What are semantic frames?

Semantic frames: different semantic role configurations
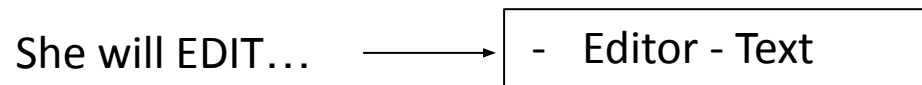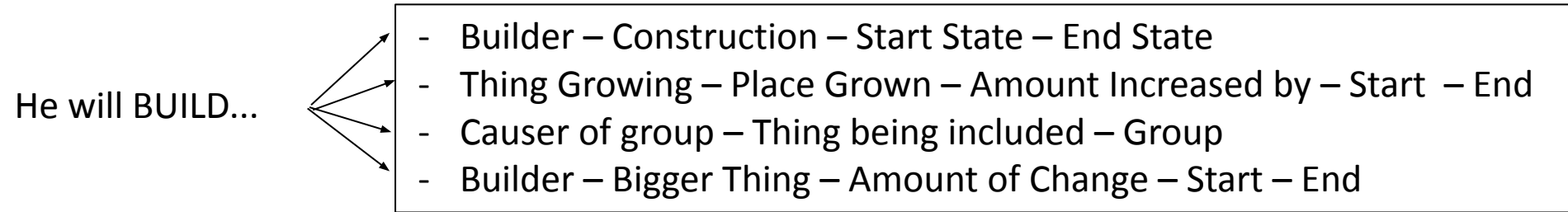
1. build: *construct*
Arg0-PAG: *builder* (agent)
Arg1-PRD: *construction* (product)
Arg2-VSP: *material, start state* (material)
Arg4-PRD: *end state* (product)

What is the role of semantic frames in sentence processing?

He will BUILD...

- Builder – Construction – Start State – End State
- Thing Growing – Place Grown – Amount Increased by – Start – End
- Causer of group – Thing being included – Group
- Builder – Bigger Thing – Amount of Change – Start – End

4 Semantic Frames = **High** Diversity → **High** Uncertainty → **High** Cognitive Load

She will EDIT...

- Editor - Text

1 Semantic Frame = **Low** Diversity → **Low** Uncertainty → **Low** Cognitive Load
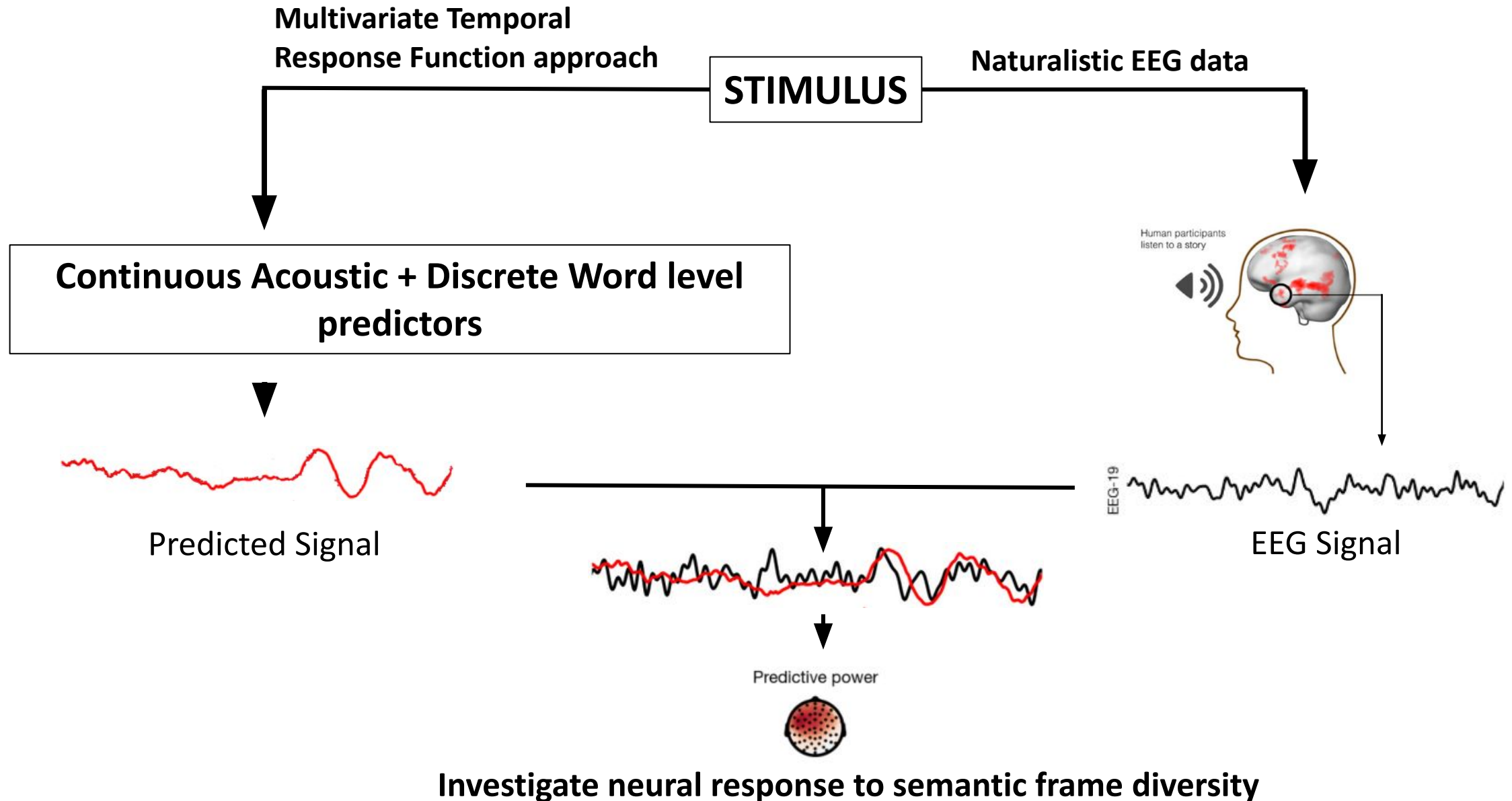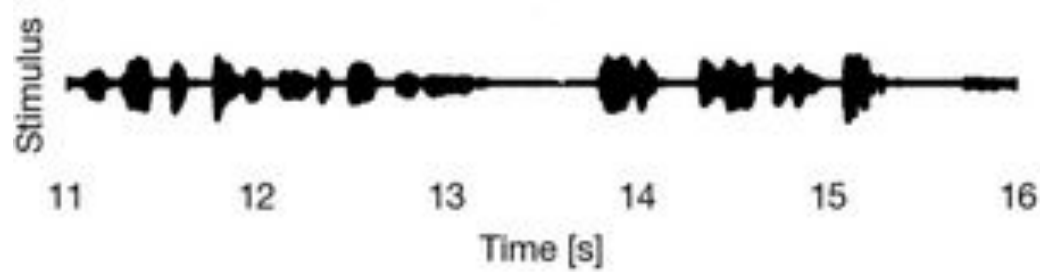
Question:

Can we find neural evidence for the use of semantic frame diversity as a top-down predictive cue during online sentence processing?

Analysis Overview

Multivariate Temporal Response Function approach

STIMULUS

Naturalistic EEG data

Continuous Acoustic + Discrete Word level predictors

Human participants listen to a story

Predicted Signal

EEG-19

EEG Signal

Predictive power

Investigate neural response to semantic frame diversity

Methods

Baseline Model:

Acoustic
+ Word Frequency
+ 5gram Surprisal
+ IsaVerb

VS

Semantic Frame Model:

Acoustic
+ Word Frequency
+ 5gram Surprisal
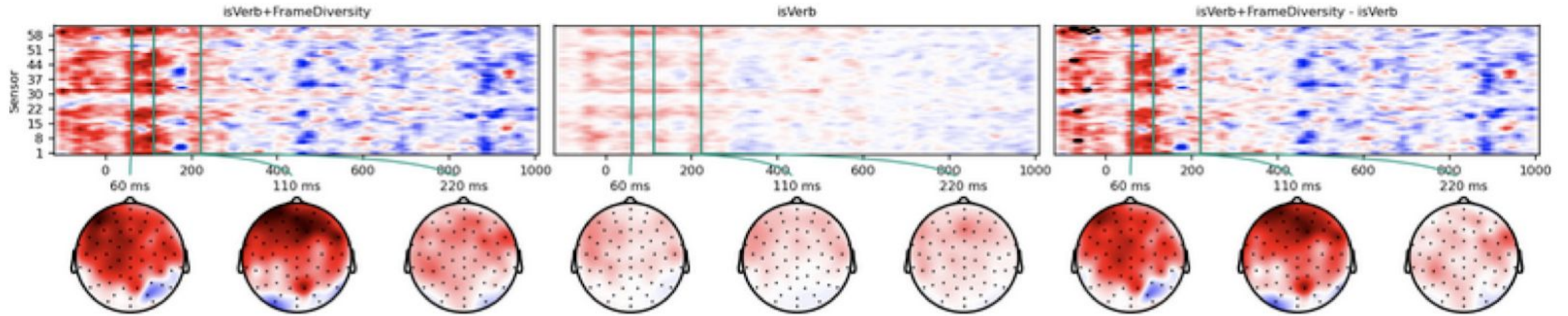+ IsaVerb
+ *Semantic Frame Diversity*

