

Gestures modulate access to referent representations

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Background & Predictions

- Co-speech gestures – the hand and arm gestures people make while speaking – are tightly coordinated with the content of what they are saying (McNeill, 1992).
- Gestures can communicate information affecting the
 - meaning of nouns and verbs (Bernardis, Salillas & Caramelli, 2008)
 - position and size of objects (Holler, Shovelton, & Beattie, 2009)
 - comprehension of action verbs (Kelly, Ozyurek, & Maris, 2010)
- The location or hand shape of gestures that speakers spontaneously produce sometimes indicate co-reference between a pronoun and its referent (Foraker, 2010; So, Kita, & Goldin-Meadow, 2009).

Gestured information influences pronoun resolution, offline

- Inhibitory effects: Gestures that contradict order of mention in a discourse can shift comprehender's interpretation of an ambiguous pronoun (Goodrich Smith & Hudson-Kam, 2012).
- Facilitative effects: Gestures consistently indicating an entity bias interpretation to that entity, whether first- or second-mention (Foraker & Delo, 2013 CUNY poster).

Does gestured information constrain pronoun resolution online? During bonding? Integration?

- Expt 1:** During early **bonding**, linking the pronoun with a referent representation (Garrod & Terras, 2000), we expected that a gesture **consistent** with a referent should **facilitate access**. We tested this with a referent probe at pronoun offset.
