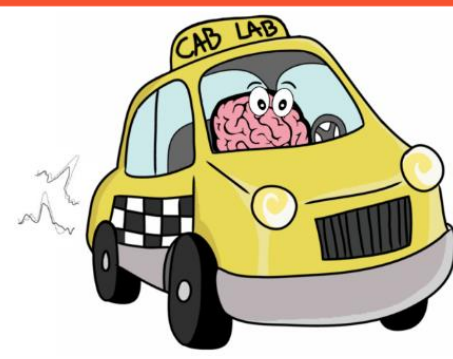# Electrophysiological Changes Across Two Days of Reading – Prediction Updating, or Memory Retrieval?

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Introduction

- When comprehending language, people predict features of upcoming words to facilitate processing
- Unexpected but plausible words elicit different neural responses (ERPs) from semantically anomalous words
- This may reflect updating of predictions vs. a failure to update the event structure (Kuperberg et al., 2020)

Frontal Positivity / **Posterior Positivity**
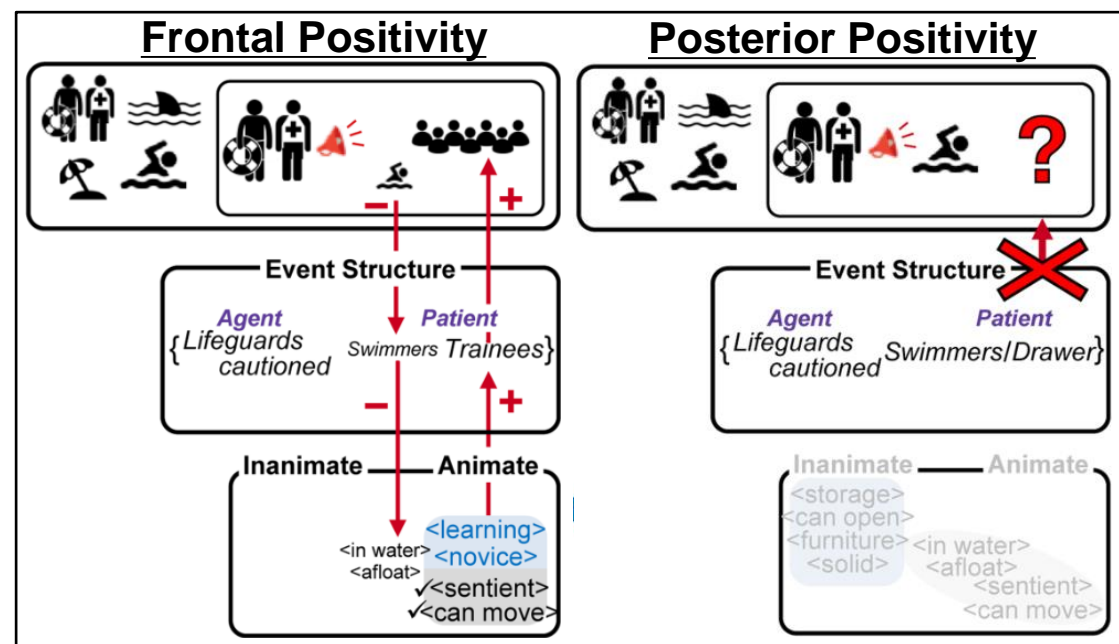
The Present Study

We examined prediction updating in a 2-day reading study, in which participants read sentences with expected or unexpected / anomalous endings (violations) on 2 separate days. We examined changes in ERP responses across days to determine if different types of prediction violations lead to different levels of prediction updating.

Methods

Study Design
- 35 participants
- Read sentences for memory test
- Switch items created by replacing the violating ending with the expected ending
- Recognition memory test on sentence endings on Day 2

EEG Setup
- 26 scalp channels, mastoids reference
- Bandpass filtered, 0.1-20 Hz
- Ocular artifacts corrected w/ ICA
- 200 ms pre-stimulus baseline
- Time-locked to onset of sentence ending word

Day 1 Stimuli

| Strong Constraint, Expected (SCE)	I could not remember his **name**.
Weak Constraint, Expected (WCE)	Tim's friend pushed him into a **pool**.
Strong Constraint, Unexpected (SCU)	He made a holster for his **father**.
Strong Constraint, Anomalous (SCA)	The rude waiter was not given a **cabin**.

