

## Introduction

Verbs aid in the proper construction and comprehension of sentences, not only by defining the number and type of arguments allow, but also by assigning thematic role knowledge to the words in the sentences.<sup>9,14</sup>

For example, *Send* is a three argument verb that requires a **subject, object and theme**<sup>4,15,18</sup>  
*The girl sends a letter to the boy*

Thematic roles are verb-specific concepts that characterize argument roles in a sentence and define arguments semantically.<sup>4,14</sup> In unimpaired individuals, verbs activate agent and patient thematic roles. The thematic information contained by verbs also includes features of the arguments<sup>8</sup>

This study used event-related potentials (ERPs) to examine the real-time processing of agent and patient thematic roles and their features when primed with a related or unrelated verb.

ERPs have excellent temporal resolution and reveals linguistic processing on a millisecond time scale. ERP components' amplitude and distribution correspond to different cognitive processes.<sup>3,6,10,12,13,16</sup>

Q: How are agent and patient thematic roles and their features processed in real-time when primed with a related or unrelated verb?

Q: Do verbs automatically activate information about their thematic roles?

## Methods

### Participant (n=14) Demographic Characteristics Mean (SE)

Age	Education	F/M
22.79 (1.45)	15.64 (0.66)	1.8

### Language Assessments:

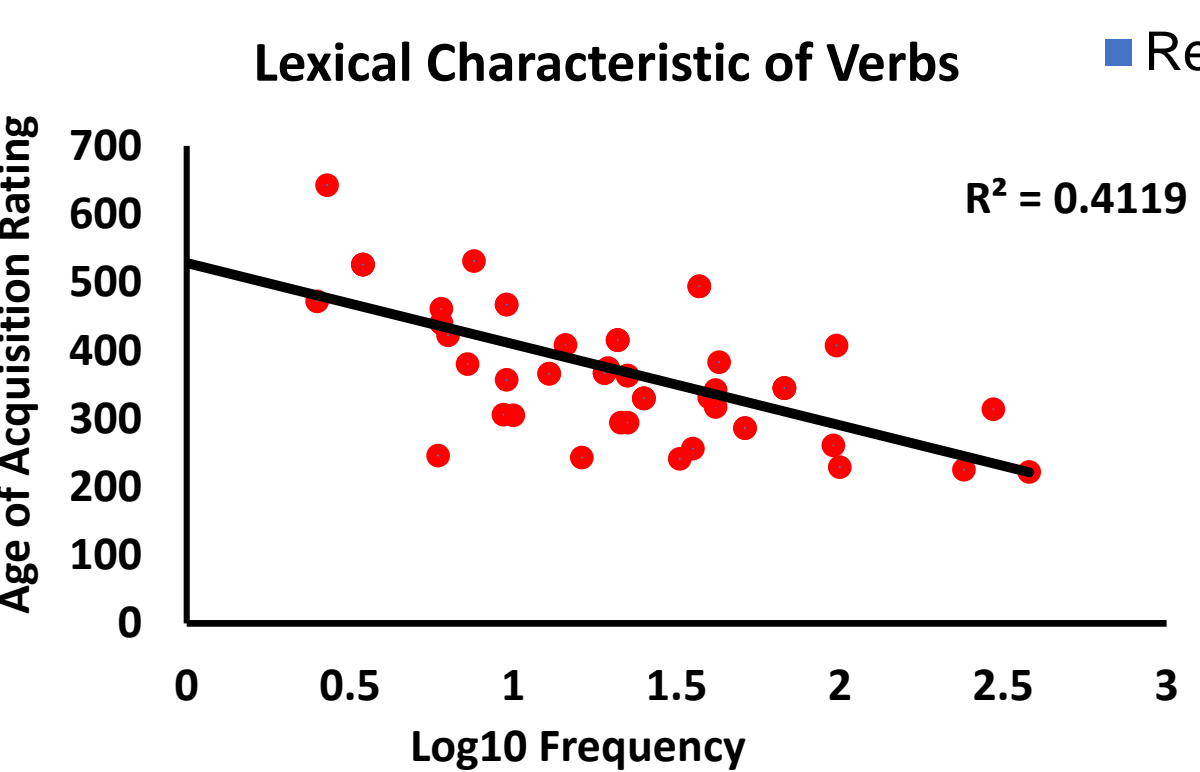
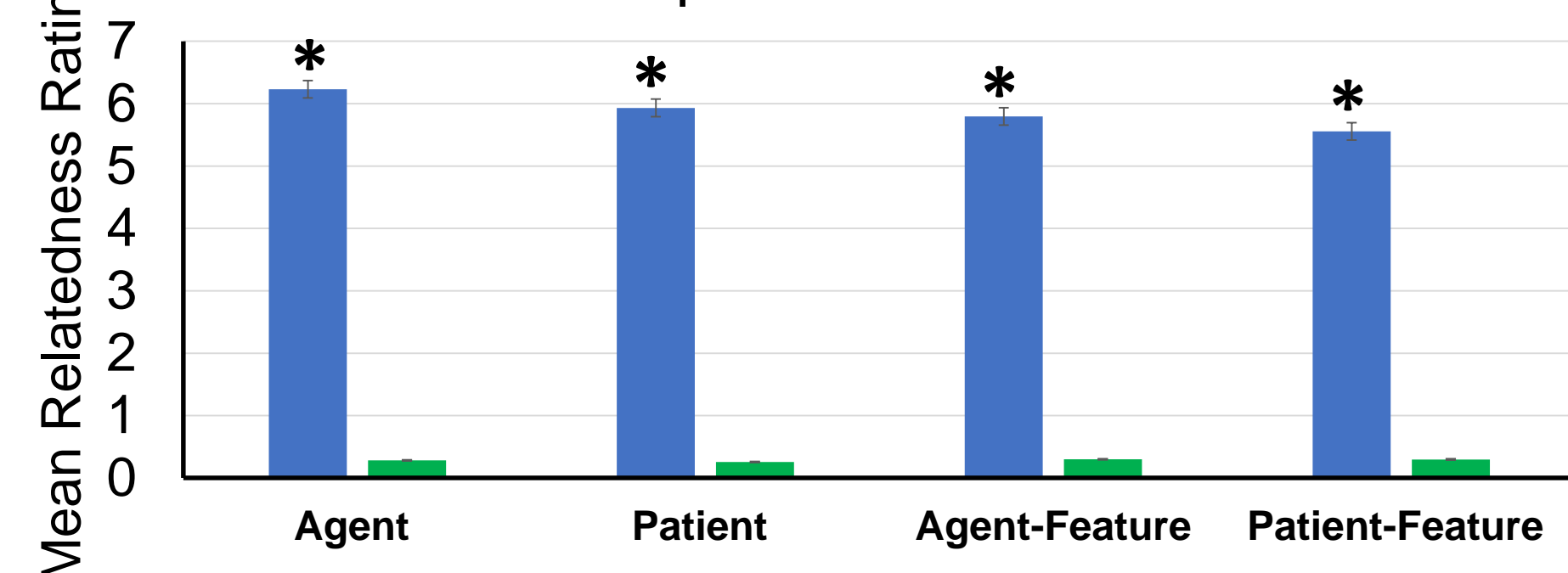
**Semantic Skills**  
 Peabody Picture Vocabulary Test (PPVT)<sup>7</sup>, Camel and Cactus Test<sup>1</sup>  
 Psycholinguistic Assessment of Language Processing in Aphasia<sup>11</sup>: PALPA 48 (W-P match)  
 PALPA 49 Verb auditory synonym judgement

**Sentence Production Skills**  
 Northwestern Assessment of Verbs and Sentences<sup>5,17</sup>,  
 Argument Structure Production Test (ASPT),  
 Sentence Production Priming Test (SPPT)

### Means (standard error) Scores on Language Assessments

ASPT (n=14)			SPPT (n=13)	PPVT (n=13)	PALPA 48 (n=13)	PALPA 49 (n=13)	Synonym Judgement (n=13)
1-Place	2-Place	3-Place					
100.0 (0.00)	99.52 (0.48)	100.0 (0.00)	98.97 (1.22)	91.97 (2.91)	83.17 (2.91)	97.88 (0.48)	100.0 (0.00)

