

Novel visual word learning tracked with FPVS-EEG

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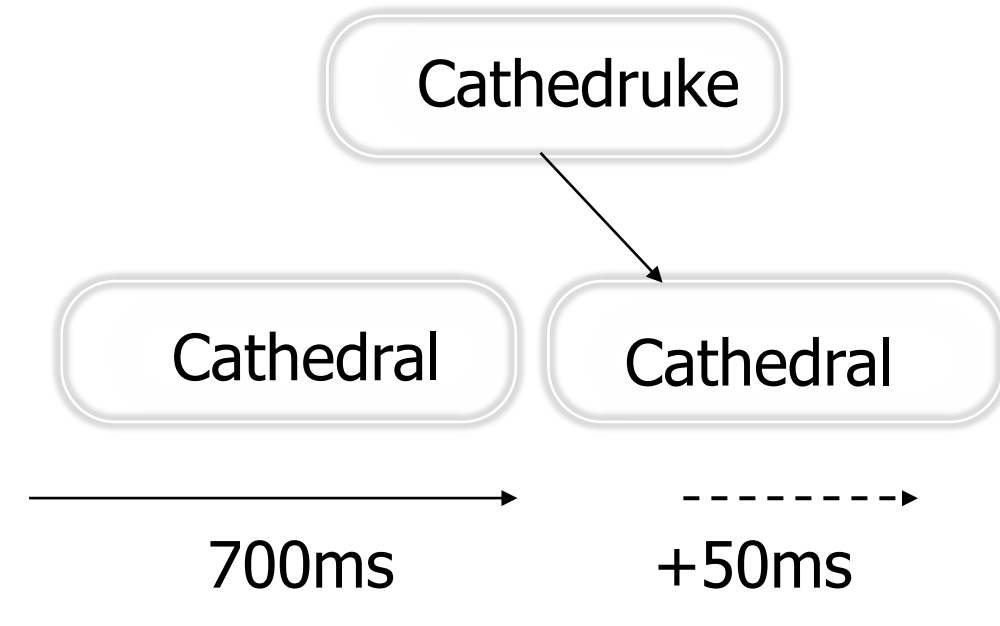
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Introduction

A lexical representation in the **left occipito-temporal cortex** has been shown with the FPVS-EEG approach in a visual word oddball paradigm (Lochy et al., 2015; Lochy et al., 2018).

"If people learn a new word such as cathedruke, the presence of this new word in the mental lexicon should **delay the recognition** of similar existing words such as cathedral through lexical competition" (Gaskell, M. G., & Dumay, N., 2003).

Here we investigate the **emergence of novel word neural** representations with **orthographic** and **semantic** learning methods using FPVS/EEG and lexical decision tasks.

