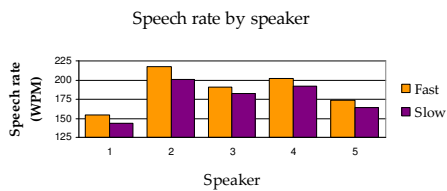
Experiment 2 cont.

- Does the effect reflect demand characteristics?
 Continuous motion for 3 seconds; same duration of motion in both conditions



Results

Mean difference in speech rate 11 words per minute, p < .02.



(Shintel, Okrent, & Nusbaum, 2006)

Conclusions

- Speakers spontaneously use acoustic properties of speech to express information that is not conveyed in the lexical-propositional content of the utterance.
- This information can be communicatively functional

Experiment 3

- Do listeners spontaneously use acoustically-conveyed information?
- Do listeners integrate information conveyed through acoustic properties of speech into their representation of the referent?

Zwaan, Stanfield, & Yaxley (2002):
 The ranger saw the eagle in the nest
 The ranger saw the eagle in the sky



Congruent trials:

Fast speech rate/ Object in motion
 Slow speech rate/ Object at rest

Incongruent trials:

Fast speech rate/ Object at rest
 Slow speech rate/ Object in motion



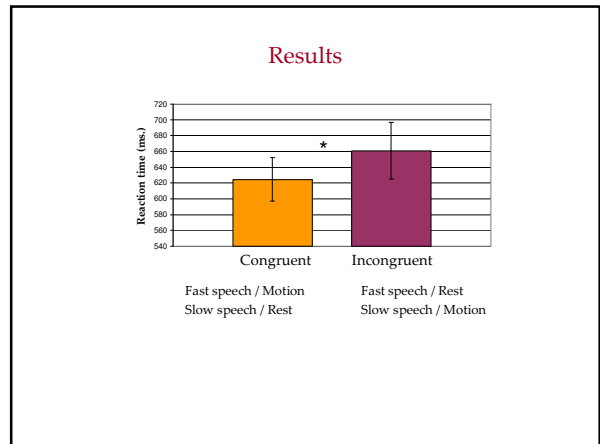
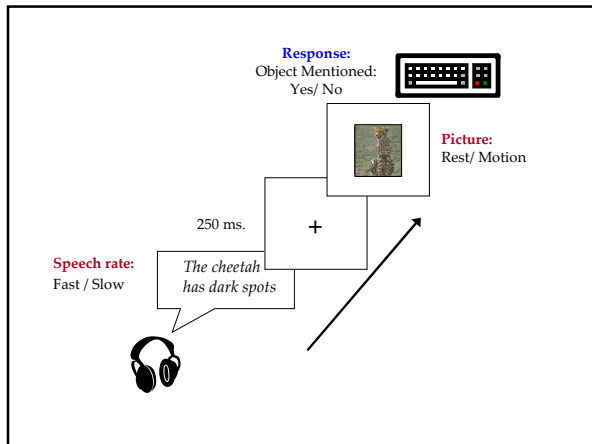
The cheetah has dark spots

Rest Motion



Speech rate:

Slow 193 WPM (mean duration 1632 ms.)
 Fast 282 WPM (mean duration 1115 ms.)
 Fillers 212 WPM



- ### General Conclusions
- Speakers spontaneously convey information by analogically mapping referential- semantic information onto acoustic properties of speech.
 - Listeners are sensitive to information conveyed exclusively through acoustic properties of speech.
 - More than simple visual properties?
Metaphorical mapping of non-spatial concepts onto spatial concepts (Boroditsky, 2000; Lakoff & Johnson, 1980)
 - Potential role in language development?
Herold, Namy, & Nygaard (2006): Use of prosodic cues to meaning in IDS

Collaborators:

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Thank you!