Surrounding linguistic context influences the role of neural oscillations underlying word learning

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INTRODUCTION

- Adult vocabulary is typically acquired by using surrounding linguistic information to determine the meaning of a word - *word learning from context*[1]
- Success in learning is influenced by whether the surrounding linguistic context provides support for the word's meaning
- The majority of EEG research focusing on word learning from context only takes into account the word being learned, not the surrounding linguistic information[2]
- Frequency bands associated with linguistic and cognitive processes are potentially related with word learning from context

PURPOSE

Examine the neural and cognitive processes as one reads sentences that support word learning from context

METHODS

Participants

- 14 adults, college students

Equipment

- Neuroscan 62-electrode cap EEG system

EEG Analysis

- Epoched (-500-7000 msec) 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
- Mean baseline power at each electrode and frequency subtracted [3]
- Study design:
  - 2 Condition (Meaning, No meaning) x 3 Sentence (1,2,3) ANOVA
  - Statistical significance ($p < 0.05$) determined using random permutation statistical analysis
  - Statistically significant clusters of 3 or more electrodes were included in the results

STIMULI

Word learning from context task[1]

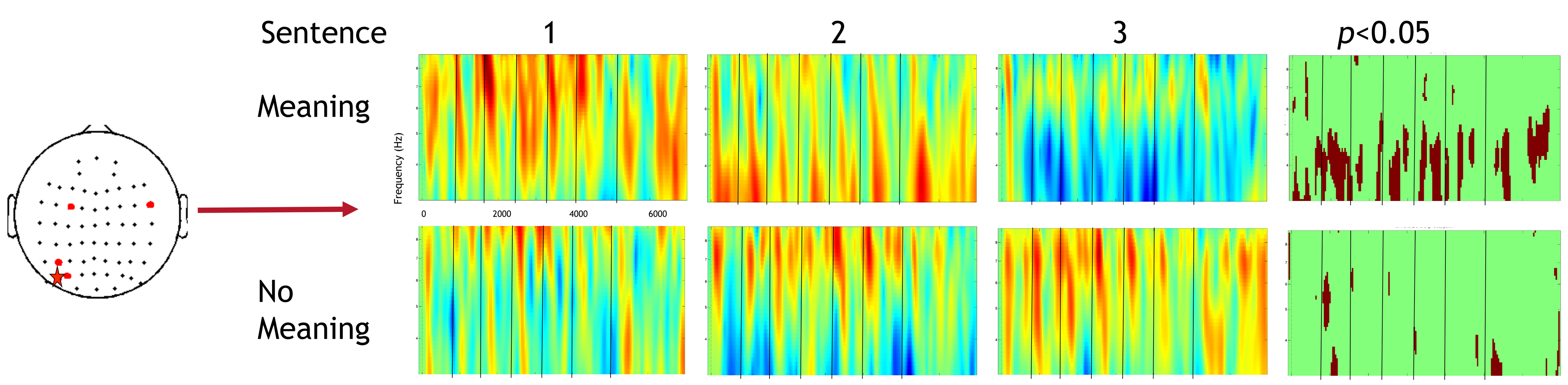
- Sentence triplets
- Target novel word sentence-final
- 7-word sentences
- Sentences presented word-by-word

Word	1	2	3	4	5	6	7
msec	0	800	1600	2400	3200	4000	5100

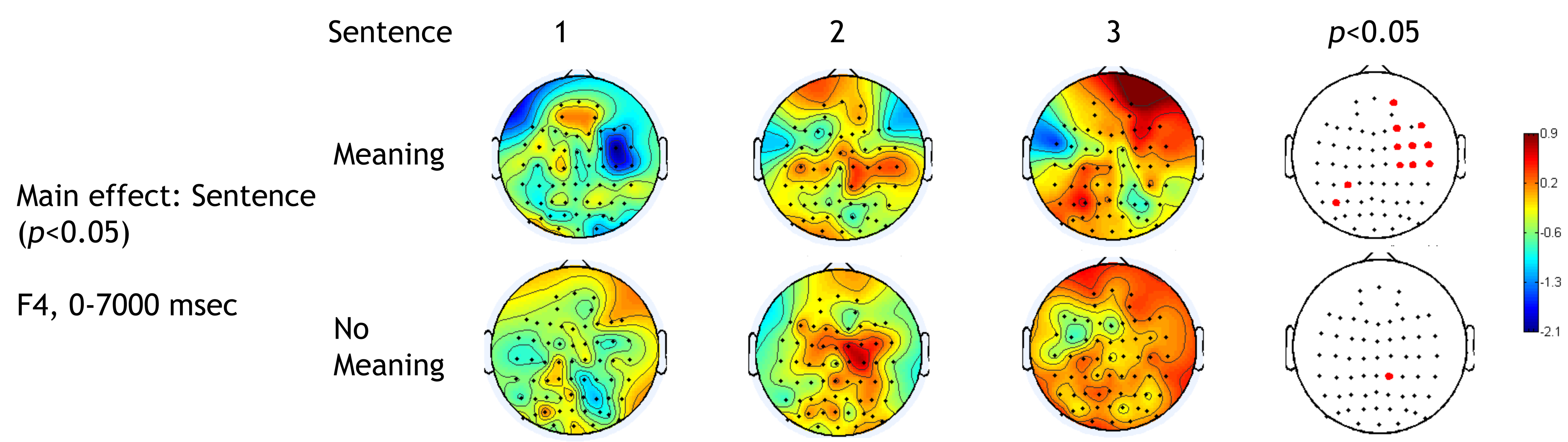
Condition	Sent #	Example sentence triplet (target word in italics)
Meaning	1	Her parents bought her a *chut*.
	2	The sick child spent the day in his *chut*.
	3	Mom piled the pillows on the *chut*.
No Meaning	1	His favorite toy of all time is the *vik*.
	2	He had a lot of food on his *vik*.
	3	Before bed, I have to take a *vik*.

