

Neural representation of syntactic prediction: A simultaneous eye-tracking and EEG study



Yi-Lun Weng¹, An Nguyen², Rachel A. Ryskin³, Zhenghan Qi¹

¹ University of Delaware ² Johns Hopkins University ³ University of California Merced

UNIVERSITY OF CALIFORNIA
MERCED



THE GOALS

- The likelihood a verb co-occurs with syntactic structures, verb bias, strongly guides incremental sentence processing (Garnsey et al., 1997; Snedeker & Trueswell, 2004; Ryskin et al., 2017).
- However, most evidence of prediction is inferred from processing cost when unexpected words are encountered.

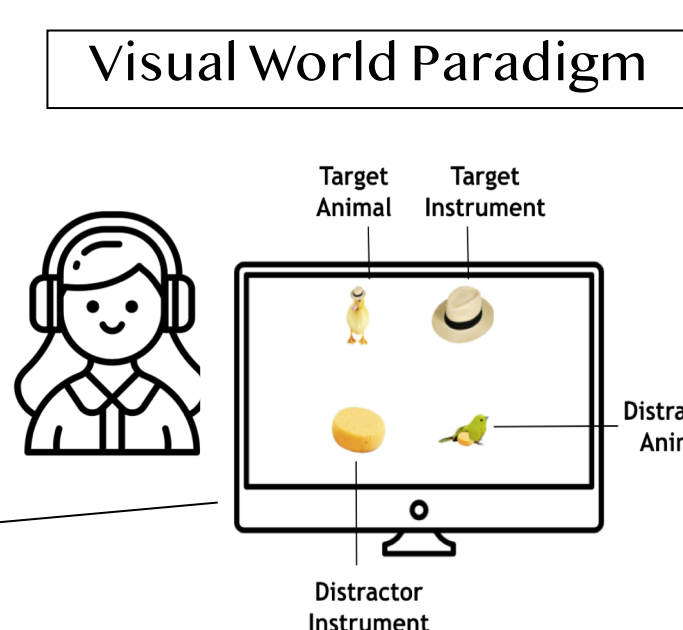
Research Questions:

- How early is syntactic prediction formed?
- What are the neural features of syntactic prediction?

METHODS

- 25 young right-handers (mean age=22.3 years, SD=1.4 years, 5 males)
- Verb bias task (Ryskin et al., 2017, Exp. 1)