### Semantic Relatedness Ratings Across Different Experimental Conditions

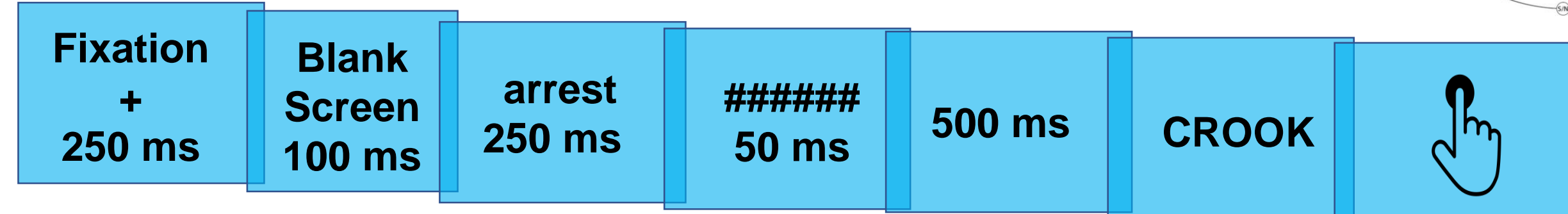
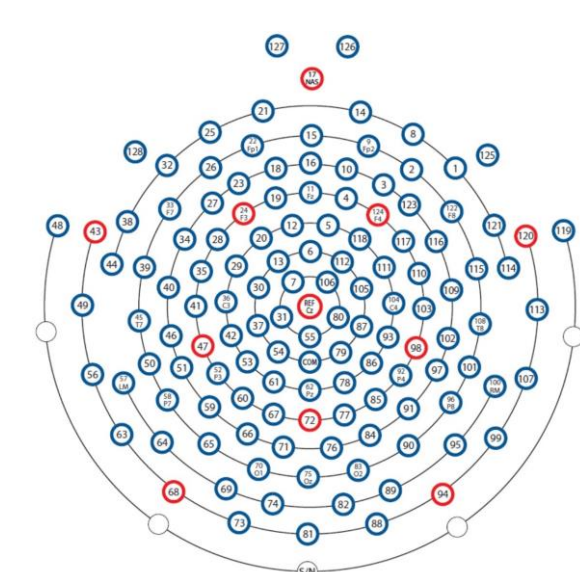


### Celex Log10 Frequencies<sup>2</sup> for Targets Across Different Experimental Conditions.

Condition	Related	Unrelated
Verb-Agent	1.20 (0.10)	1.17 (0.08)
Verb-Patient	1.37 (0.09)	1.01 (0.10)
Verb-Agent Feature	1.17 (0.13)	1.24 (0.14)
Verb-Patient Feature	1.21 (0.13)	1.33 (0.12)

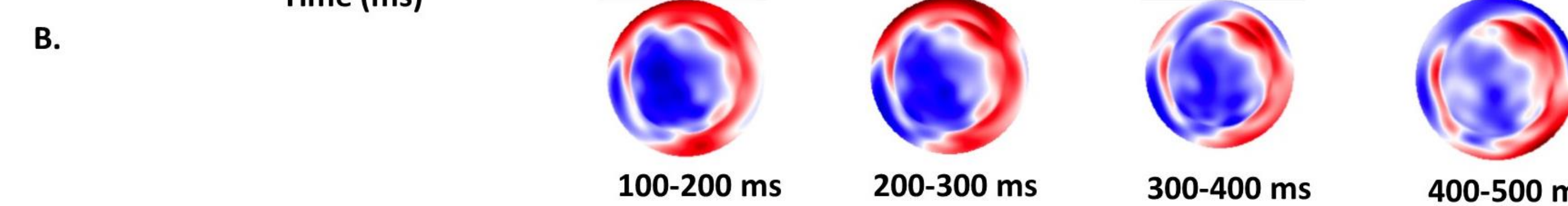
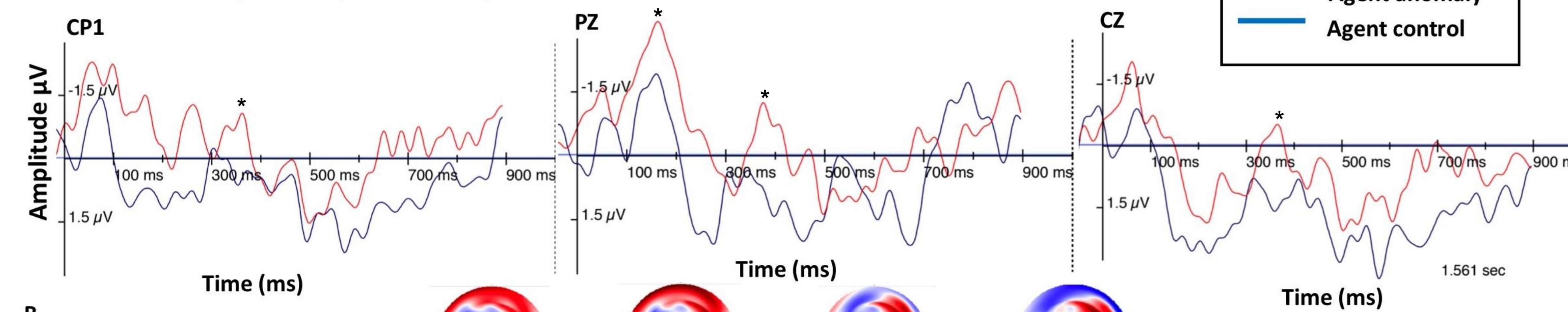
### Task: Lexical Decision

