



# Continuous acoustic information trickles up; discourse information trickles down

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## INTRODUCTION

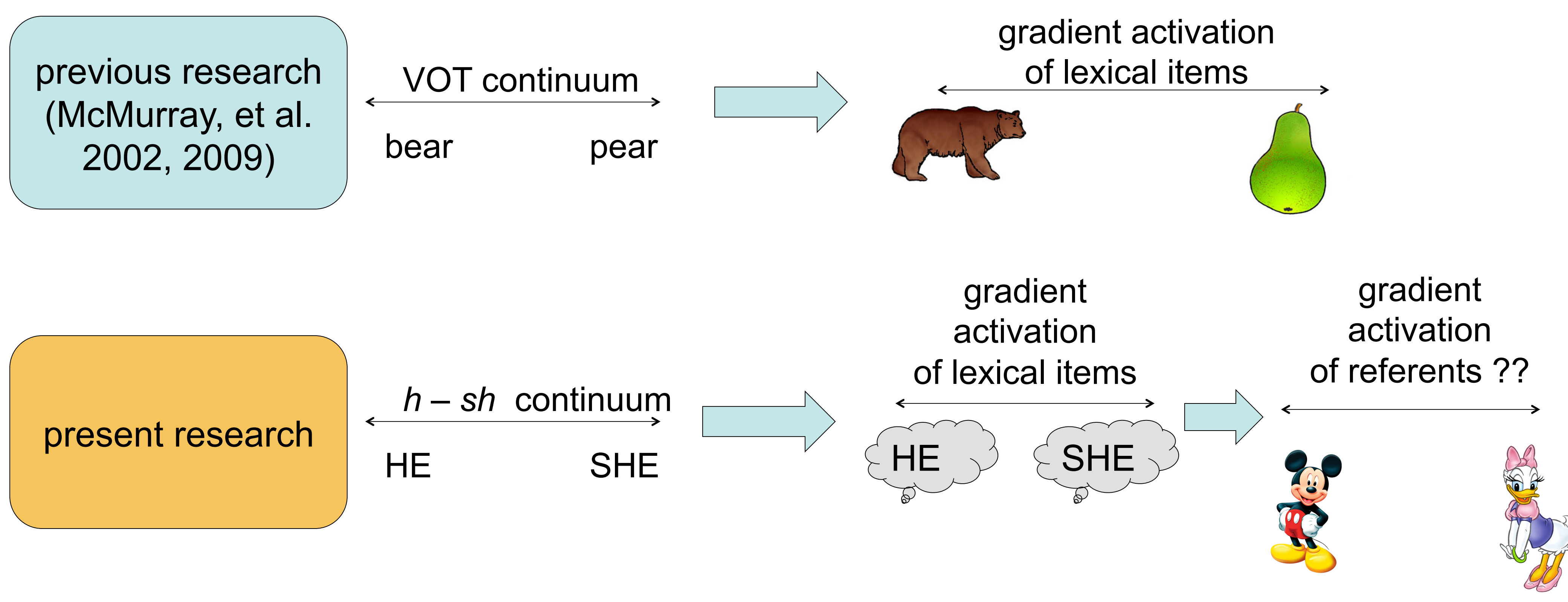
How is fine-grained acoustic information COMBINED and with high-level information about discourse structure, and MAINTAINED throughout the discourse?

**PREVIOUS RESEARCH** shows that differences in continuous acoustic-phonetic cues result in gradient activation of candidate lexical items during spoken word recognition.

- 5-ms differences in voice onset time (VOT) along /b/-/p/ continua result in gradient changes in lexical activation for the two words (McMurray, Tanenhaus, & Aslin, 2002)
- Gradient representations maintained across multiple phonemes (McMurray, et al. 2009).

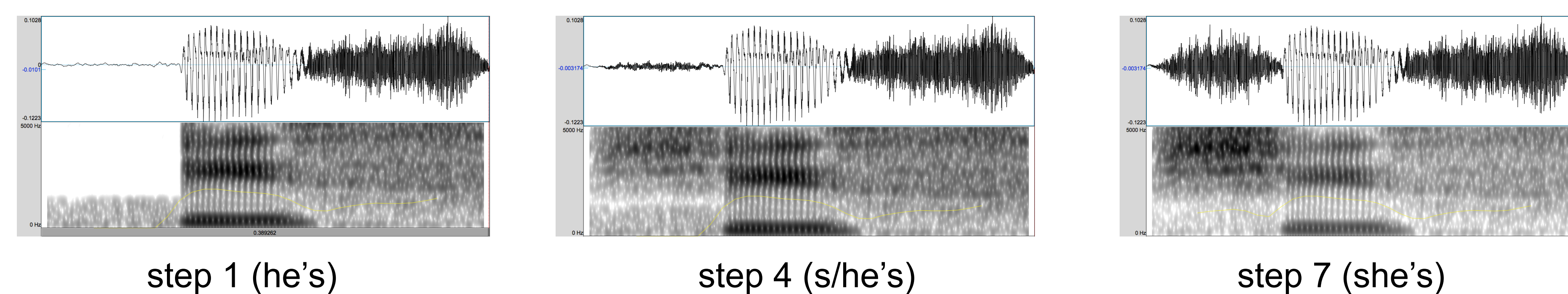
**THE PRESENT RESEARCH distinguishes lexical from referential representations:**