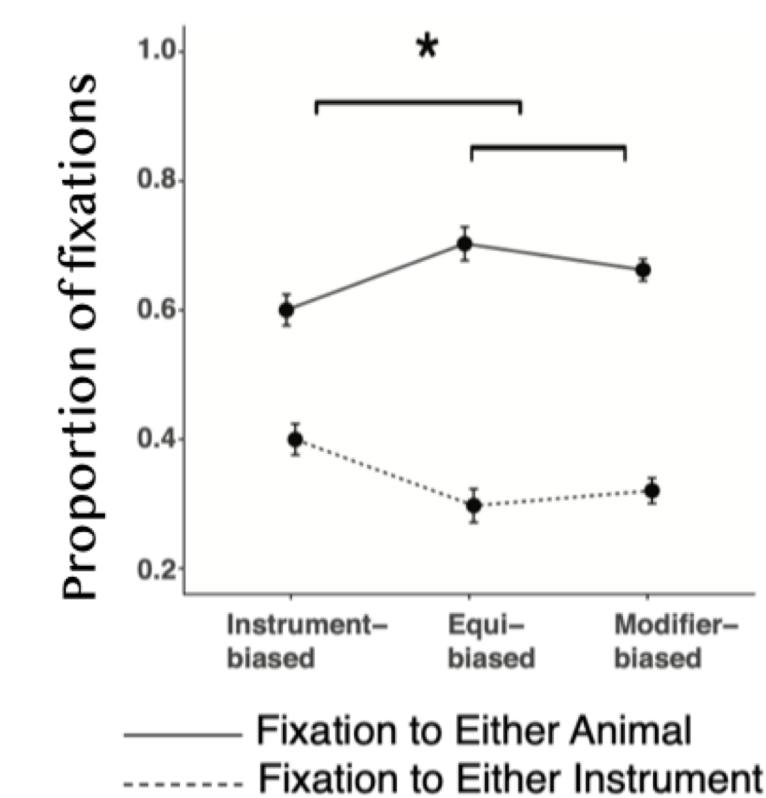
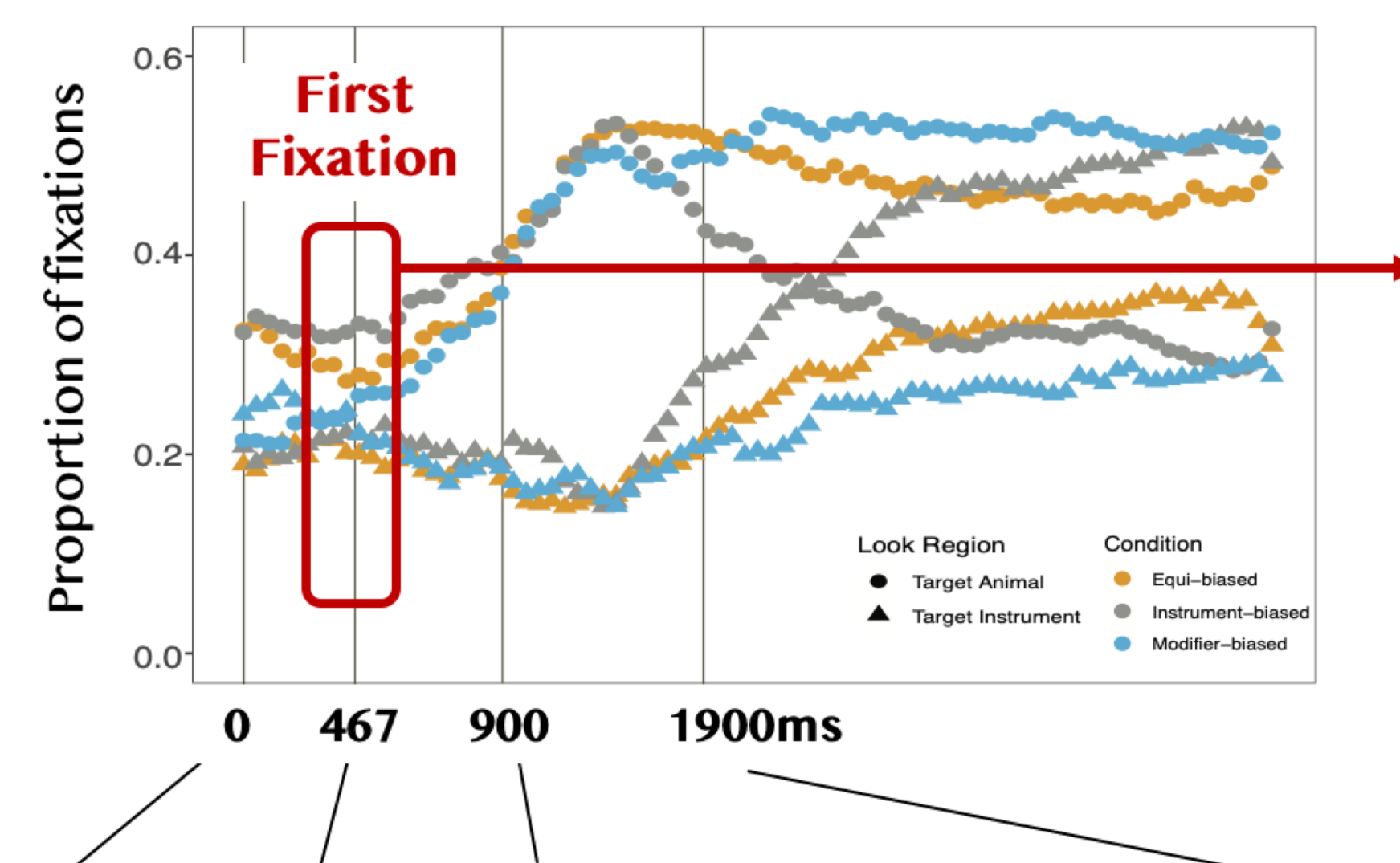
- Instrument-biased verb
"Strike the bear with the necklace."
- Equi-biased verb
"Feel the chicken with the feather."
- Modifier-biased verb
"Pet the duck with the hat."