**EEG Measurements:**  
 Recorded with a geodesic high-density EEG acquisition system with 128 channel sensor net, amplified using a NetAmps 300 DC amplifier and acquired using NetStation v5.4 software on iMAC (3.2GHZ Intel core i5).

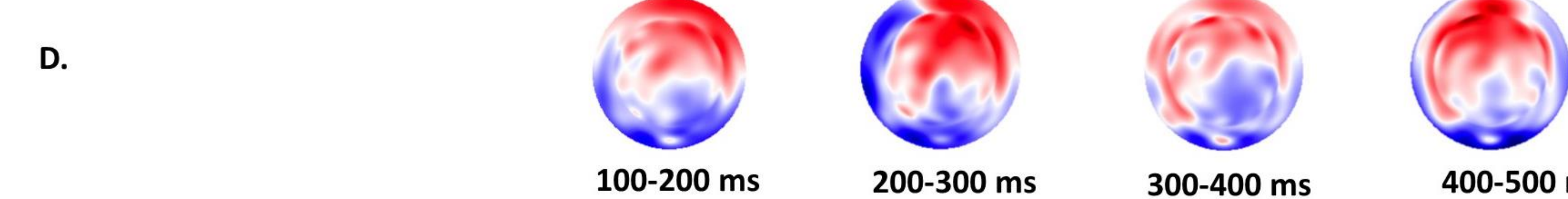
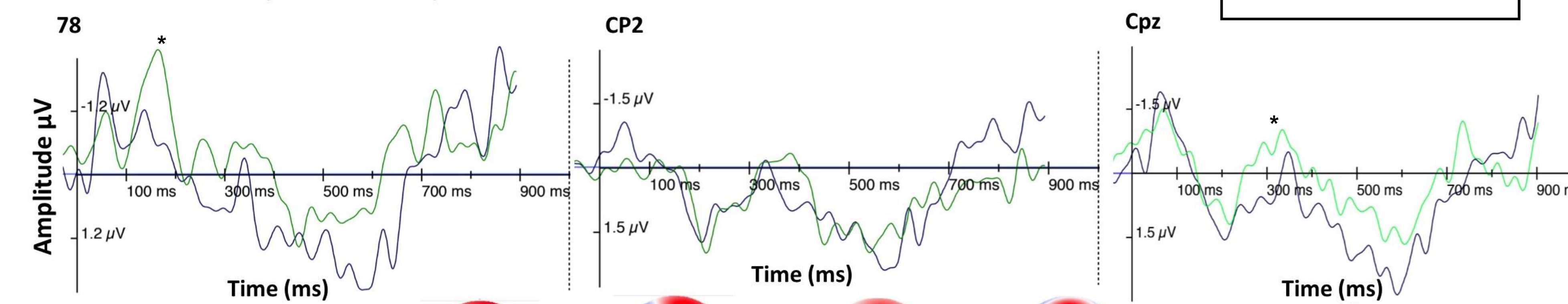