Day 2 Stimuli

| SCE, Repeat (SCE)	I could not remember his **name**.
WCE, Repeat (WCE)	Tim's friend pushed him into a **pool**.
SCU, Repeat (SCU)	He made a holster for his **father**.
SCU, Switch (SCU)	He made a holster for his **gun**.
SCA, Repeat (SCA)	The rude waiter was not given a **cabin**.
SCA, Switch (SCA)	The rude waiter was not given a **tip**.

Day 1 ERP Results

Frontal Positivity to Unexpected Endings

SCU – WCE 700-1000 ms
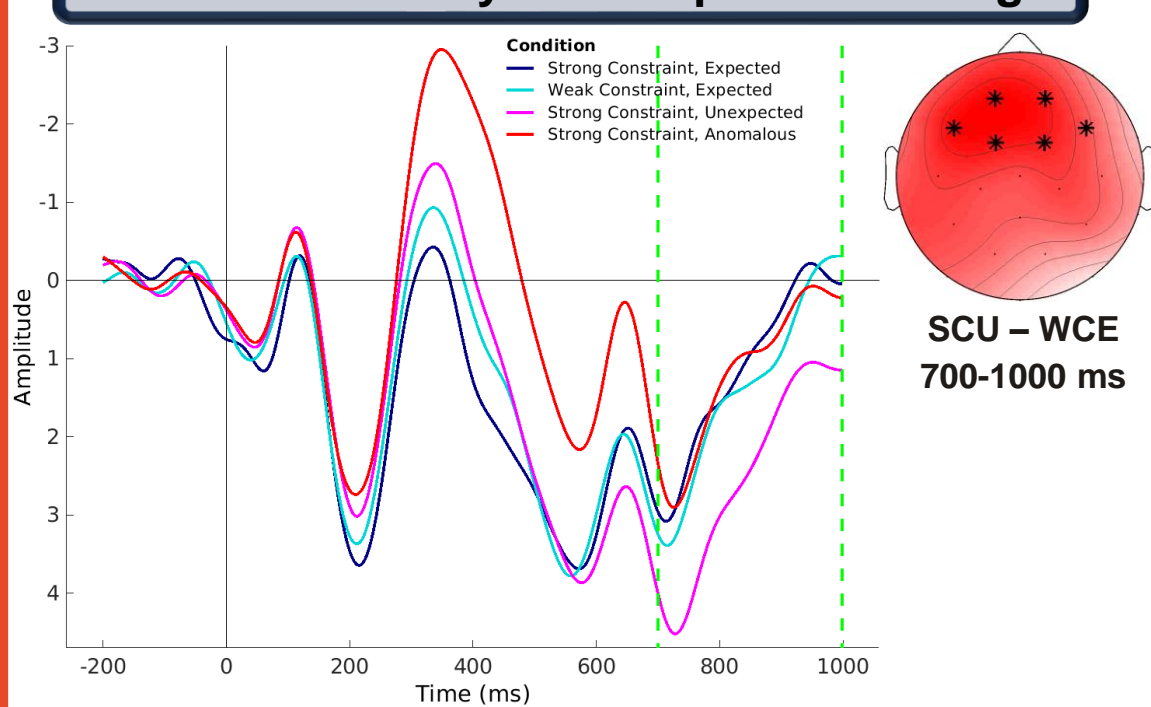
Graded N400 by Predictability