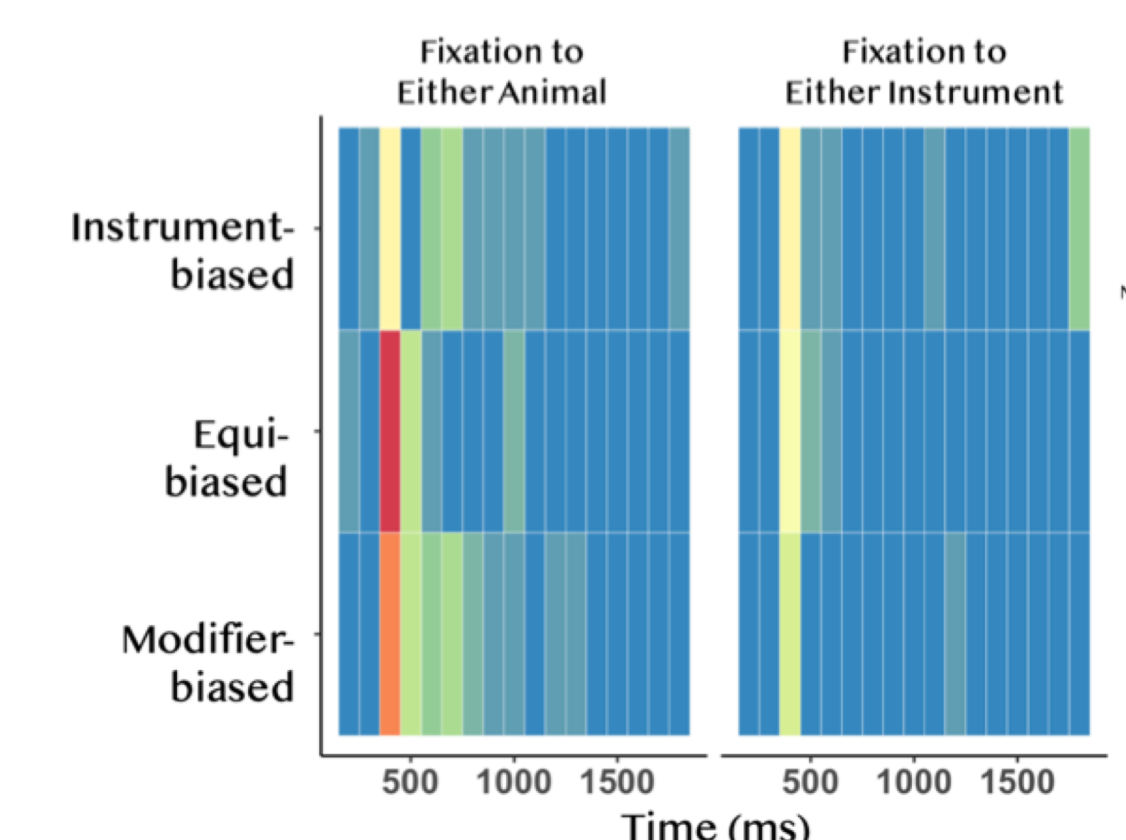
- Data analysis:
 - Anticipatory looking (Linear mixed-level model)
 - The first fixation after the offset of the verb
 - Last more than 200 msec
 - Decoding EEG topographic patterns
 - ERP anchor to individual's anticipatory looking
 - Cluster-based permutation p 's < 0.05

RESULTS

Analysis 1. How early is syntactic prediction formed?