## Results

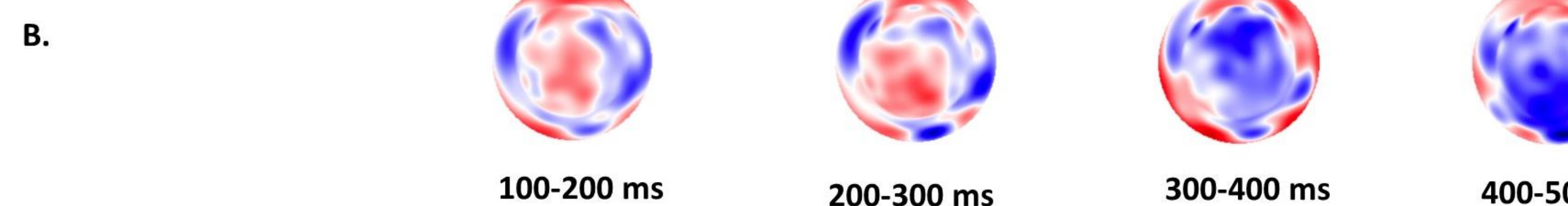
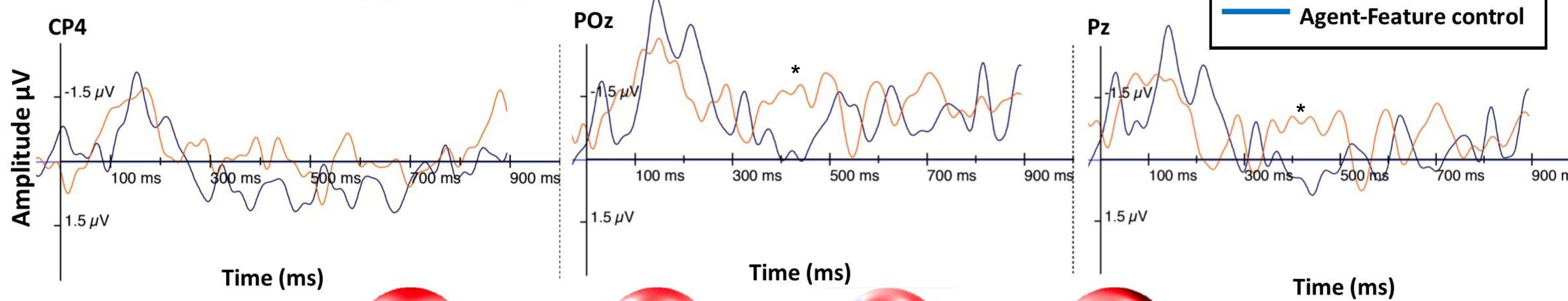
### A. VERB-AGENT (*accuse-prosecutor*)



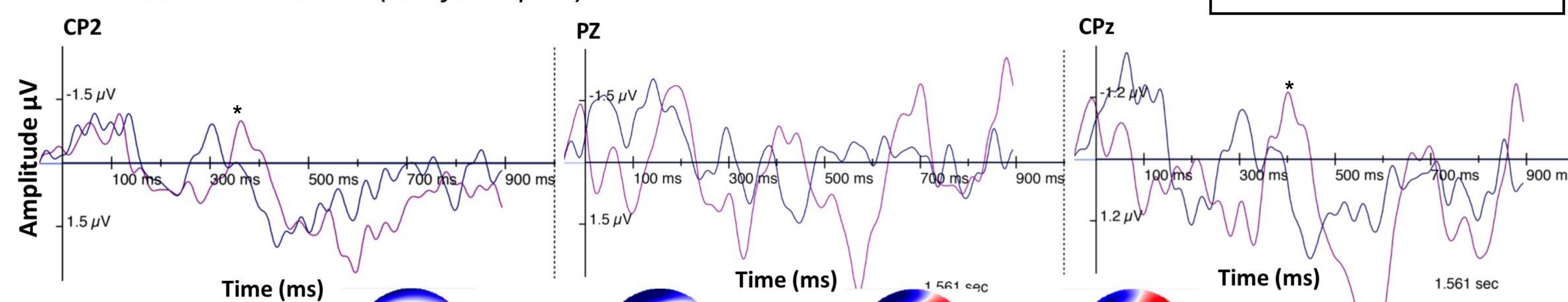
### C. VERB-PATIENT (*arrest-crook*)



