

PERCEIVING SURPRISE ON CUE WORDS: PROSODY AND SEMANTICS INTERACT ON *Right* AND *Really*

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Questions

- How does variation in prosody vary meaning?
- How do we represent and model this interaction?

Cue Words and Prosody

Cue words are used to maintain and further a dialogue in various ways.

- *Right* → Agreement, Backchannel.
- *Really* → Backchannel, Question.

Prosodic features appear differentiating these uses. However, they don't appear to separate the *really* categories above [1]. *What do they signal then?*

Corpus Study

Does surprise differentiate really's interpretation?

Data:

- 307 *really*s from MDE 2003 annotations of Switchboard I (LDC2004T12, LDC2004S08) → backchannel/question.
- F0 values: manual alignment of glottal pulses, trimmed and smoothed [3]

Surprise levels

- (a0) unsurprising → backchannel?
- (a1) new but not particularly unlikely.
- (a2) new and undesirable.
- (a3) highly improbable but not contradictory.
- (r0) contradictory to their beliefs.

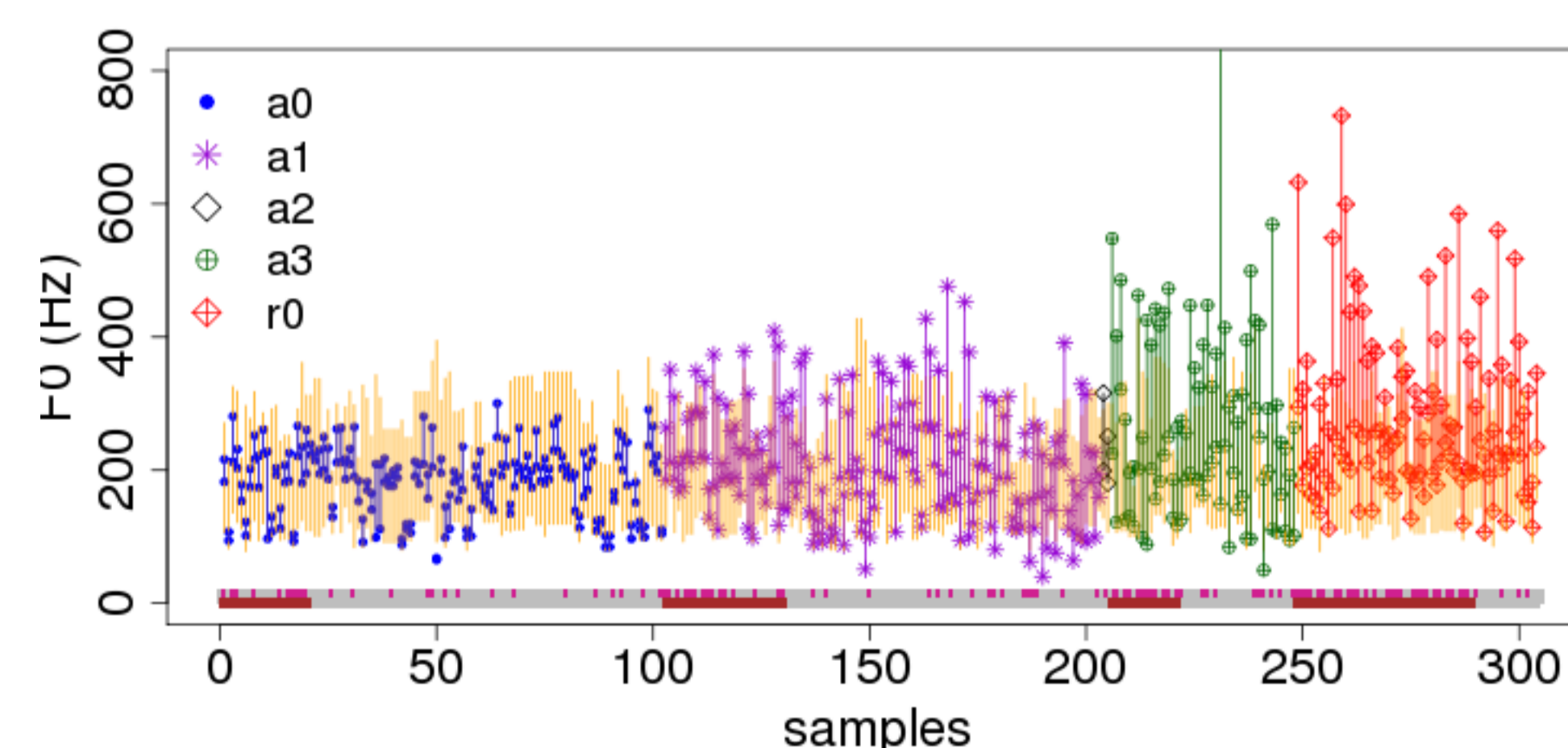


Figure 1: *Really* pitch range overlaid on normalization data, grouped by surprise category. Bottom bars: affirmative response (top) MDE question.