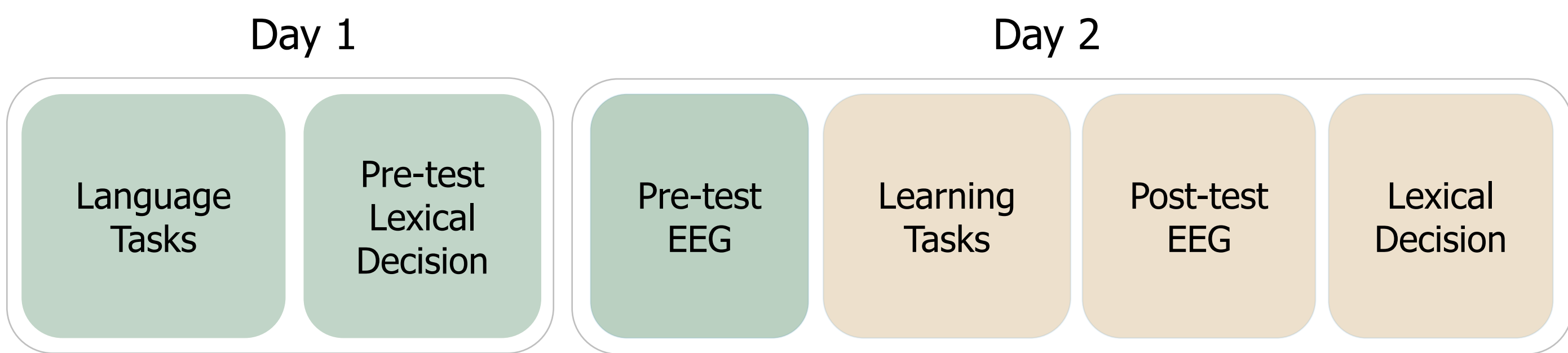


Methods

Design

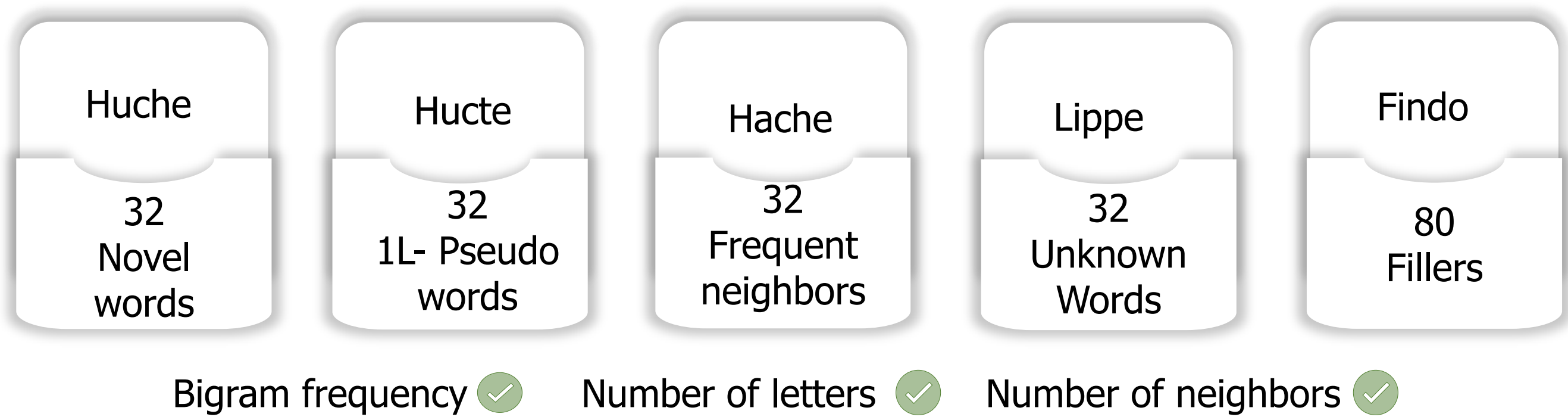
32 right-handed French speakers

32 French words: split in Set A & Set B to vary learning methods