- Expt 2:** During later resolution, when the bond is integrated into the discourse (Garrod & Terras, 2000), we predicted that the gesture should **shift the interpretation** (toward Referent 1 or 2, respectively), and that a gesture **consistent** with referent choice should **facilitate resolution time**. We tested this with a forced choice at pronoun offset.

Materials & Design

- First sentence introduced both referents; no gestures
- Second sentence provided unique information about each referent, with an accompanying gesture as the name was uttered.
- Third sentence: **4 gesture conditions** – a gesture accompanies the pronoun



VIDEO: "Craig and Matt went on vacation.

Craig_[G1] took a trip to Hawaii, while Matt_[G2] took a trip to Florida.

He_[G1/NoG/AmbigG/G2] thought the weather was great while on vacation."



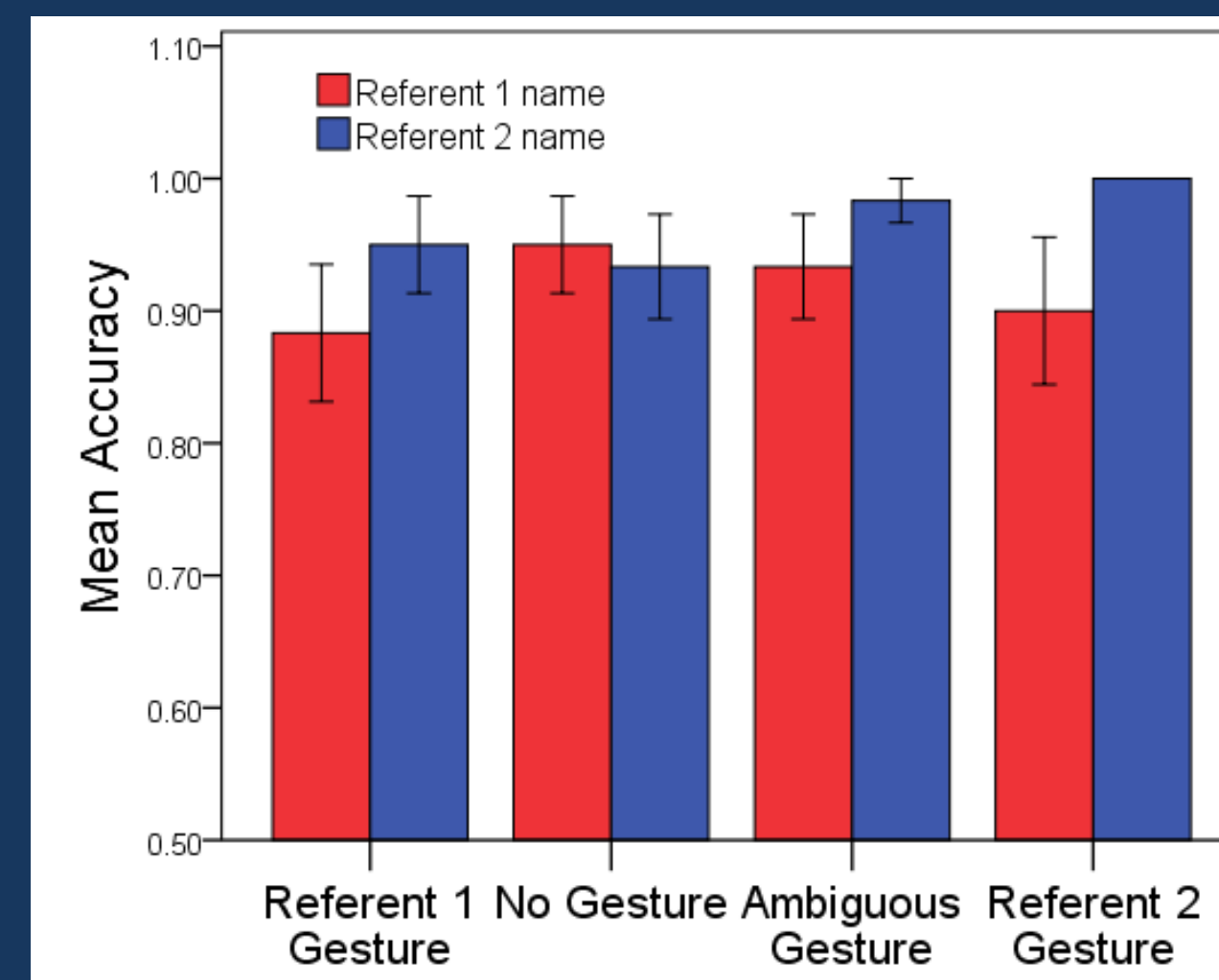
- First, 24 of 30 items were chosen from a written norm, where the pronoun was ambiguous with no preferred interpretation (scale below), and referent/pronoun gender was balanced.
- Videos were re-taped until rated naturalness of delivery and clarity of speech were equal in all conditions (4 naïve raters).
- Hand used was counterbalanced across order of mention; half deictic and half representational illustrator gestures; balanced across two speakers (1 M, 1 F)
- The extracted audio was first tested in the experimental design to ensure prosodic or other auditory information did not bias interpretation in our materials (32 participants, 24 items).