- Pitch range/level associates with surprise. (cf. effort code [2])
- Prosody signals update magnitude, with context and semantics → derive backchannel/question.

Perception Experiment

*Are surprise and questioning meanings orthogonal?
Do ratings match MDE annotations?*

- **Stimuli:** 64 backchannel *really*s, question *really*s (MDE/corpus study), and *rights* (192 tokens), each representing different quantiles: pitch range × level × duration.
- **Subjects:** 8 Penn students, native English speakers, paid.
- **Method:** The randomized stimuli were rated on 1-7 scales (1=not at all, 7=extremely) via a computer interface:
 - 'How surprised does the speaker sound?'
 - 'How much like a real question does this sound like?'

Results

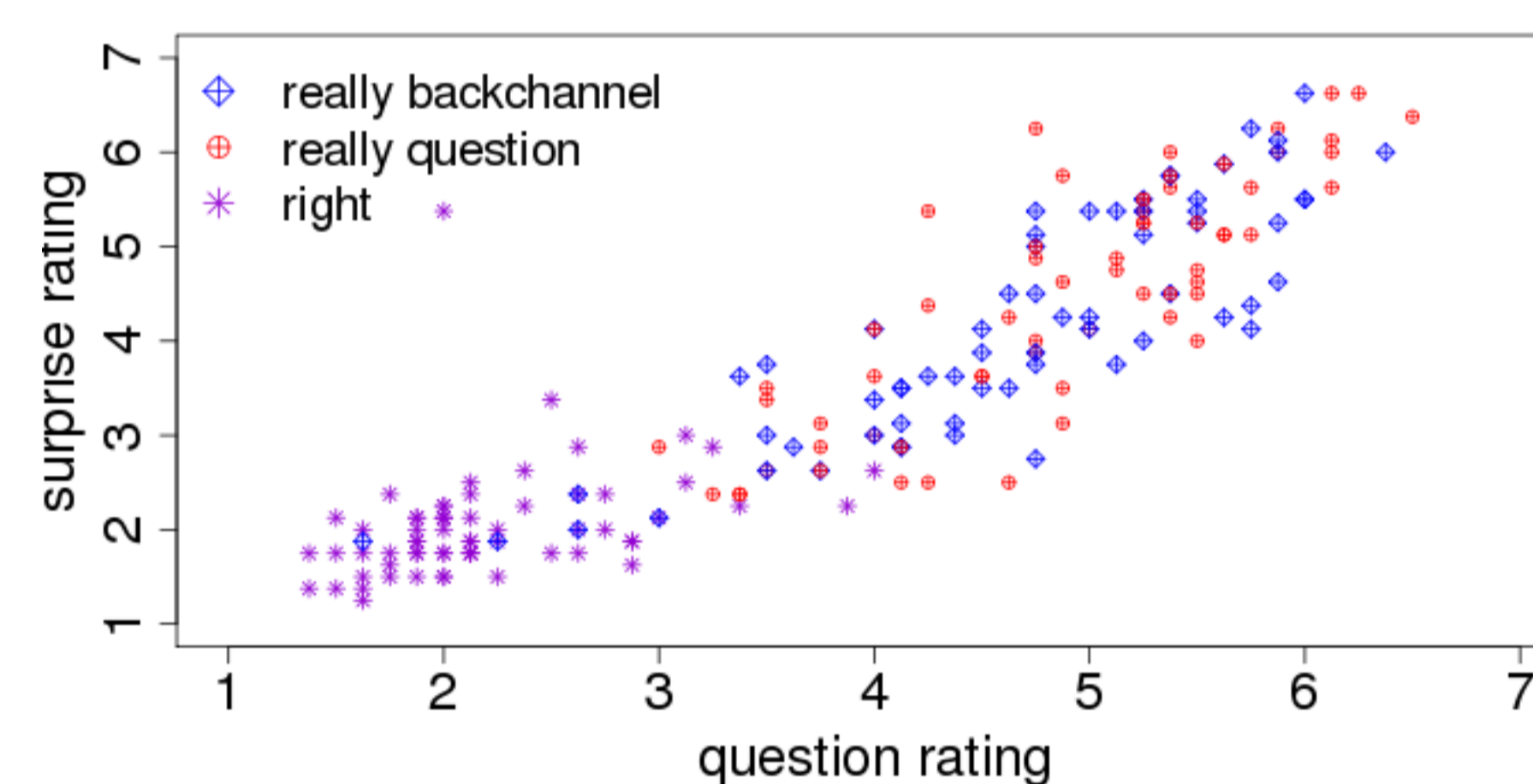


Figure 2: Average surprise v. question ratings. Note the difference between *right* and *really*.

- Backchannel/question MDE categories are not significantly different with respect to ratings. Mann-Whitney U test: question $p = 0.30$, surprise $p = 0.18$.
- Surprise/questioning are correlated. Kendall's $\tau = 0.63$, $p < 0.001$, distributions are non-normal.