SCA – SCE 250-500 ms
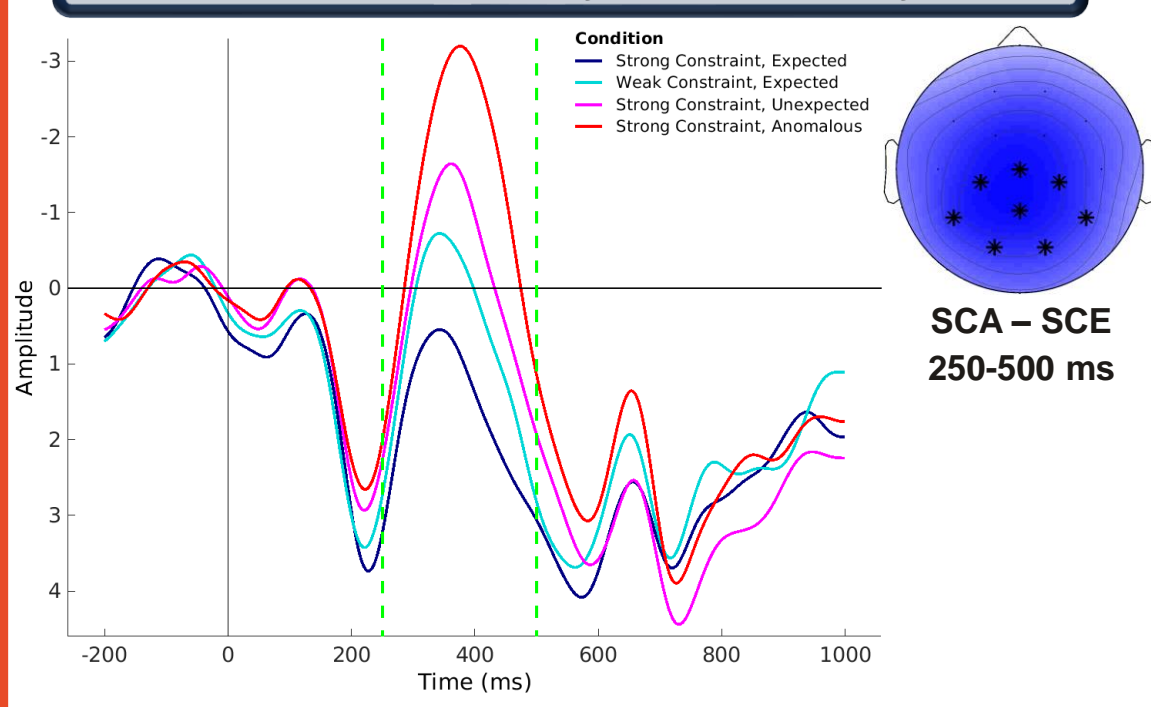
Posterior Positivity to Anomalous Endings