### A. VERB-AGENT FEATURE (*fight-strong*)

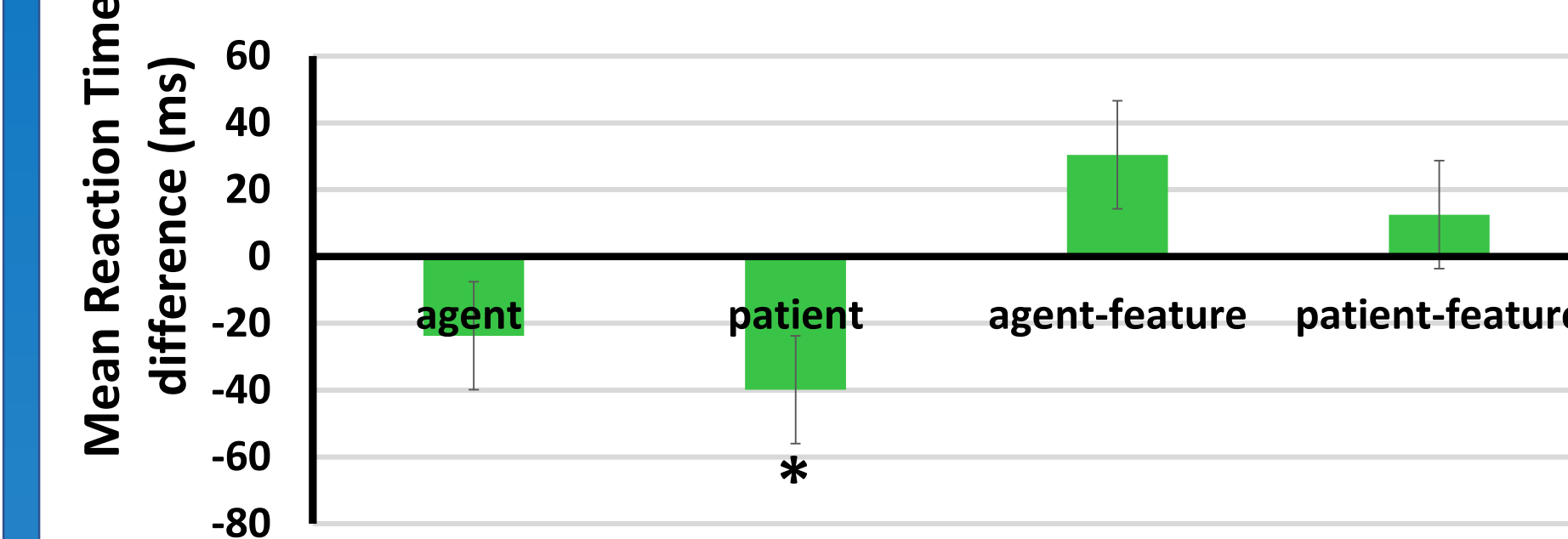


### C. VERB-PATIENT FEATURE (*comfort-upset*)



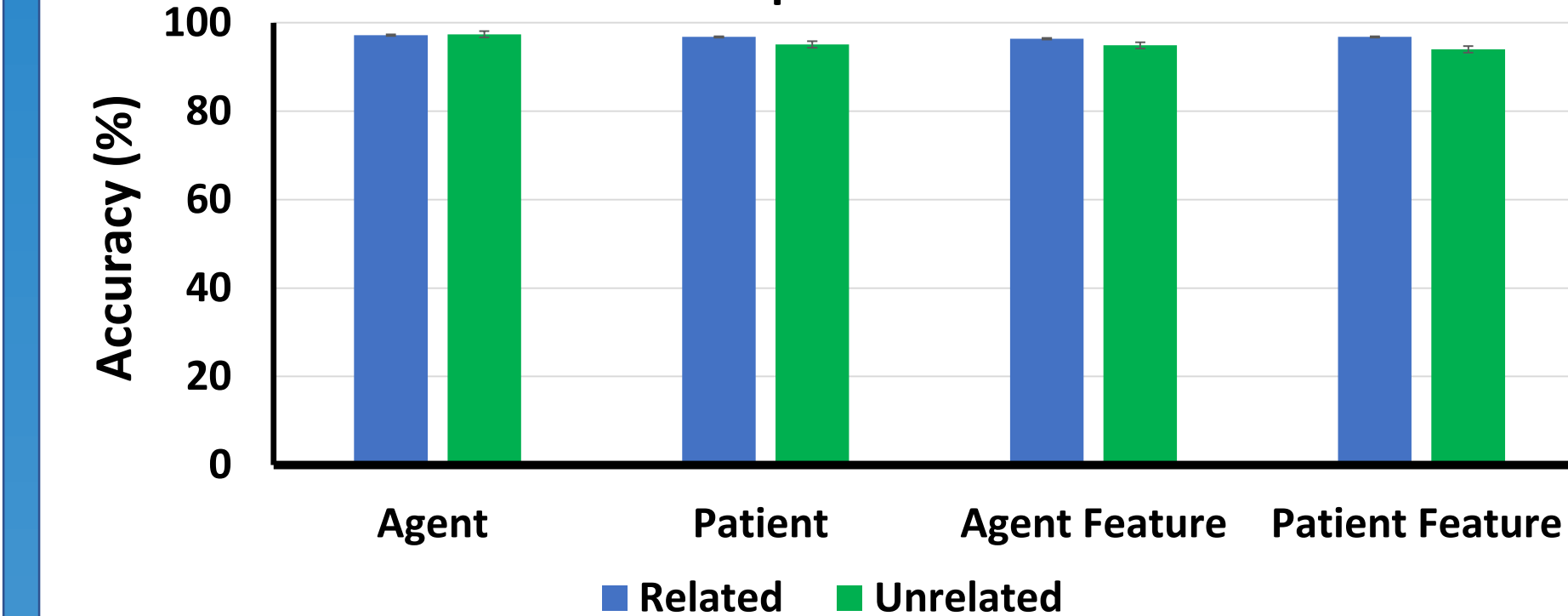
## Behavioral Effects

### Priming effects across different experimental conditions



### RT Related-Unrelated

### Accuracy average in young controls (n=14) across different experimental conditions



## Discussion

- The behavioral effects showed significant priming effect for patient condition, indicating that participants were faster in responding to the related patients in the context of related verbs than to the unrelated patients
- The ERPs showed N100 effect associated with early visual processing of unpredictable stimulus
- In the 300-500 ms time window processing of agent, patient and feature information elicited N400 effect
- The N400 effect was the strongest for verb-agent condition. It started at 350 ms post-stimulus onset and continued till 450 ms
- The N400 effect for verb-patient condition was weaker and effects for verb-feature conditions lasted till 500 ms post-stimulus onset
- These results indicate that participants automatically access information about verb thematic roles by 300 ms post-stimulus onset
- Lexical information about agents is accessed earlier compared to patients and features
- This experiment is part of a larger study that will compare the same results across young controls, older controls, and participants with aphasia.