Prosodic Features

- Question/surprise ratings are most highly correlated with pitch range and pitch level → *effort!*
- First, rather than second, syllable slope of *really* was significantly correlated with the ratings. → *final fall/rise does not seem associated with question interpretation.*
- Pitch range 5-10 st: $\text{mean}_q \text{right} = 2.41$, $\text{really} = 4.93$.

Subject Variation

- Subjects could perform the task but had different rating biases. Krippendorff's agreement α for ordinal data: above chance $\alpha_s = 0.58$, $\alpha_q = 0.50$.

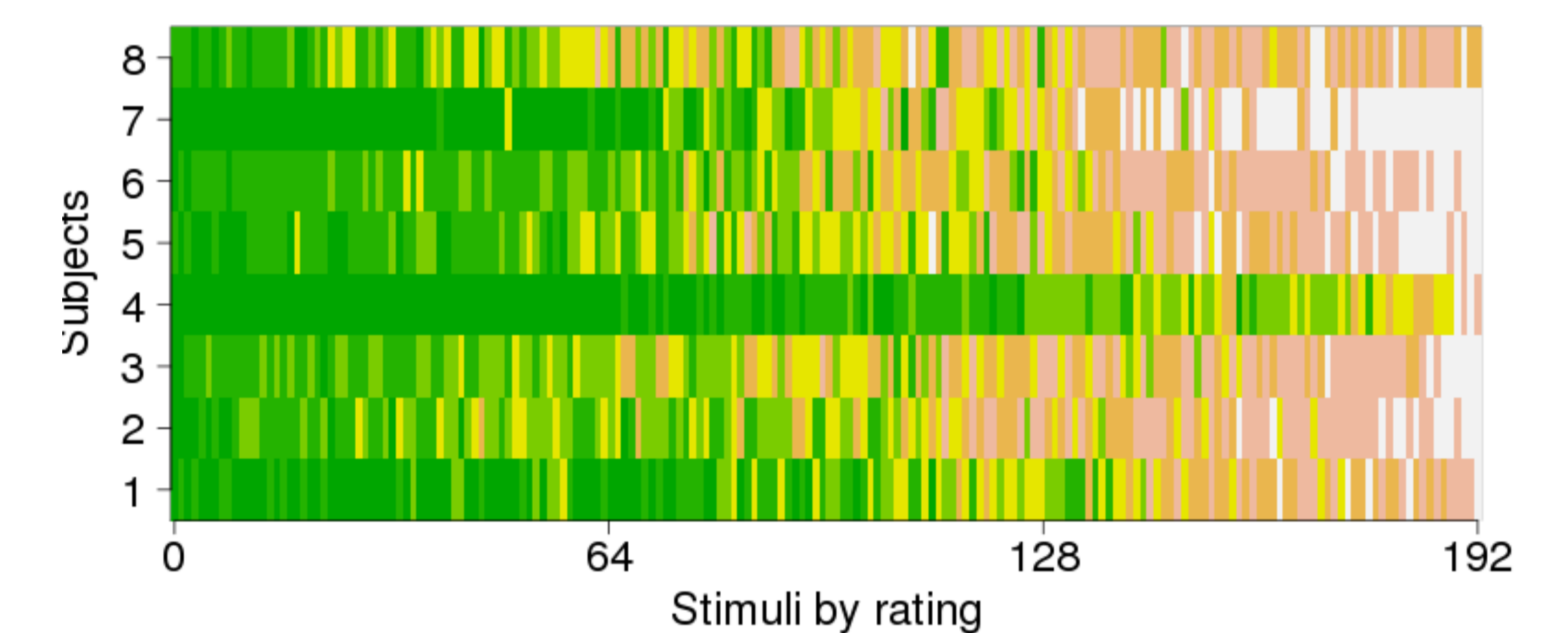


Figure 3. Stimuli ordered by mean average rating (increasing rightwards) by subject. Subject 4 was significantly different from the rest (Pairwise U tests: $p < 0.001$).

Prosody and Meaning

- Effort code features intensify the underlying meanings of these words.
- *Right* (p) $\approx p$ is now in the speaker's public beliefs, ie. not response seeking ⇒ effort \propto agreement.
- *Really* (p) $\approx p$ is new information, ⇒ effort \propto surprise → questioning, ie. response seeking.

Conclusion & Further Work

- Surprise: a good measure *really*'s prosodic variance.
- Semantic/pragmatic features affect whether a cue word is interpreted as questioning.
- Final rise is associated with uncertainty, is this the same as questioning? What does it mean with *right*? Hypothesis: Uncertainty relates to truth or relevance depending on context.

References

- [1] C. Lai, "Prosodic Cues for Backchannels and Short Questions: *Really?*" in *Proceedings of Speech Prosody 2008, Campinas, Brazil, May 2008*, 2008.
- [2] C. Gussenhoven, "Intonation and Interpretation: Phonetics and Phonology," in *Speech Prosody 2002, International Conference*. ISCA, 2002.
- [3] Y. Xu, "Effects of tone and focus on the formation and alignment of f0 contours," *Journal of Phonetics*, vol. 27, pp. 55-105, 1999.