SCA – WCE 600-900 ms
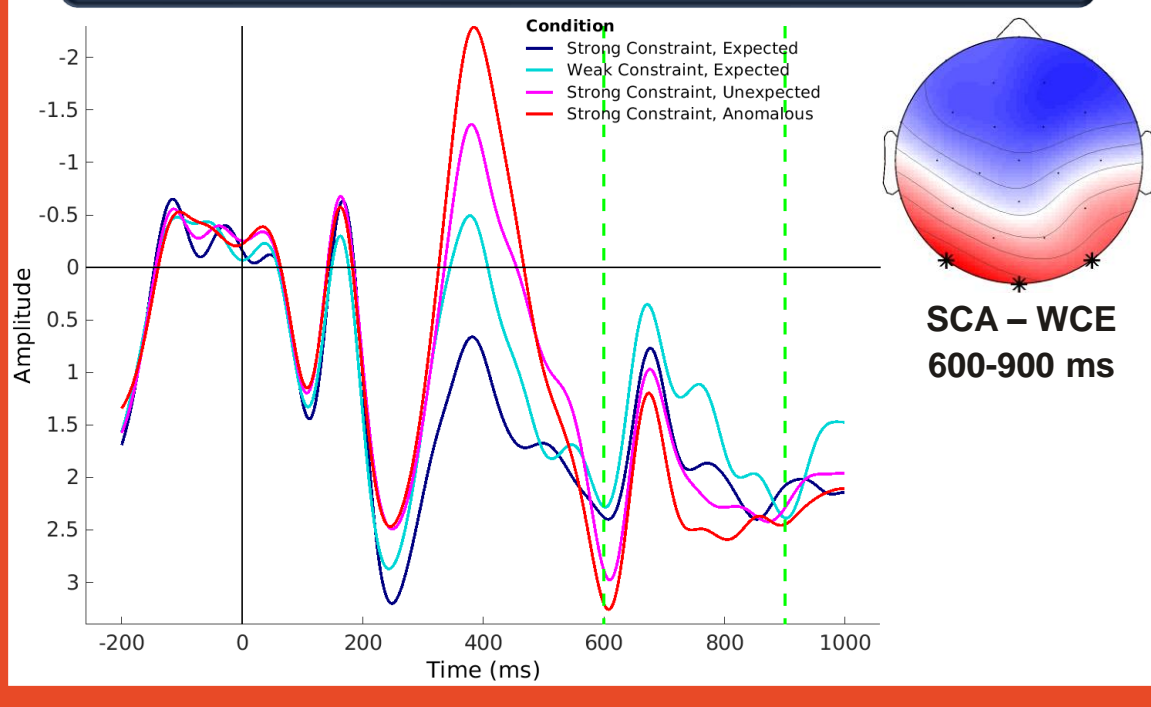
Day 2 ERP Results

ERPs to Repeated Expected Endings

SCE Day 2 – Day 1 500-800 ms   **WCE Day 2 – Day 1 500-800 ms**