within participants (counterbalanced)



Lexical decision task

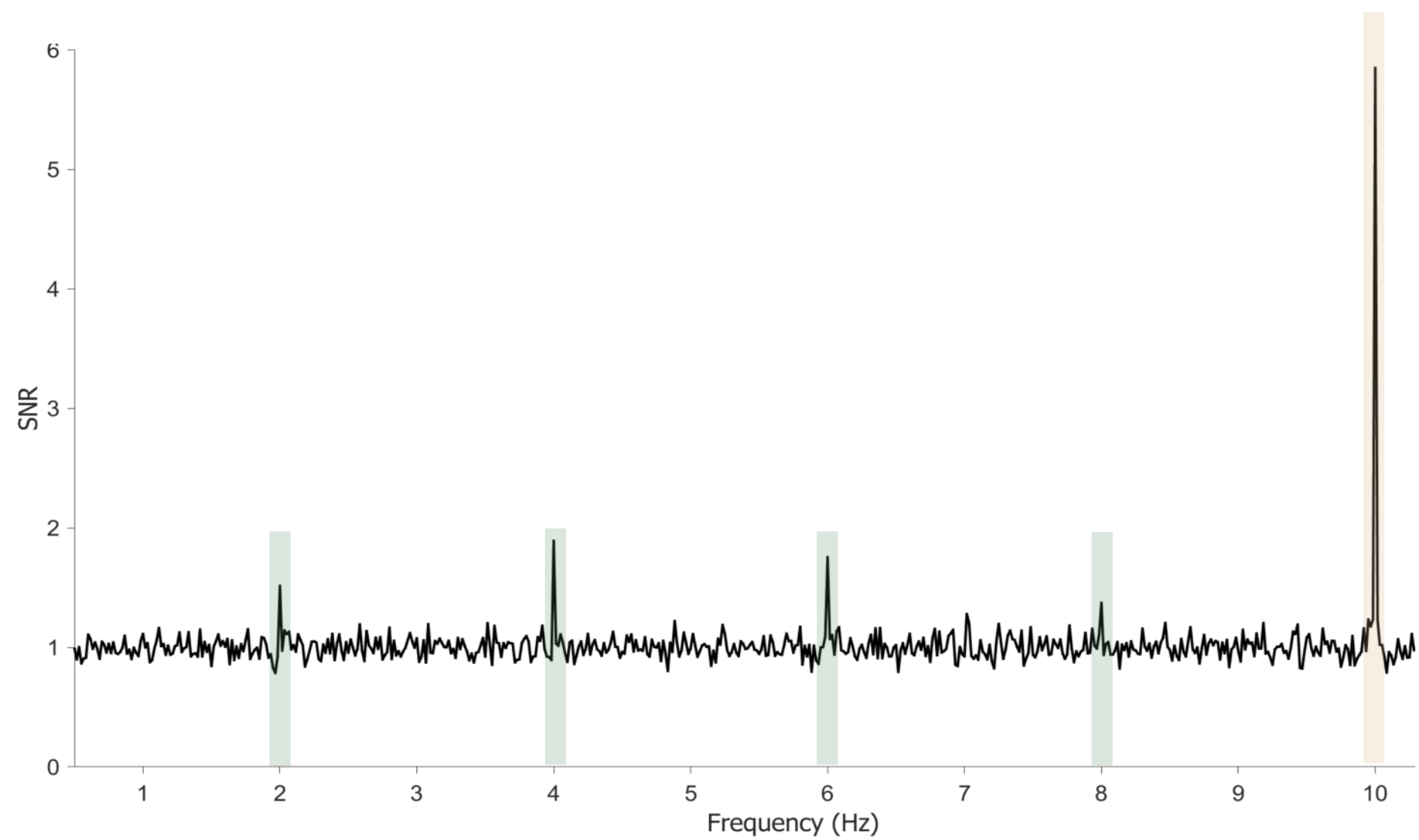
Participants decide as quickly as possible if the letter string presented is a word or not.



