

# An ERP study of the beneficial effects of gesture on associative memory formation

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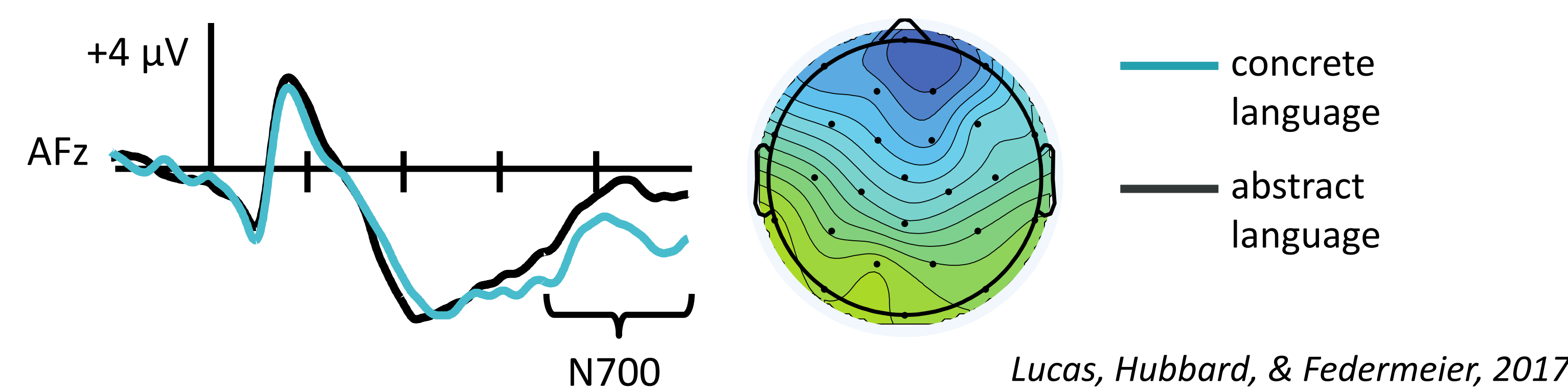


## How does co-speech gesture affect memory?

- Gesture is an integral part of human communication that has been shown to benefit language comprehension and memory.
- Co-speech gestures can include:
  - **Iconic gestures:** hand movements that mimic speech
  - **Beat gestures:** small hand movements for emphasis<sup>1</sup>
- Gestures may benefit memory by:
  - **Dual coding:** providing a visual representation of information, which may enhance imagery<sup>2</sup> and/or
  - **Attentional highlighting:** calling attention to parts of speech<sup>3</sup>
- While both iconic and beat gestures can enhance memory via attentional highlighting, only iconic gestures can support dual coding.
- To compare these accounts, we recorded study-phase ERPs and tested recall for unrelated word pairs with the first words (W1s) paired with iconic, beat, or no gestures.

## Hypotheses

- If gesture benefits memory via **Attentional Highlighting:**
  - both iconic and beat gestures will improve memory
- If gesture benefits memory via **Dual Coding:**
  - only iconic gestures will improve memory
  - iconic-gestured pairs may be perceived as more imageable
  - Iconic-gestured pairs may elicit greater N700 amplitudes, an ERP component linked to concreteness and imagery in prior work<sup>4</sup>



## Methods

### Participants

- N = 30 young adults, 23 female
- Mean age = 20 yrs (range = 18-27)
- All native speakers of English

### Stimuli & Procedures

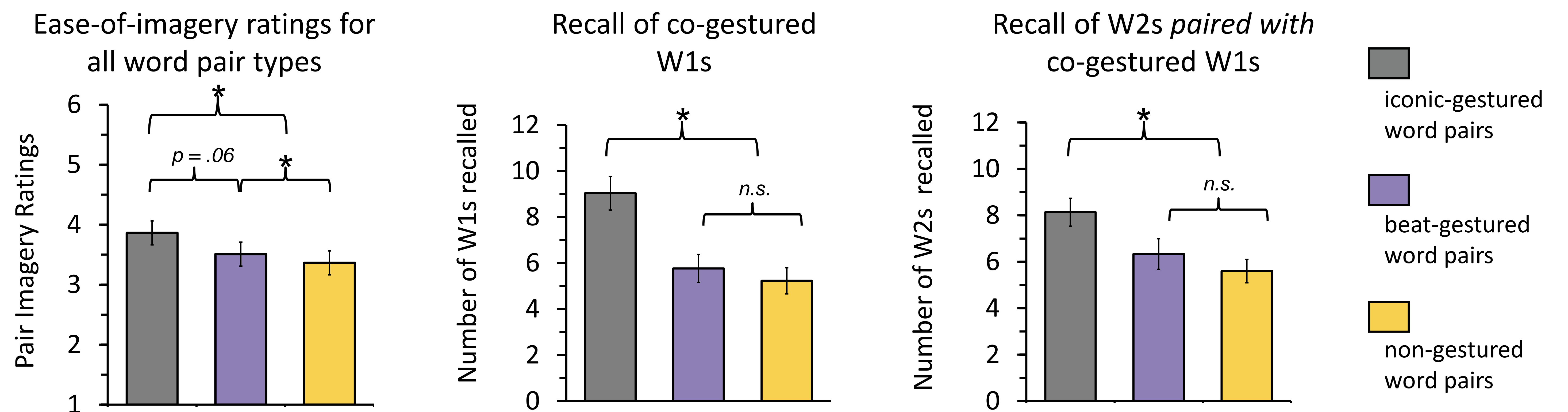
- Participants watched videos of an actor reciting 108 sentences ending in unrelated verb-noun (W1-W2) pairs:
  - 36 with iconic-gestured verbs
  - 36 with beat-gestured verbs
  - 36 with non-gestured verbs
- Stimuli presented in 3 blocks of 36, followed by a free recall test
- After viewing each video, participants had 4 seconds to rate from 1-6 how easy it was to generate mental images of the word pairs
- Continuous EEG recorded from 32 electrodes