- Do gradient changes along a PRONOUN continuum from *he* → *she* result in graded activation of potential referents?



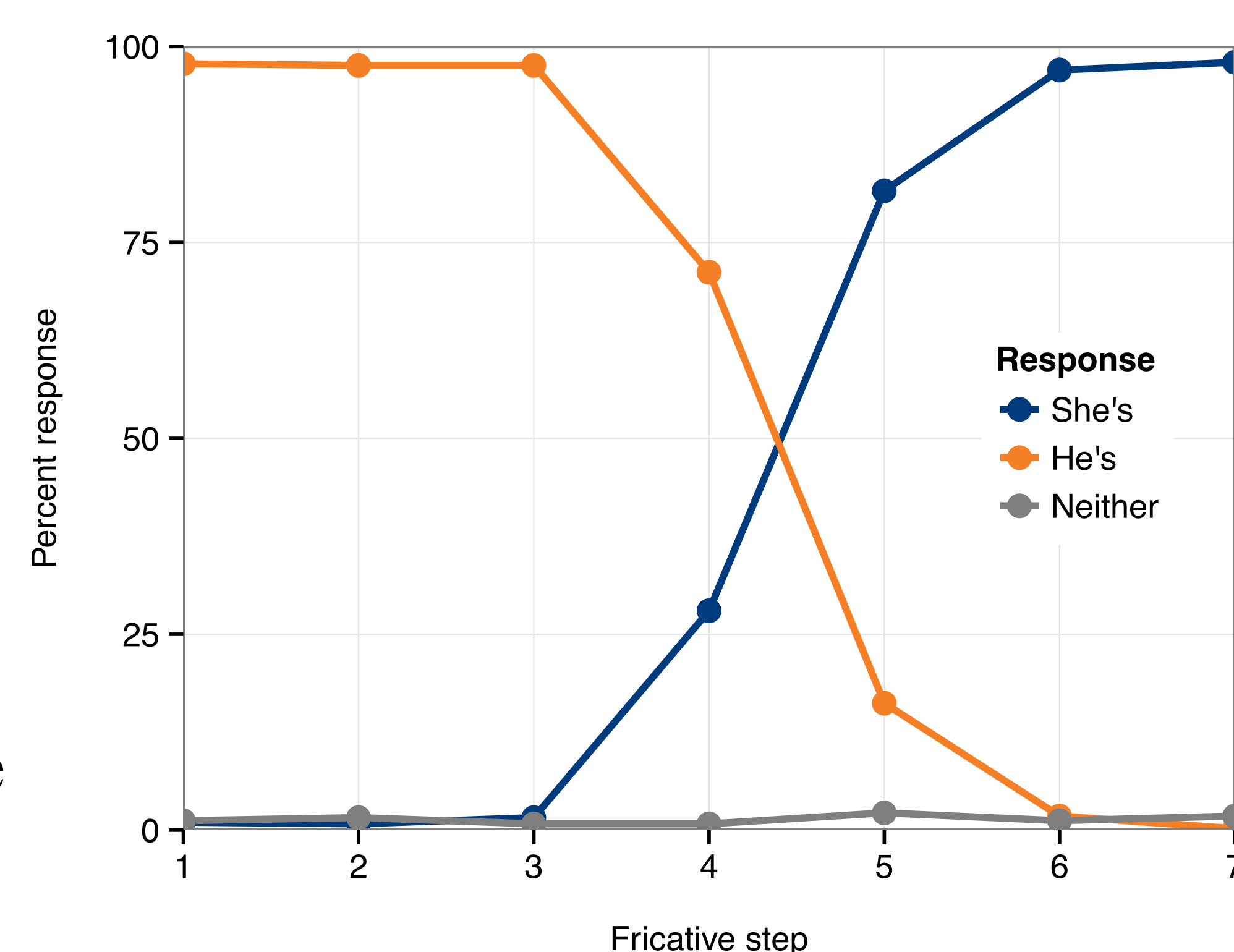
## The acoustic continua

- Tokens of the pronoun and verb (“he’s” and “she’s”) were extracted from sentence contexts, e.g., “...as the telephone is ringing. She’s looking at the phone...”
- Twenty, seven-step continua were created from he’s and she’s recordings by manipulating the /h/-/ʃ/ frication amplitude above 1.3 kHz.