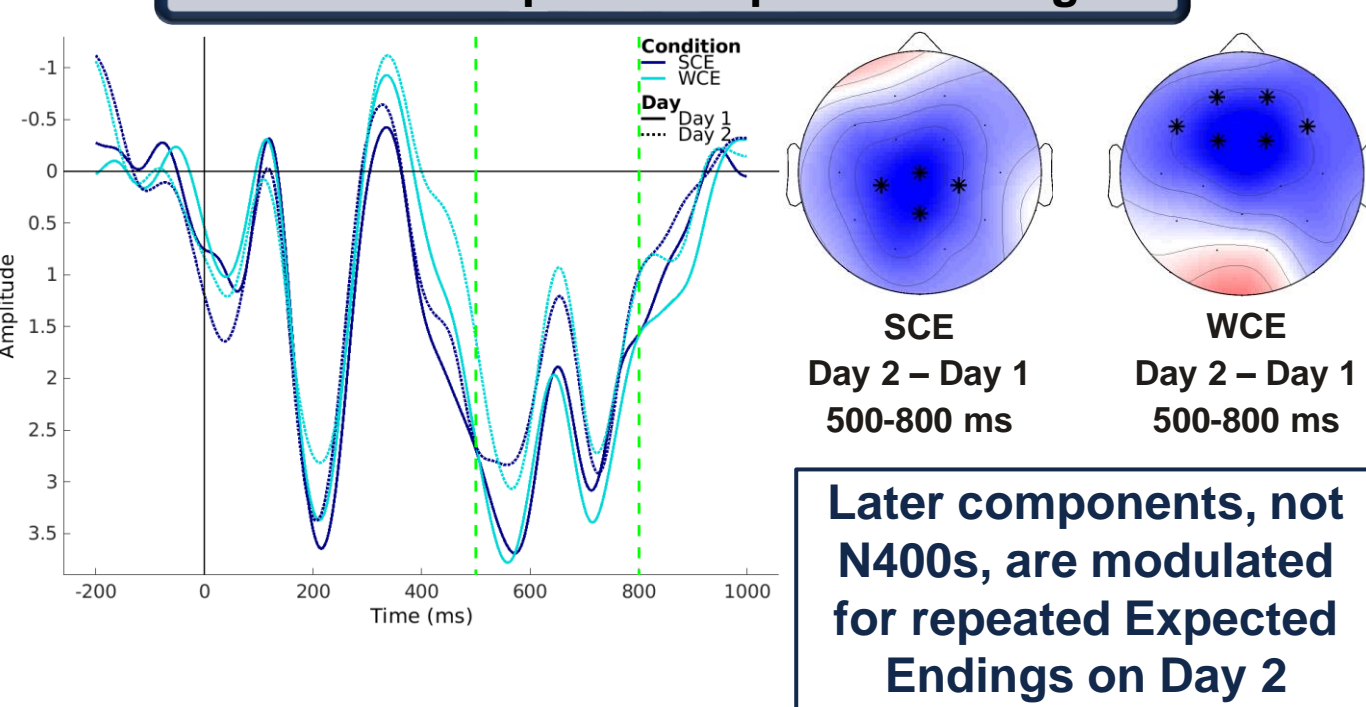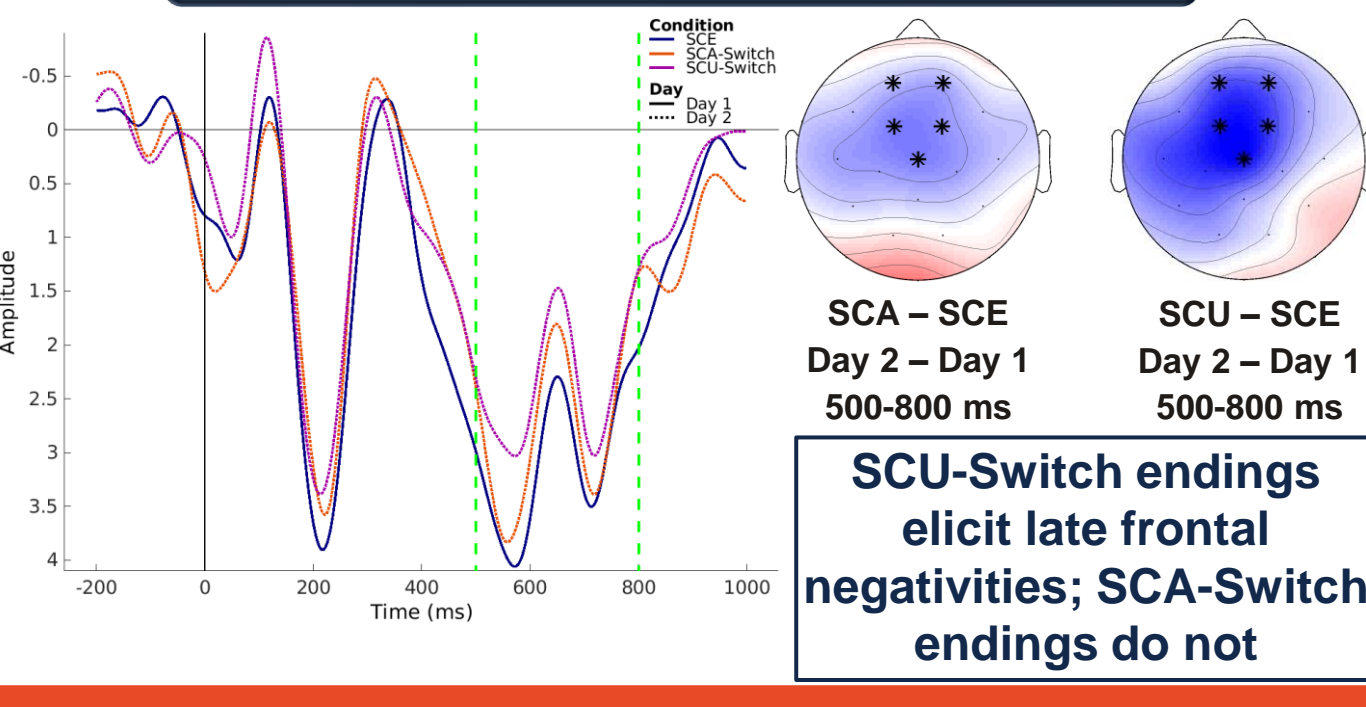
Later components, not N400s, are modulated for repeated Expected Endings on Day 2