## References

[1] Adam et al. (2010). *Neurocase*, 16, 193-207. [2] Baayen et al. (1995). Linguistic Data Consortium, University of Pennsylvania, Philadelphia, PA. [3] Bentin, et al. (1985). *Electroencephalography and Clinical Neurophysiology*, 60(4), 343-355. [4] Boland (1993). *Journal of Psycholinguistic Research*, 22 (2), 133-152. [5] Cho-Reyes & Thompson (2012). *Aphasiology*, 26, 1250-1277. [6] Donchin & Coles (1988). *Behavioral and Brain Sciences*, 11(3), 357-427 [7] Dunn, L.M., & Dunn, D.M. (2007). San Antonio, TX: Pearson, Inc. [8] Ferretti et al. (2001). *Journal of Memory and Language*, 44, 516-547. [9] Friederici & Frish (2000). *Journal of Memory and Language*, 43, 475-507. [10] Hillyard & Picton (1987). In F. Plum (Ed.), *Handbook of Physiology*, Sec. 1. The nervous system. Vol. 5. Higher functions of the brain (Part 2, pp. 519-584). Bethesda, MD: American Physiological Society. [11] Kay et al. (1992). Psychology Press. [12] Kutas & Van Petten (1988). *Greenwich, CT: JAI Press*. [13] Kutas & Van Petten (1991). *Memory & Cognition*, 19 (1), 95-112. [14] McRae et al. (1997). *Language and Cognitive Processes*, 12(2&3), 137-176. [15] Shapiro & Levine (1990). *Brain and Language*, 45, 423-447. [16] Tabullo et al. (2015). *Psychology & Neuroscience*, 8(4), 509-528. [17] Thompson (2011). Northwestern University. [18] Trueswell et al. (1993). *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 19 (3), 528-553.

## Funding

University of Arizona Faculty Seed Grant and UA startup grant to Dr. A. Kielar.



## Acknowledgements

I would like to thank Dr. Kielar for her guidance and support throughout this project.