## Experiment 1: Proof of concept

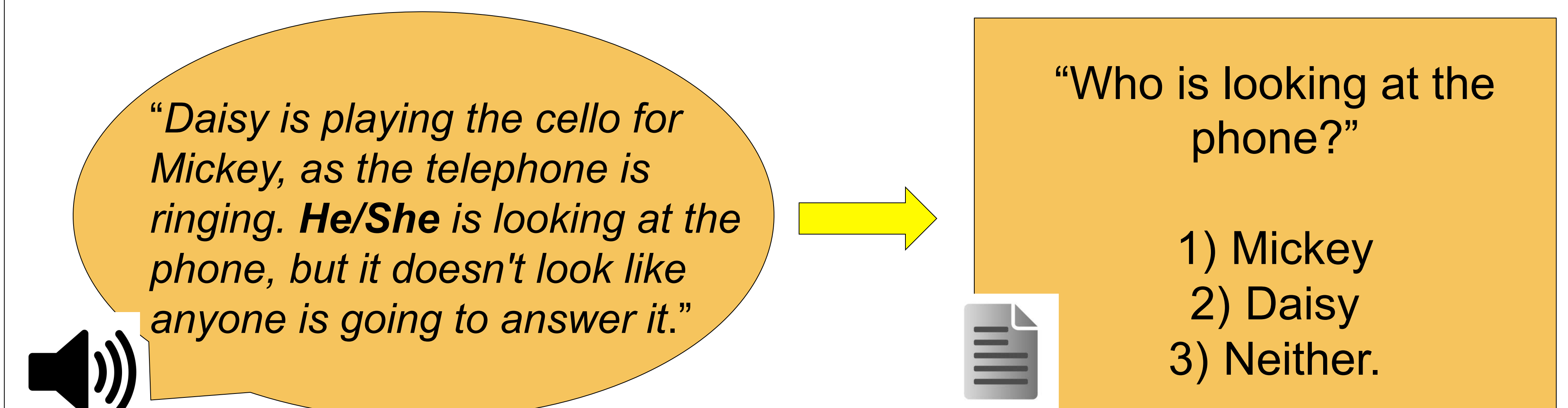
- MTurk participants (n=50, native English speakers)
- Listened to 20, 7-step continua plus 2 unedited endpoints, and 20 fillers
- Responded “he’s”, “she’s” or “neither.”
- Listeners reliably categorized continua endpoints as “he’s” and “she’s” with a category boundary near the center of the continua. Main effect of continuum ( $z=16.92$ ,  $p<.0001$ ).