ERPs to Repeated Violations

SCA Day 2 – Day 1 250-500 ms   **SCU Day 2 – Day 1 700-1000 ms**
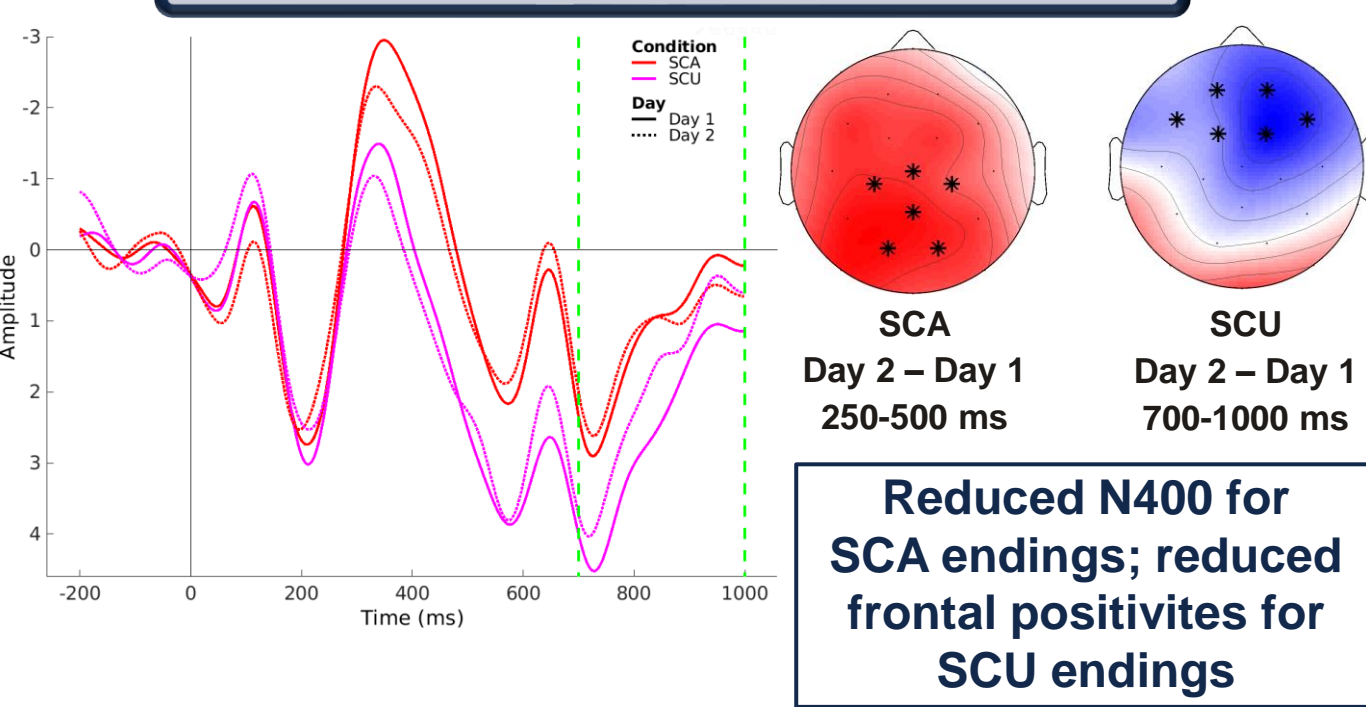
Reduced N400 for SCA endings; reduced frontal positivites for SCU endings

