# Alpha power reflects prediction differences in learning of nouns and verbs

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## BACKGROUND

Academic success is contingent upon the ability to learn new words. Prediction, or the expectation of upcoming information, aids the word learning process because the continual stream of semantic information integrated during sentence processing can be used in an anticipatory manner to determine the most likely meaning of a novel word even before it is encountered (1).

Studies investigating changes in oscillatory dynamics have identified alpha power changes as having a role in prediction (2), but have yet to investigate the role of predictive alpha in word learning. Additionally, studies have investigated the role of theta in semantic retrieval and integration during sentence processing (3), but have yet to determine the role of prediction in semantic retrieval of novel words.

## PURPOSE

**The current study addresses this gap in the literature by using electroencephalography (EEG) to investigate how changes in oscillatory dynamics reflect prediction differences in semantic retrieval of nouns and verbs during word learning.**

## METHODS

### Participants.

Thirty-eight right-handed, monolingual, English-speaking adults, ages 18-31 years (10 male; *M*age=23.6, *SD*=4.7)

### EEG Equipment.

Neuroscan EEG System, 62 electrode cap

### Methods.

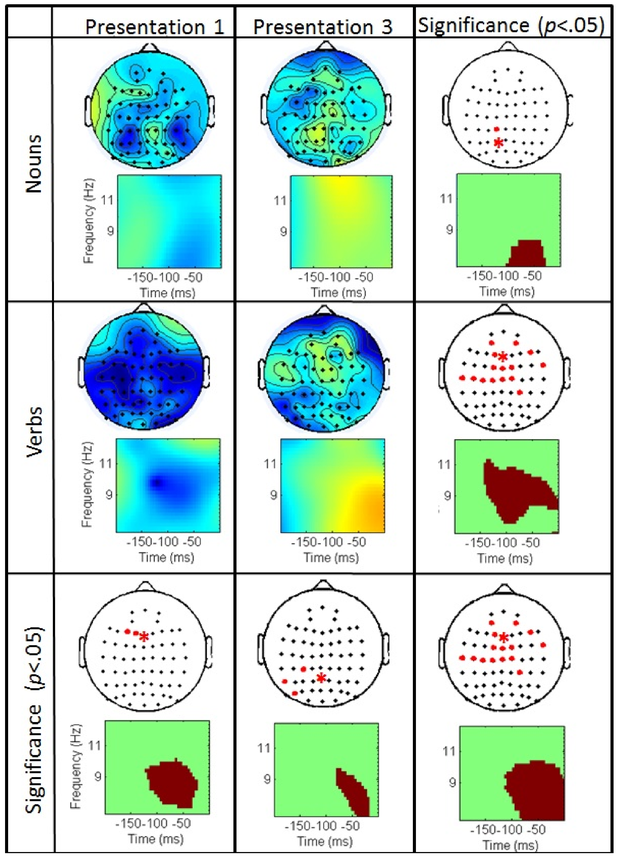
- Read sentence triplets that replaced the final word with a nonsense word.
- Average cloze probability (CP) increased across the triplet (*M*CP=4.08%, 41.15%, 81.03%, respectively).
- Following each triplet participants responded if they thought the nonsense word represented a real word, and if so, what that real word was.

## EXAMPLE STIMULI

| NOUNS | VERBS |
|---|---|
| Be sure to stay out of the THUV. | To do well in school you must DARP. |
| That room gets light from the THUV. | That letter is something you must DARP. |
| Some glasses protect your eyes from the THUV. | Charlotte's Web is my favorite book to DARP. |

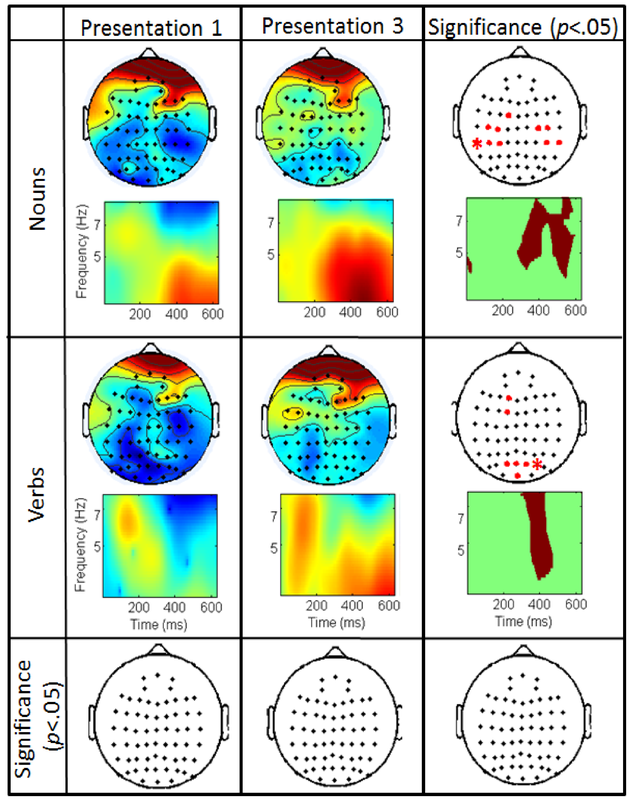
***Only the first presentation (i.e. *Her parents bought her a pav*) and third presentation (i.e. *The girl goes to sleep in her pav*) sentences, correctly responded to, were included in this analysis.

## PREDICTION DIFFERENCES




Alpha power changes during the 200 msec prior to novel word onset. During prediction, alpha power decreased before the onset of the first presentation for both word classes.

## WORD PROCESSING DIFFERENCES




Theta power changes from 300-500 msec after novel word onset. During word learning, theta power increased from the first to third presentation, regardless of word class; however, nouns demonstrated more widespread theta increases than verbs.

## ANALYSIS

- EEG data were cleaned and epoched using Neuroscan.
- Data were Fourier transformed, magnitude squared, and normalized to obtain the power spectral density.
- Data were averaged across trials and subjects, and computed using the log power values minus the baseline (4).
- Within EEGLAB, random permutation statistical analysis of the EEG data was performed and *p*-values for both the time and frequency points for each comparison of interest were computed.

## INTERPRETATION

### Prediction

- Changes in alpha are related to differences in the attentional demands required to anticipate an upcoming novel word.
- Verbs require greater attention than nouns.

### Word Processing

- Increases in theta during word learning for the third presentation suggests a supportive context and multiple exposures assist in semantic retrieval and integration of the novel word.

## TAKE HOME MESSAGE

Differences in prediction may contribute to differences in how nouns and verbs are learned, but multiple exposures and a supportive context appear to lead to successful word retrieval and learning.

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