## Experiment 2: Integration of acoustic continuum with discourse representations

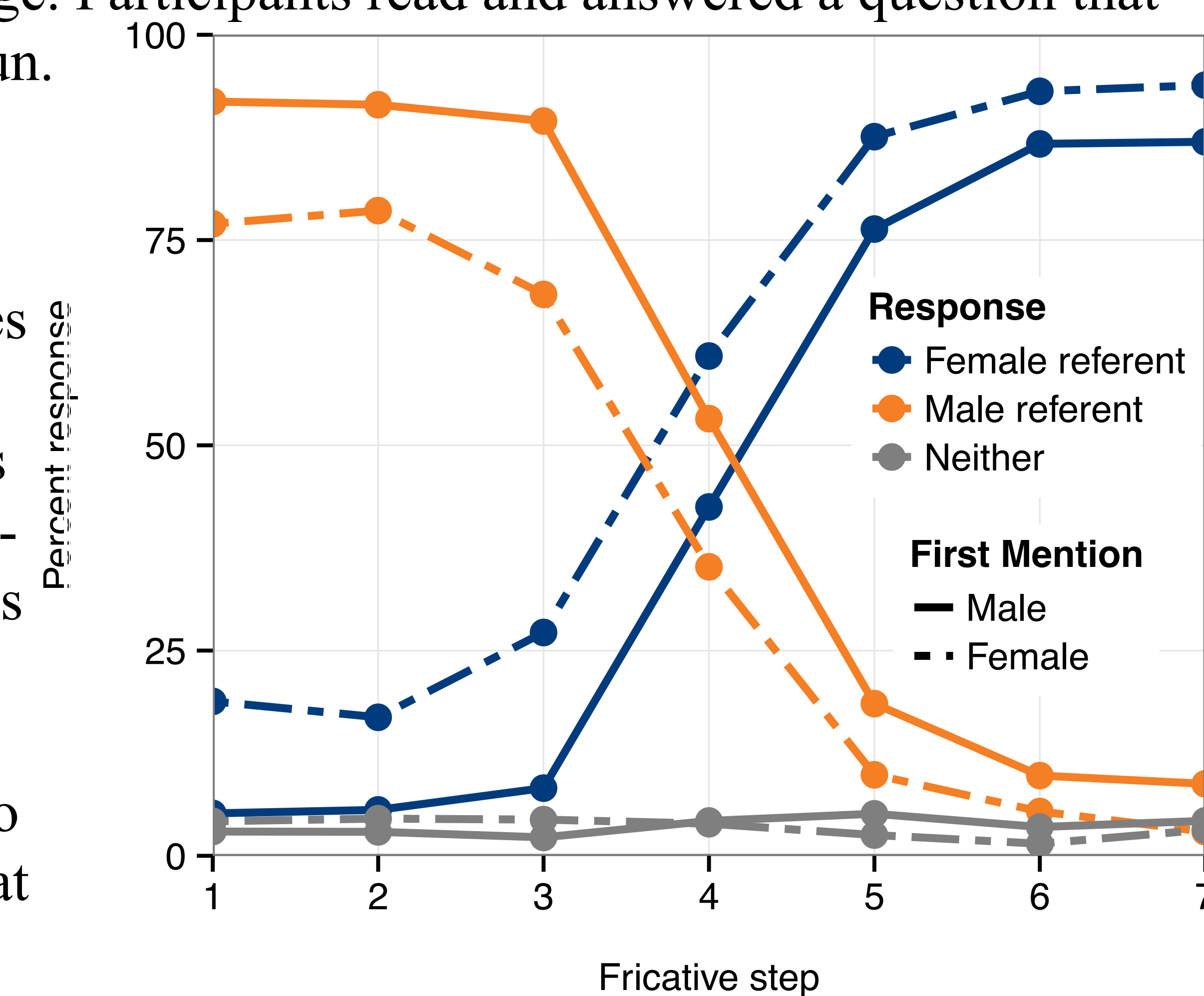
QUESTION: How are these continuous acoustic cues combined with discourse-level information?

DESIGN: Native English speaking MTurk participants (N=227) listened to 32 different stories that introduced two referents of different gender, and then referred back to one with a pronoun, plus 35 filler stories.



Stories were modeled after Arnold, et al. (2000) but not accompanied by a picture. Two factors were manipulated: (1) the pronoun step on the continuum; (2) whether the 1<sup>st</sup>-mentioned character was male or female. Following the story, participants clicked a button to get to a new page. Participants read and answered a question that probed interpretation of the pronoun.

**RESULTS:** Representation of discourse event structure was guided by both acoustic differences AND discourse salience. A linear effect of continuum ( $z=22.47$ ) was overlaid with a main effect of first-mention ( $z=3.94$ ), with participants more likely to have encoded a representation of the discourse in which the pronoun referred back to the 1<sup>st</sup>-mentioned character, even at the endpoints ( $z>2.9$ ,  $ps<.01$ ).



## CONCLUSIONS

**Our findings allow for two important conclusions:**

- Continuous acoustic differences not only guide consideration of isolated words (e.g., she/he), but also lead to graded activation of referential candidates (Daisy/Mickey).
- Discourse can override a clear acoustic signal pointing to a different interpretation. While consistent with discourse effects on ambiguous stimuli (Rohde & Ettlinger, 2012), we show the stimulus need not be ambiguous to find strong discourse effects.

**These findings go beyond previous work (McMurray, et al., 2002) by showing that continuous acoustic information affects both lexical and referential interpretation. Ongoing research examines whether this fine-grained acoustic information (McMurray, et al, 2009) guides integration of right-context information during referential interpretation.**

## References

Arnold, et al. (2000). *Cognition* 76, B13-B26. McMurray, Tanenhaus, & Aslin (2002). *Cognition* 86, B33-B42. McMurray, Tanenhaus, & Aslin (2009). *JML* 60, 65-91. Rohde & Ettlinger, (2012). *JEP:LMC* 38, 967-983.

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