THETA (4-8 Hz)

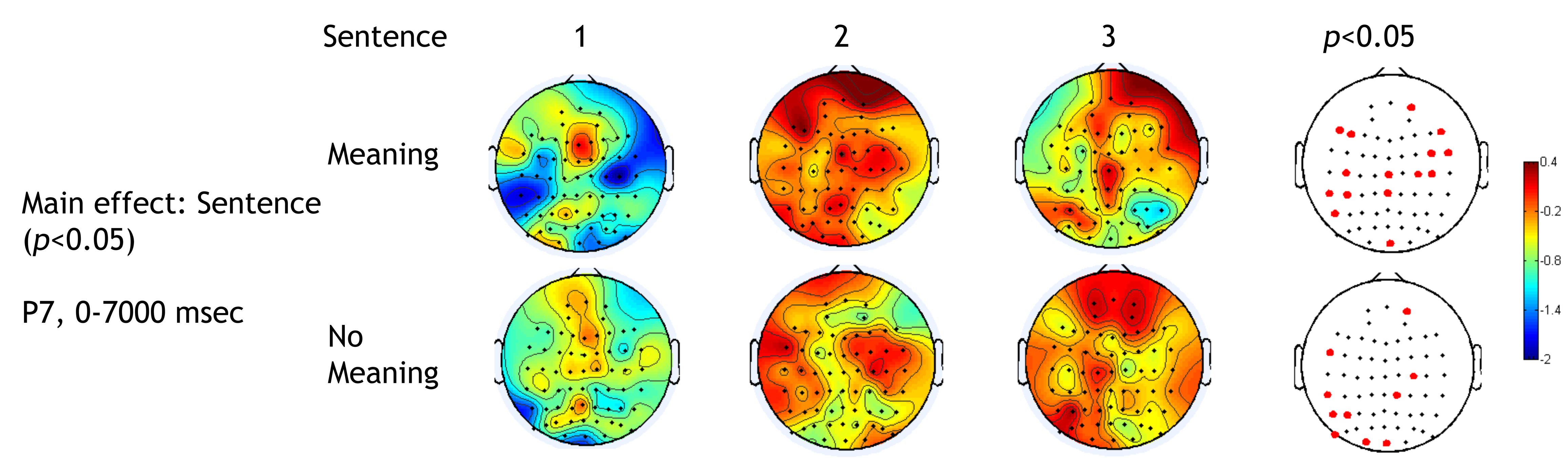
2 Condition (Meaning, No Meaning) x 3 Sentence (1,2,3) interaction ($p<0.05$) PO7, 0-7000 msec



UPPER BETA (20-30 Hz)



GAMMA (30-50 Hz)



FINDINGS

No significant findings in alpha and lower beta

Theta

Findings: Increase with presentation of each word; interaction driven by greater increase during 3rd sentence for No Meaning vs. Meaning

Interpretation: Greater lexical/semantic processing in trying to assign meaning to the novel word [4]

Upper Beta

Findings: Main effect of sentence in Meaning, driven by increase during 3rd sentence

Interpretation: Suggests increased memory demands during verification of the novel word's meaning

Gamma

Findings: Increase during 2nd sentence, consistent across conditions

Interpretation: Active maintenance of sentence stimuli in memory while trying to identify the meaning of the novel word[5,6]

CONCLUSIONS

Early stages of learning (1st and 2nd sentences)

- Presence/absence of contextual support doesn't influence how they approach the task
- Draw similarly on lexical/semantic processing (**theta**) and maintenance (**gamma**)

Final stages of learning (3rd sentence)

- Effect of contextual support
- Engage memory (**upper beta**) more in supportive contexts
- Engage lexical/semantic processing (**theta**) more in non-supportive contexts

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