Results

Fig. 1: Topomaps show that the brain responses for frame count predictor differ from the brain responses to the baseline model. Responses were estimated from the TRFs of Model 2. The outlined region is significantly different between the frame count predictor and the baseline based on a mass-univariate related-measures *t-test*.
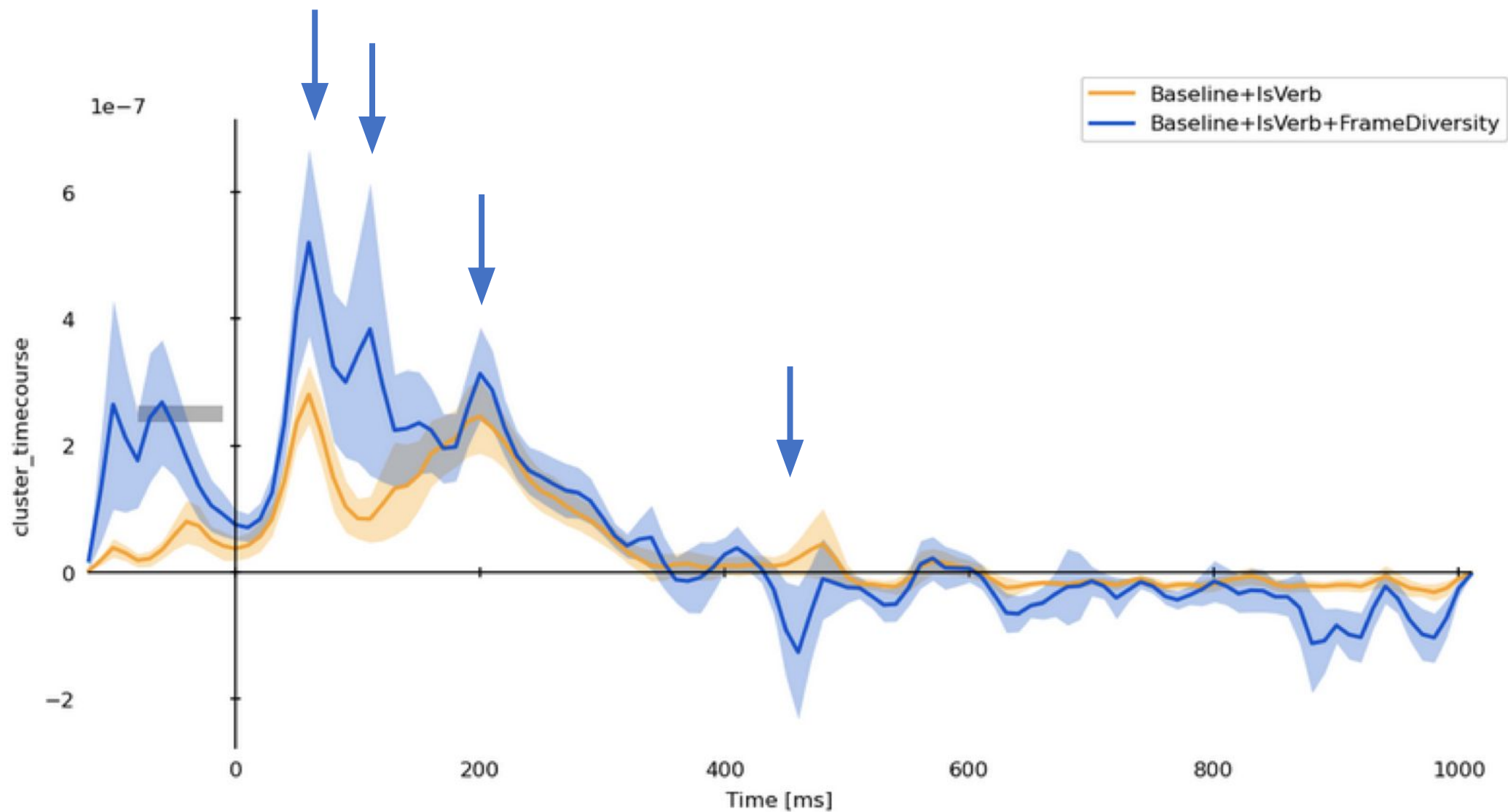
Fig. 2: Magnitude of temporal response functions (TRFs) to frame uncertainty and categorial verb predictor: We observe the average activation (over time) of the sensors that are associated with the clusters of significant difference. There is a peak around 60 ms after the onset of stimulus, followed by a smaller peaks at 150ms and 220 ms, along with a small N400.

Takeaways:

- Implicit knowledge about the semantic frames associated with the verb informs our expectations during sentence processing

    - Higher cognitive load, top-down predictive cue

Thanks 😊

Pipeline

Chapter Text

wonder   go   fall

PropBank Corpus

2   20   6

0.1   1.0   0.3

Prediction Model

Predicted Signal

Stimulus

ALICE IN WONDERLAND
The Original 1865 Edition With Complete Illustrations
By Sir John Tenniel (A Classic Novel of Lewis Carroll)

LEWIS CARROLL

Naturalistic EEG data

Human participants listen to a story

EEG-19

EEG Signal

Predictive power