ERPs to Violation Switch Endings
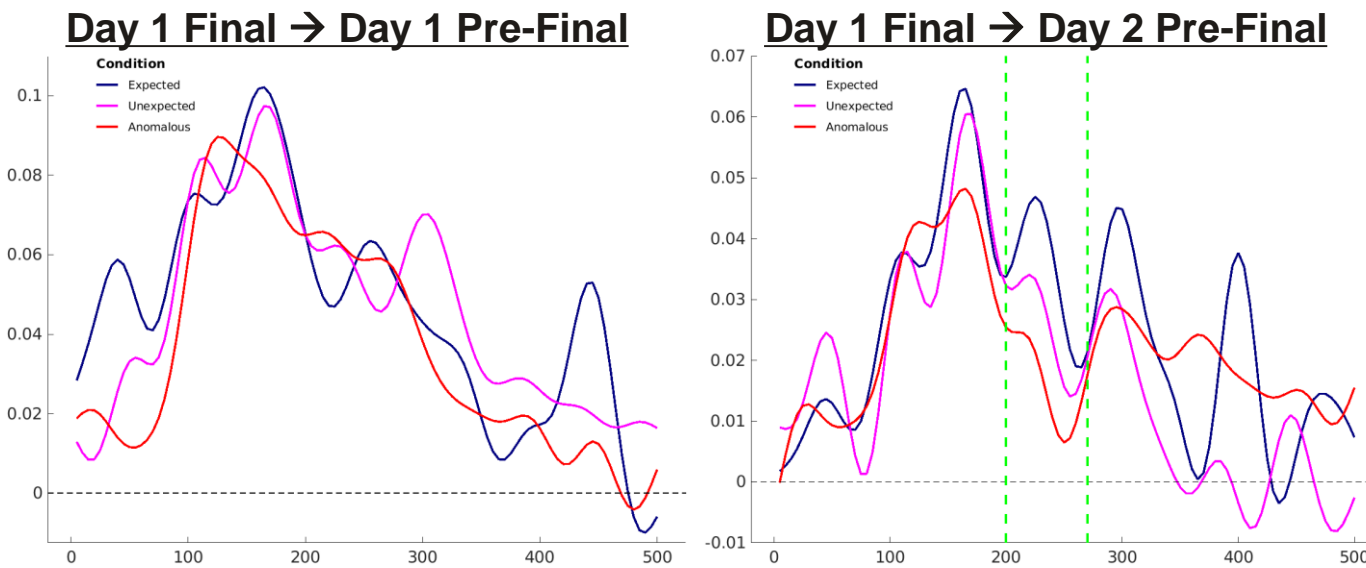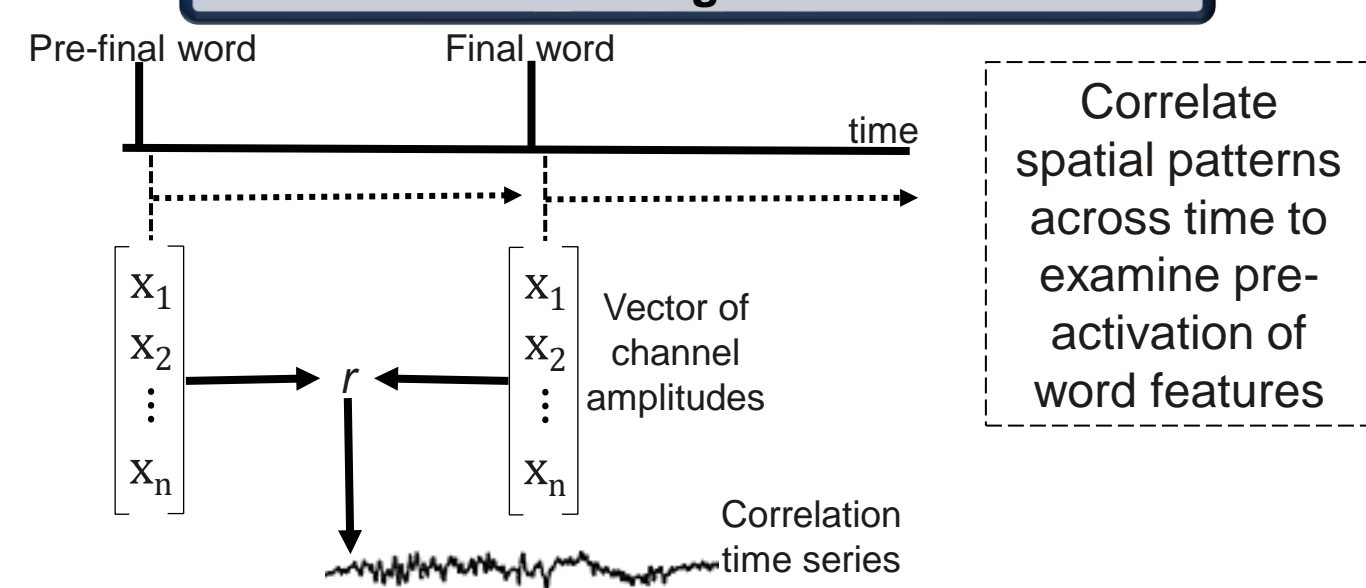

SCA – SCE Day 2 – Day 1 500-800 ms   **SCU – SCE Day 2 – Day 1 500-800 ms**

SCU-Switch endings elicit late frontal negativities; SCA-Switch endings do not

Day 2 RSA Results

RSA Examining Pre-Activation

Correlate spatial patterns across time to examine pre-activation of word features

Day 1 Final → Day 1 Pre-Final   **Day 1 Final → Day 2 Pre-Final**

Greater neural similarity for Expected Endings
Pattern of neural similarity did not change across days for prediction violations