Offline Q: Who thought the weather was great while on vacation?

Craig for sure 1 probably Craig 2 maybe Craig 3 either one 4 maybe Matt 5 probably Matt 6 Matt for sure 7

Experiment 1: Referent Recognition

Procedure: Participants watched each video and decided if the name appearing above the video had been mentioned in that discourse or not. The name probe appeared at pronoun offset, and was either the referent 1 name (Craig), referent 2 name (Matt), a same gender foil (Brian), or an opposite gender foil (Susan).



Accuracy Results

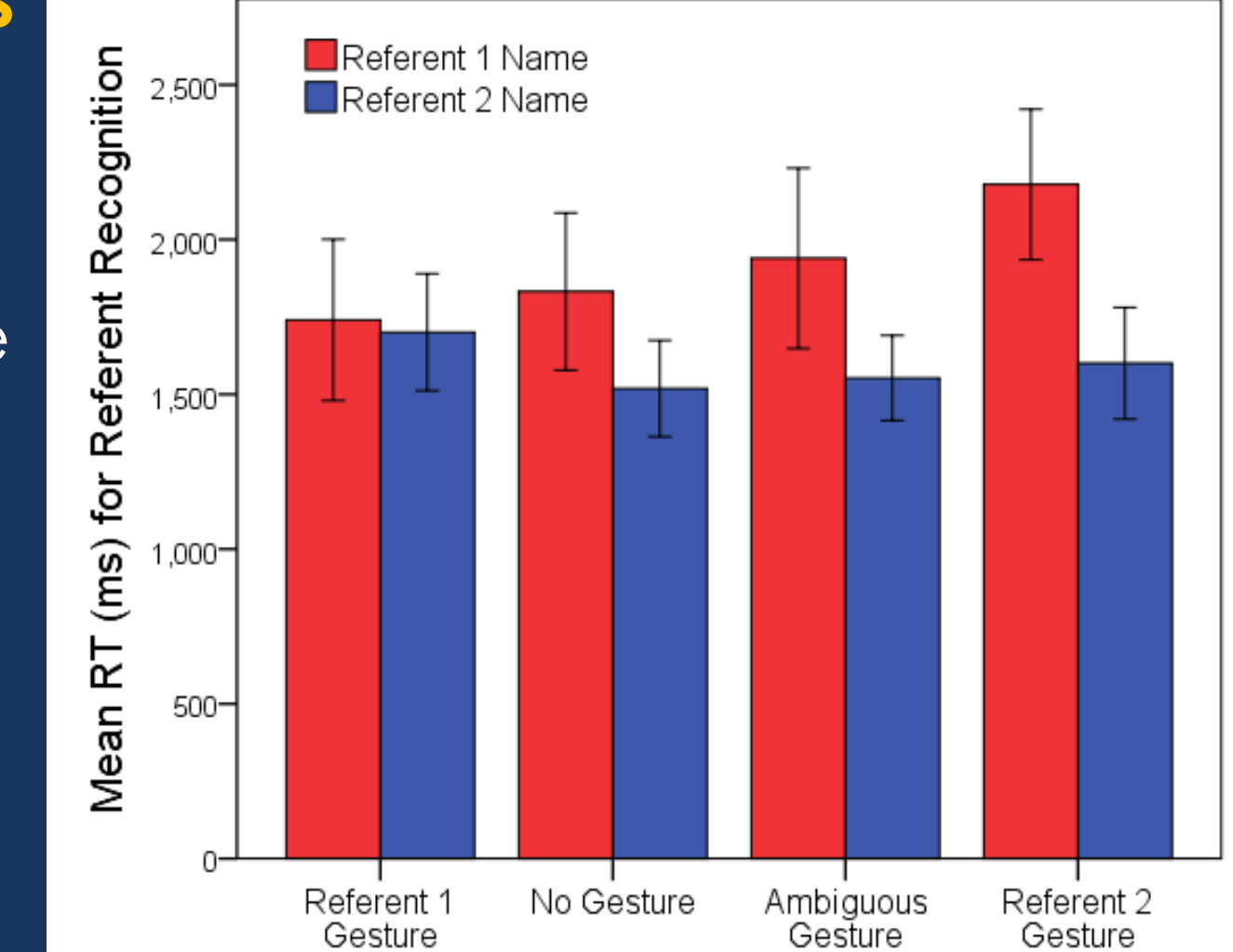