1. McNeill, D. (1992). Hand and mind: What gestures reveal about thought. University of Chicago press.  
 2. Paivio, A. & Csapo, K. (1973). Picture superiority in free recall: Imagery or dual coding? *Cognitive Psychology*, 5, 176-206  
 3. Biau, E., & Soto-Faraco, S. (2013). Beat gestures modulate auditory integration in speech perception. *Brain and Language*, 124, 143-152.  
 4. West, W. C., & Holcomb, P. J. (2000). Imaginal, semantic, and surface-level processing of concrete and abstract words: an electrophysiological investigation. *JocN*, 12, 1024-1037

## Stimuli

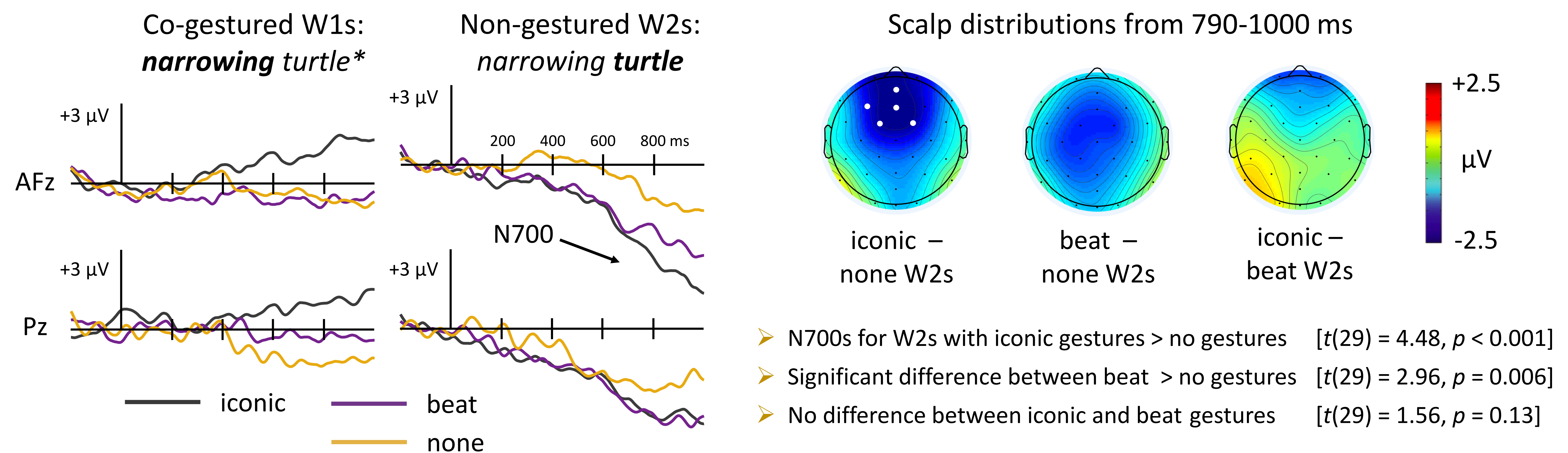


## Behavior: W1 Iconic, but not beat gestures enhanced imageability ratings and recall.



## ERPs: W1 gestures enhanced W2 N700 ERPs, suggesting facilitated associative imagery.

- Analyses focused on ERPs elicited by the non-gestured W2s (e.g., narrowing **turtle**) so as to examine the impact of the co-W1 gesture on brain activity while holding sensory input constant.
- Factorial mass univariate analyses revealed differences in five frontal electrodes (in white) from 790-1000 ms, consistent with N700.



\* W1 ERPs are provided for display purposes only and were not formally analyzed.

## Conclusions

- Iconic gestures, but not beat gestures, enhanced recall for unrelated word pairs, suggesting that these memory benefits stemmed from the presence of semantic content rather than attentional highlighting.
- Both trial-by-trial imagery ratings and imagery-related ERPs (N700) were largest for word pairs accompanied by iconic gestures, suggesting that mental imagery may mediate the relationship between gestures processing and enhanced memory.
- However, imagery and ERP effects of beat gestures were not distinguishable from those of iconic gestures, leaving open the possibility that beat gestures can also be effective at enhancing imagery.
- These results tentatively support a dual-coding based theory of the beneficial effects of iconic gestures on memory.