RSA of Repeated Endings
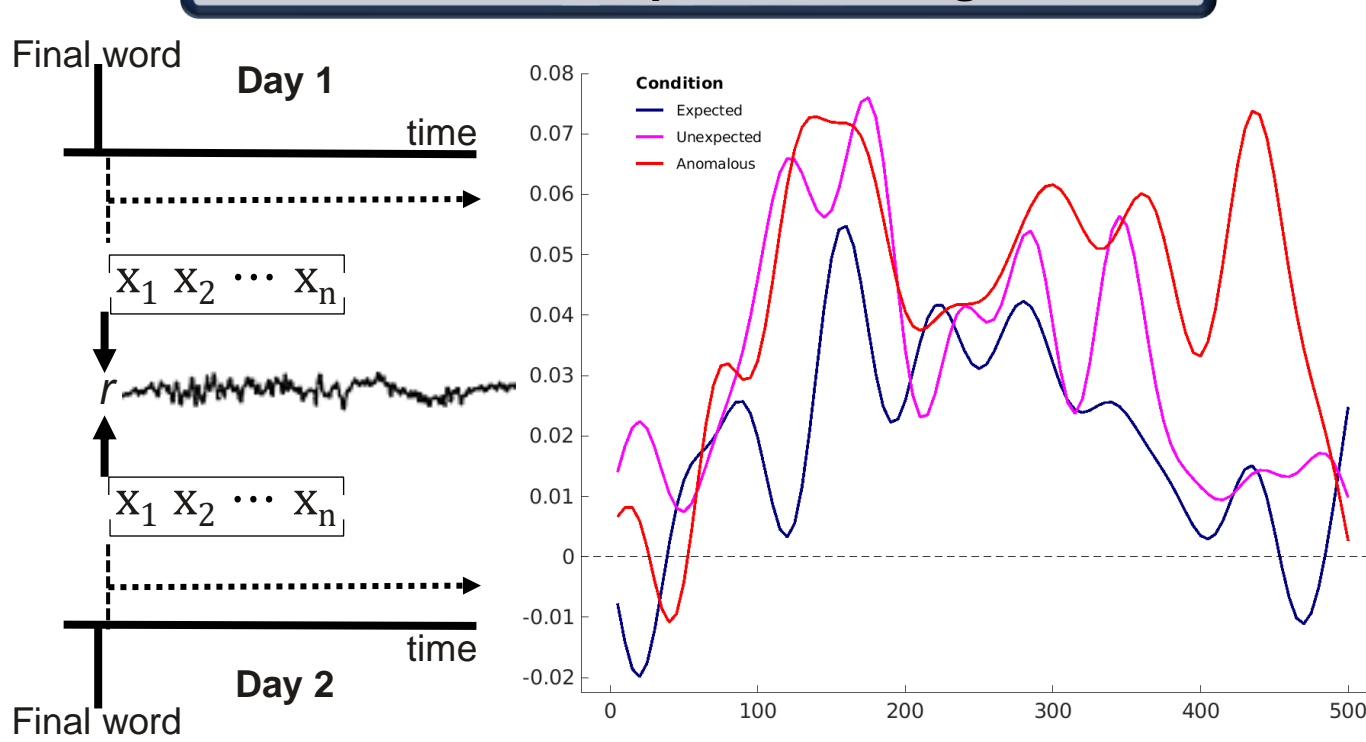
Reduced similarity across days for Expected Endings
Pattern of neural similarity did not largely differ for prediction violations

Conclusions

- Expected endings to on Day 2 did not elicit reduced N400 amplitudes, but later responses were modulated, potentially more in line with memory for the words rather than prediction
- Repeated anomalous endings elicited reduced N400s, whereas repeated unexpected endings elicited reduced frontal positivity responses; potentially some reduction in revision specifically for unexpected endings
- Only SCU-Switch endings elicited a frontal negativity response, similar to effects observed when reinterpretation is necessary; more evidence of revision specifically for unexpected endings
- Results from RSA were inconsistent with a change in predictive pre-activation of words that were previously unexpected; however, later processes, potentially reflecting memory or revision, could differ

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