Developmental differences in neural oscillations reveal role of prediction in noun and verb learning

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INTRODUCTION

- Verbs are more difficult to learn than nouns, even throughout adulthood[1-2].
- One reason for this difficulty is that verbs require more linguistic support than nouns due to semantic and syntactic differences[3].
- In adults, differences in alpha have implicated the role of predictability during word learning[4].
- Here, we test if differences in predictability exist in children during learning of nouns and verbs from context.

OBJECTIVE

Examine neural oscillatory dynamics using electroencephalography (EEG) in school-aged children to investigate the role prediction has upon noun and verb learning from context to better elucidate questions related to verb acquisition.

METHODS

Participants.

Fourteen right-handed, monolingual, English-speaking children ages 9-11 years (M_{age}=10.2, SD=0.8)

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.
- Following each triplet participants responded if they thought the nonsense word represented a real word, and if so, what that real word was.

Frequencies of Interest.

- Lower Alpha (8-9 Hz) power decreases related to attentional processes[5]
- Upper Alpha (10-12 Hz) power decreases related to semantic memory[6]

EXAMPLE STIMULI

NOUN	VERB
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.

BEHAVIORAL RESULTS

A paired samples t-test revealed that children learned significantly fewer verbs than nouns [M_{verb}=59.3%, M_{noun}=81.4%; t(10)=3.52, p=.006]

EEG RESULTS

Analysis: 2 (word class: noun, verb) x 2 (presentation: 1,3) within-subjects ANOVA
Frequency: lower alpha (8-9 Hz) and upper alpha (10-12 Hz) frequencies
Time Window: 200 ms before the onset of the nonsense word to word onset (0 ms)

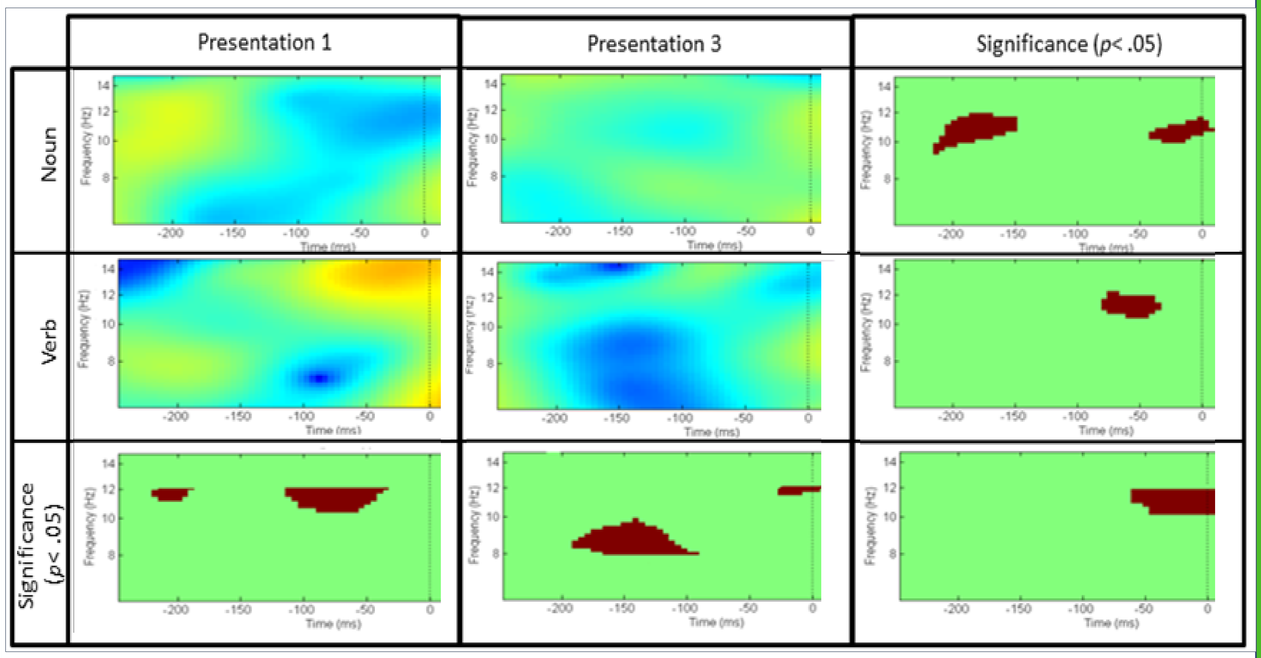

Figure 1. Event Related Spectral Perturbations (ERSPs) within lower (8-9 Hz) and upper (10-12 Hz) alpha at FC1. Increases in power are denoted by yellow/red, while decreases are denoted by blue. Significant differences are indicated by the red clusters in the bottom row and right column.

DISCUSSION

Nouns: Decrease in upper alpha prior to the novel word at presentation one.

Interpretation: Semantic memory was used to make predictions about the upcoming word as early as the first presentation for nouns.

Verbs: Decreases in upper and lower alpha prior to the novel word at presentation three.

Interpretation: Verbs required additional attention (lower alpha decrease), multiple exposures, and increasing linguistic support to make predictions about the upcoming word using semantic memory (upper alpha decrease).

CONCLUSIONS

Learning verbs, compared to nouns, from linguistic context requires additional cognitive and linguistic resources for school aged children, similar to previous findings with adults.

Based on these findings, it appears that there are word class differences in attention and semantic memory when making predictions during word learning.

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