- No main effects or interaction, $F_s < 1$.

32 participants, 24 items, 16 lists (data collection ongoing)

Reaction Time Results

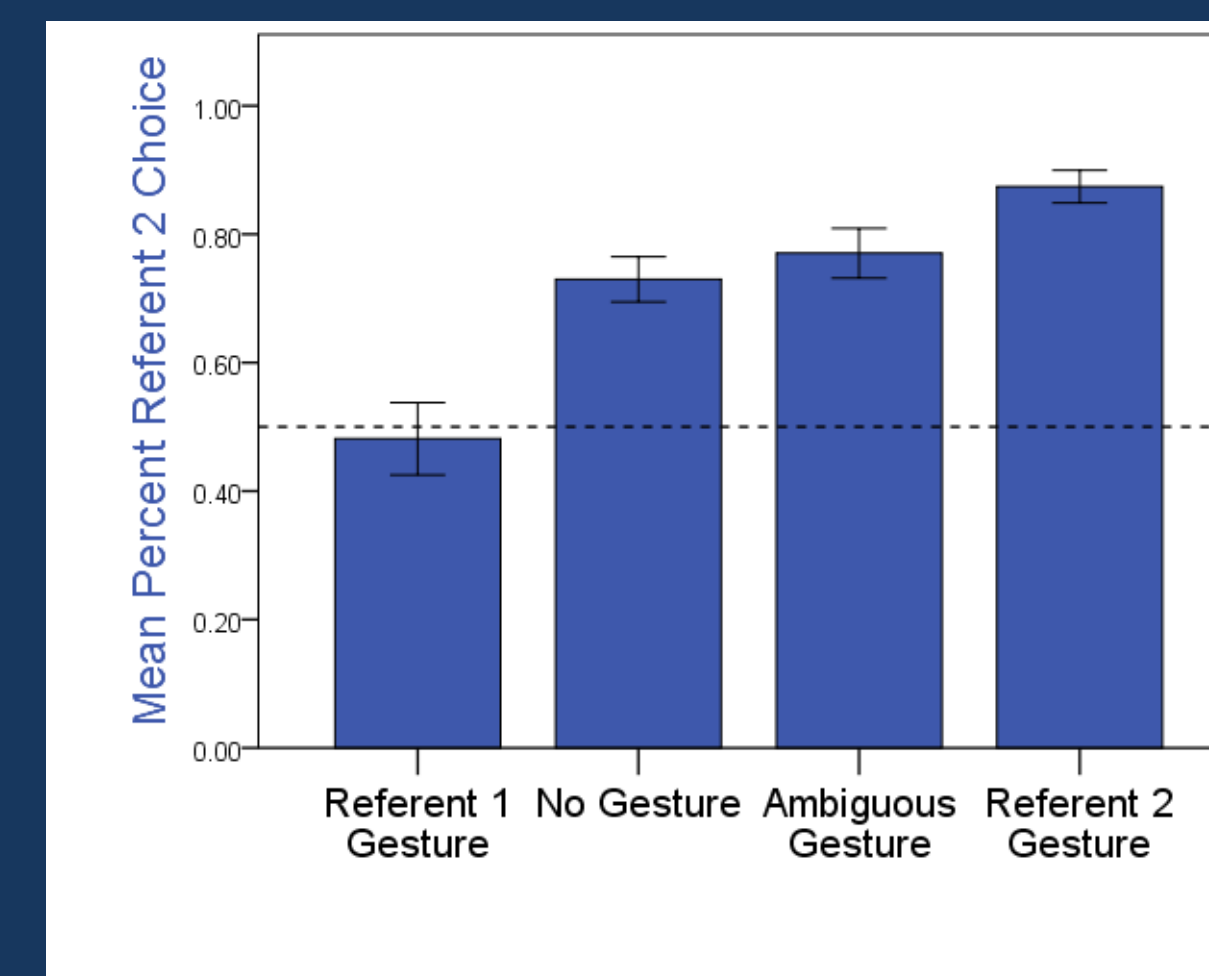
- Recency effect, $p = .005$
- Referent 2 Name probes showed **no differences** between gesture types.
- Referent 1 Names** showed a **linear effect** of gesture type, with increasingly slower times, from Referent 1 through the baselines to Referent 2, $p = .035$. As well, reaction time was **faster** with a **consistent Referent 1 Gesture** vs. an inconsistent Referent 2 gesture, $p = .046$.
- No main effect of gesture; no interaction, $p_s > .31$

