What Neural Processes Support Word Learning in School-Aged Children?

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INTRODUCTION

Word learning from context (WLfC)
- Using the surrounding language to determine a novel word's meaning[1]
- Incremental process, with increased lexicalization occurring with multiple exposures to the word
- How children learn most of their new words starting in elementary school[1,2]
- Typically assessed using behavioral measures, which assess the final stage of learning but not the *process* of word learning

Purpose

Examine the neural processes underlying WLfC in typically developing school-age children by collecting EEG data as children complete a WLfC task

METHODS

Participants
- 7 typically-developing children, M_{AGE}=9;4
- Inclusion criteria: right handed, monolingual English, no history of neurological disorders, significant neurological history, or language or learning disability
- Standardized assessments within normal limits, *M*(SD): WISC nonverbal 101.6 (6.6); CELF 107.1 (9.4); PPVT 111.4 (10.9); EVT 107.6 (9.4)

EEG Analysis
- ERP
  - Data epoched -100-1000 msec around the target word
  - Voltage maps plotted to show change between sentences
- ERSP:
  - Data epoched -500-1000 msec around the target word
  - Data Fourier transformed, magnitude squared, and normalized
  - Power spectrum data averaged across trials and subjects and computed using the log power values minus the baseline
  - Statistical significance (p<0.05) determined using random permutation statistical analysis
  - Only statistically significant clusters of 3 or more electrodes were considered in interpretations

WLfc task

Stimuli
- Sentence triplets with target word in sentence-final position
- 2 conditions: Meaning, No Meaning

Procedure
- Auditory presentation
- Test question following each triplet: *Is there a meaning for the novel word? If so, what is it?*

Table 1. WLfC task example stimuli

Conditions (50 triplets each)	Sent #	Example triplet (target in italics)
Meaning sentence triplet supports the target word's meaning	1	Her parents bought her a *chut.*
	2	The sick child spent the day in his *chut.*
	3	Mom piled the pillows on the *chut.*
No Meaning sentence triplet does not provide support for learning the target word's meaning	1	His favorite toy of all time is the *vik.*
	2	He had a lot of food on his *vik.*
	3	Before bed, I have to take a *vik.*

RESULTS

Behavioral: **Meaning**: 73.4% (SD=4.5%); **No Meaning**: 78% (SD=12.9%)

Figure 1. ERP (A) voltage maps and (B) waveforms representing N400 change in the Meaning condition

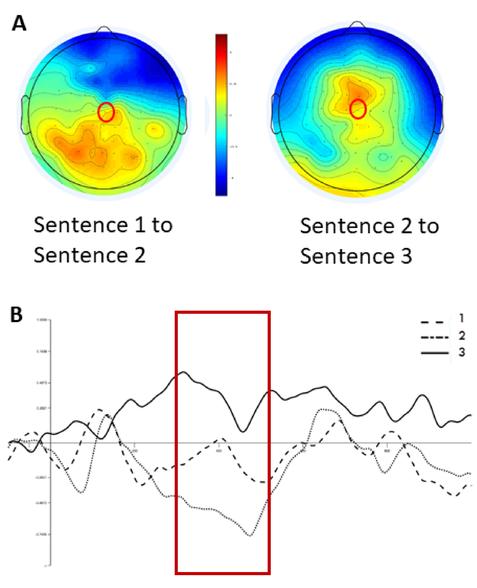
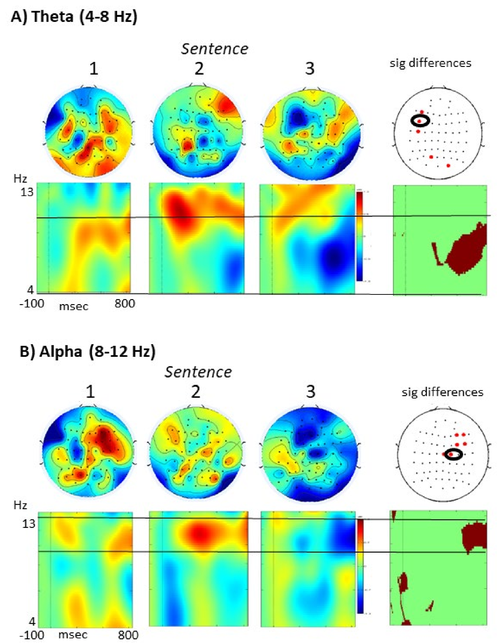


Figure 2. ERSP engagement of (A) theta and (B) alpha in the Meaning condition, **synchrony** and **desynchrony**



FINDINGS

Behavioral
- Participants were successfully able to learn words in our experimental WLfC task

ERP
- The N400 amplitude to the novel word attenuated across exposures in the Meaning condition
  - Suggests engagement of semantic processing during word learning when contextual support for the word's meaning is available

ERSP
- Differences in patterns of oscillatory engagement across exposures to the novel word in the Meaning condition
  - Theta synchrony was followed by alpha synchrony then alpha and theta desynchrony
  - Suggests differential engagement of lexical retrieval[3-5], inhibition[6], and attention[7] during the course of WLfC.

CONCLUSIONS

School-age children appear to draw on multiple processes at different times during word learning. These findings have implications for our understanding of how children approach the task of word learning.

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Acknowledgments: *This study was funded in part by the SDSU University Grants Program awarded to AA. Thank you to participants as well as members of the Language Learning Lab for their assistance with data collection and data analysis.*