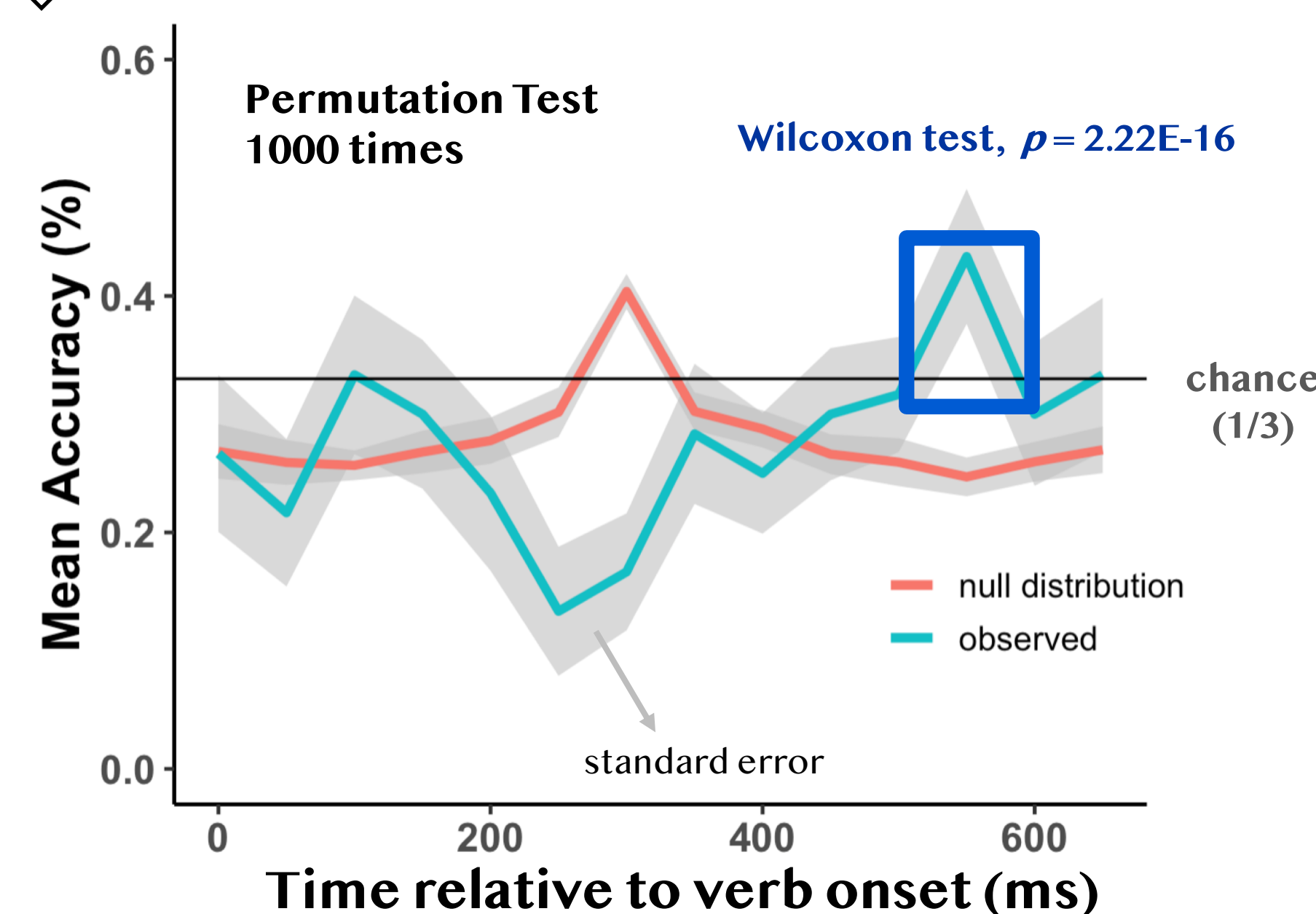
Significant verb bias effects emerges immediately after the verb offset (p 's < .01)



