

 Jin DouSupervised by
Drs. Ed Lalor & Aaron White

*“Identifying and Explaining
Electrophysiological Measures of
Linguistic Processing During
Natural Speech Comprehension”*

Seminar Abstract: Speech plays a crucial role in people’s daily lives. However, how the human brain so effortlessly processes the complex dynamic patterns of acoustic speech remains incompletely understood. One widely used method for studying this process involves modeling brain responses to natural speech. Among different brain recording techniques, electroencephalography (EEG) has the advantage of noninvasively recording brain activity from the scalp with high temporal resolution. By modeling EEG responses to speech stimuli, various acoustic and linguistic features have been found to be represented in the brain during naturalistic and narrative speech perception.

However, a number of limitations and unanswered questions exist in this widely used modeling framework. First, many speech-EEG models only consider the amplitude of EEG responses, rather than their timing or morphology, which may mask important variability in how brains process complex natural speech. Second, the total amount of explainable variance in EEG responses to natural speech is unknown, complicating the interpretation and benchmarking of speech-EEG models. Third, identifying EEG responses related to linguistic processing is challenged by the cost of searching for linguistic features and their correlation with acoustic features. Finally, it is unclear whether and which aspects of word meaning are represented in EEG during natural speech comprehension.

This thesis seeks to address these issues across four studies involving the modeling of EEG responses to natural speech. The first study developed an interpretable time-variant model to explain word-level EEG responses indexed by word unexpectedness and revealed that responses to predictable words are both smaller and earlier. The second study introduced a new approach for estimating the explainable variance in EEG responses to speech based on the assumption that people listening to the same speech would generate similar brain responses. The third study further identified supramodal responses to naturalistic stories by measuring correlations between EEG recordings collected during speech-only and text-only presentation of the same story. The fourth study decoded word embeddings from EEG responses to stories narrated by different speakers. By addressing these issues, this thesis aims to better identify and explain EEG measures of linguistic processing during natural speech comprehension.

Thursday, July 16, 2026 | 10:00am EST | SMD Large Aud (2-6424, Med Center)

<https://rochester.zoom.us/j/95777512722>

UNIVERSITY OF ROCHESTER, BIOMEDICAL ENGINEERING DEPARTMENT