bonding



Experiment 2: Two-Alternative Forced Choice

Procedure: Participants watched each video and decided which of two characters was talked about in the last sentence, as quickly as possible. The two referent names appeared at pronoun offset, beneath the video on the side consistent with the deictic gesture (for illustrators, balanced between right & left), and participants had to choose one of the referent names.



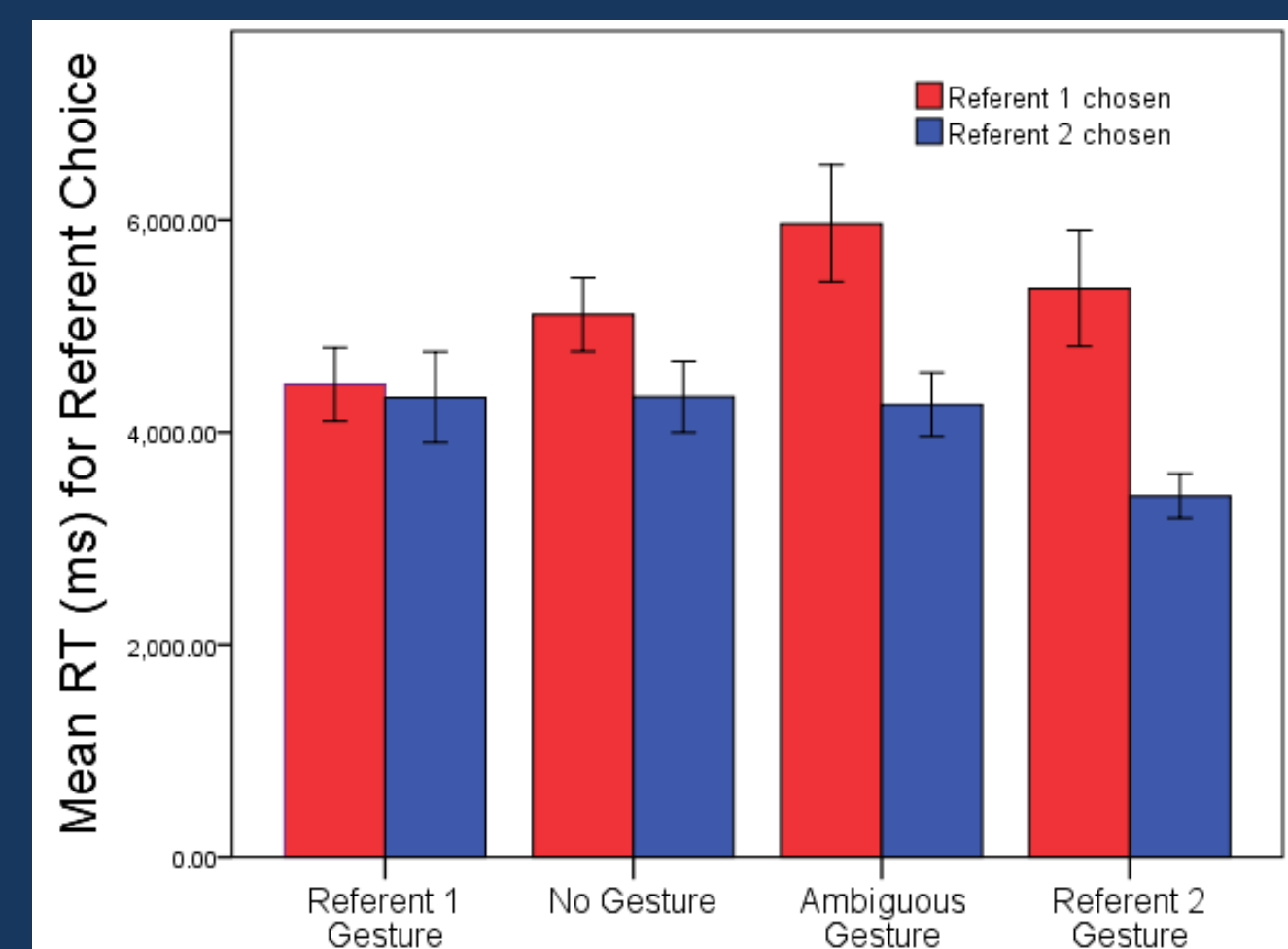
Choice Results

- Main effect of gesture type, $p < .001$
- Paired comparisons all significant, $p_s < .004$, except No vs. Ambiguous gesture, n.s.

44 participants, 24 items, 4 lists

Reaction Time Results

- Recency effect: $p = .052$
- For **Referent 2 choices**, the consistent **Referent 2 gesture** produced **faster** RTs than the other gesture conditions, $p_s < .017$.
- For **Referent 1 choices**, the consistent **Referent 1 gesture** produced **faster** RTs than other gesture conditions, $p_s < .047$.
- No main effect of gesture type or interaction with referent choice, $p_s > .67$