The probabilistic map of first fixation pattern after verb offset

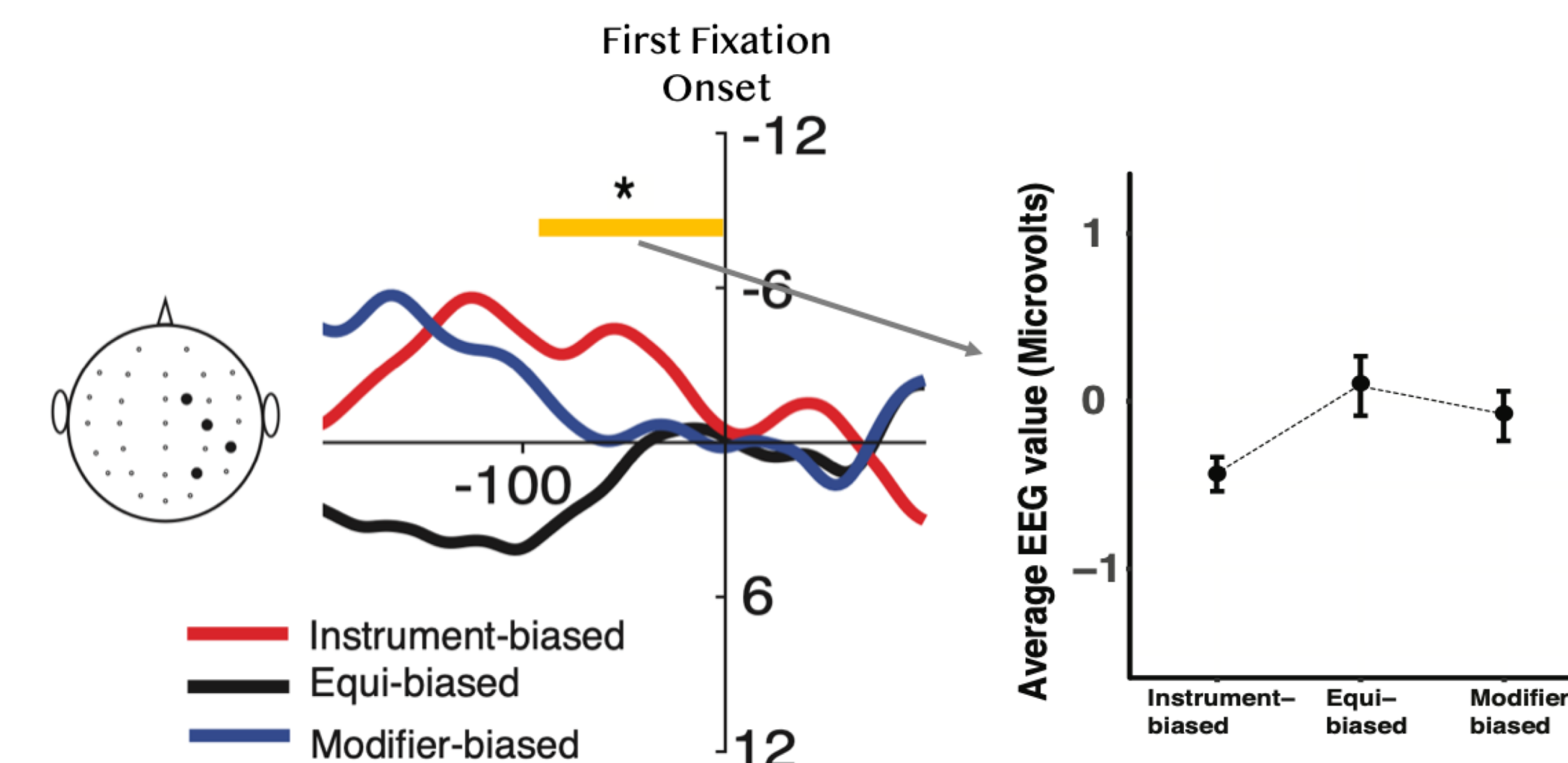


Decode verb bias prediction using Support Vector Machine
smoothing window 100 ms, sliding window 50 ms, cross-validation.



Analysis 2. What are the neural features of syntactic prediction?

ERP analysis (time-lock to individual's first fixation)



A greater negativity in the instrument-biased condition compared to the modifier-biased condition between -100 and 0 ms before the first fixation

SUMMARY

- How early is syntactic prediction formed?
After the verb and before the first NP
 - First fixation patterns showed a verb bias effect: more looks to the instruments and less looks to the animals upon hearing the instrument-biased verbs, compared to the modifier and equi-biased verbs.
- What are the neural features of syntactic prediction?
 - Listeners' EEG topographic patterns reliably decode the three verb biases between 500-600 ms after the verb onset.
 - Listeners' ERPs showed a greater negativity elicited by the instrument-biased verb, compared to the modifier- and equi-biased verbs 100 ms before the first fixation.

FUTURE ANALYSIS

- How does early verb bias effect impact final ambiguity resolution?



QLAB at UDel



@udelqlab