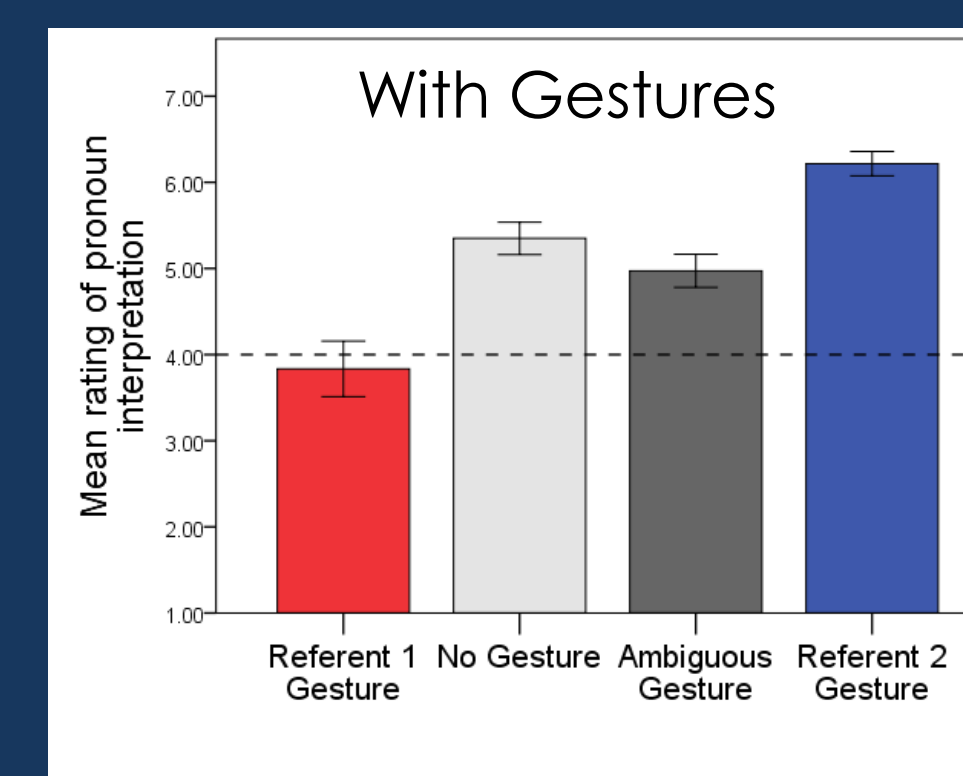
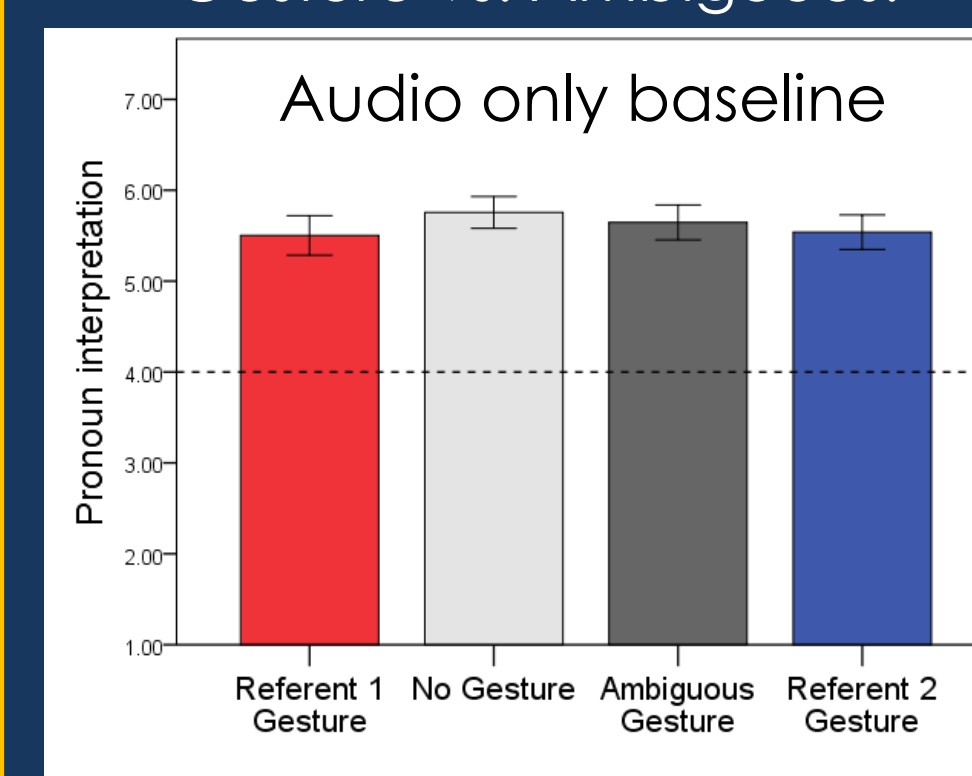
integration

Discussion

- Gestures can modulate online referent resolution, with interpretations shifted in either direction from baseline. These experiments indicate that gestured content acts as one of several constraints during anaphor and co-reference resolution (e.g., Kaiser & Trueswell, 2008; Kaiser, 2011).
- For the earlier stage of accessing a referent representation (bonding; referent recognition), a consistent gesture facilitated access to the Referent 1 probe, with no effect of gesture for the uniformly faster Referent 2 probes. This suggests that gestured information can act as a retrieval cue for a referent representation that is less available in memory (Foraker & McElree, 2007).
- For the later resolution stage (integration; forced choice), a consistent gesture eased pronoun resolution, for both Referent 1 and Referent 2 interpretations.

Offline judgments: Audio only; with Gestures

- The auditory materials produced an overall recency preference.
- Referent1 gestures biased offline interpretation to the 1st-mentioned entity, and Referent 2 gestures to the 2nd-mentioned entity.
- No effects of deictic vs. illustrator gestures, $F_s < 1$; gesture type comparisons remained significant, except for deictics did not differ for No Gesture vs. Ambiguous.



32 Ps, 24 items
Main effect of gesture cond., $p < .001$

All paired comparisons significant by subjects and items, $p_s < .01$

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