Bigram frequency ✓ Number of letters ✓ Number of neighbors ✓

Oddball paradigm (FPVS / EEG)

Type of response:
 • **Base stimulation:** synchronization of the visual system to the periodic stimulation at 10hz
 • **Oddball frequency:** discrimination of words at 2hz among base stimuli at 10hz (pseudo words)

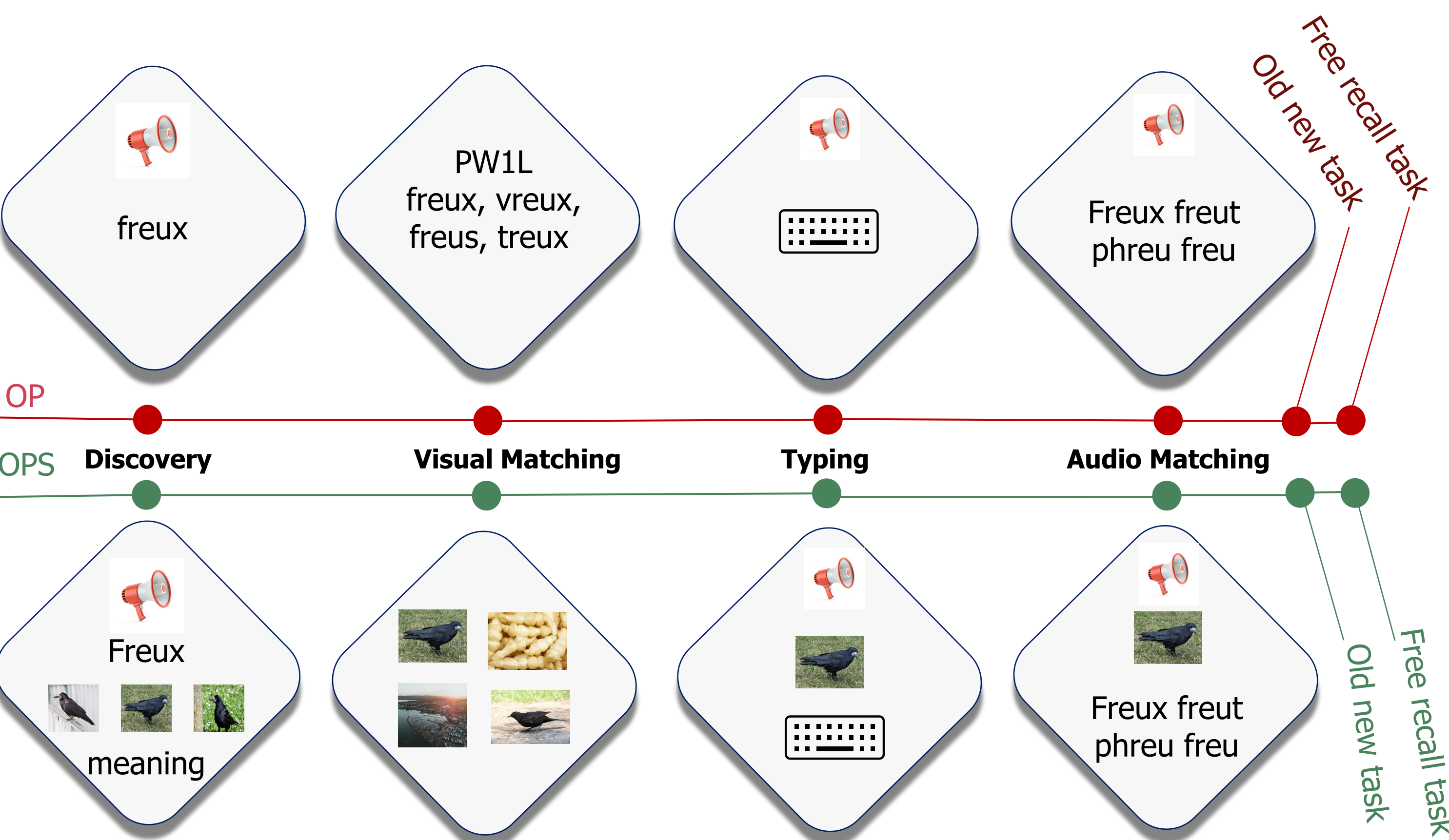


4 Conditions of words embedded in matched pseudo words (PW):

- Novel words method OP
- Novel words method OPS
- Known words
- Unknown words

Learning Task

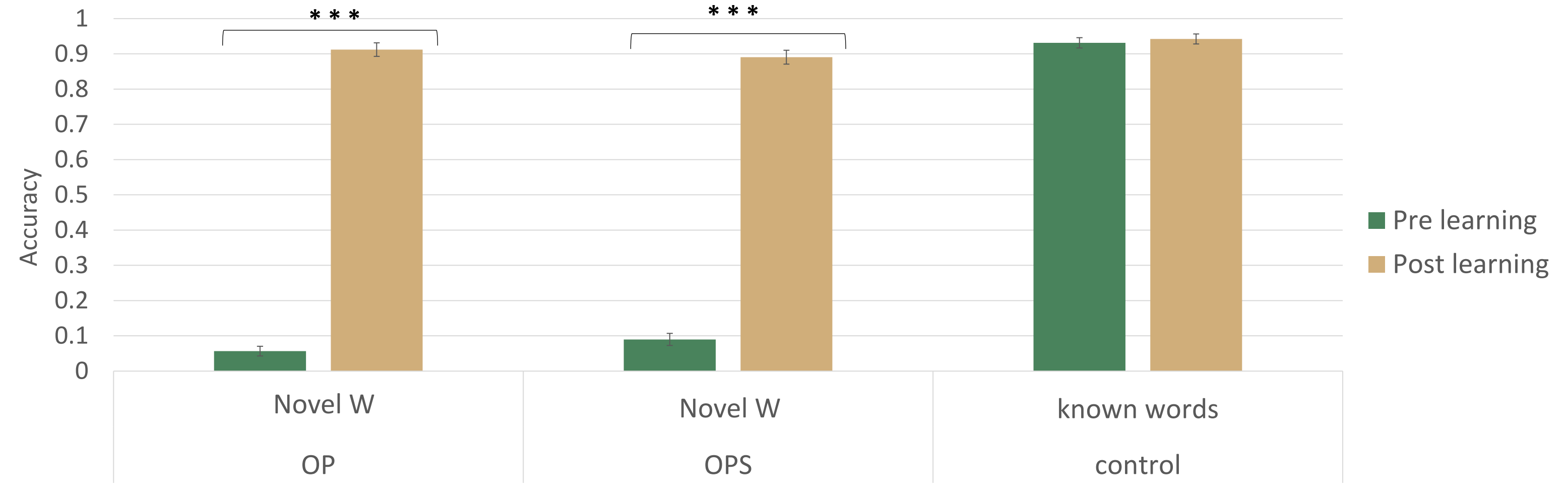
Conditions:
 • 16 words: orthography + phonology of the words are learned (OP) ●
 • 16 words: orthography + phonology + semantics of the words are learned (OPS) ●



Results

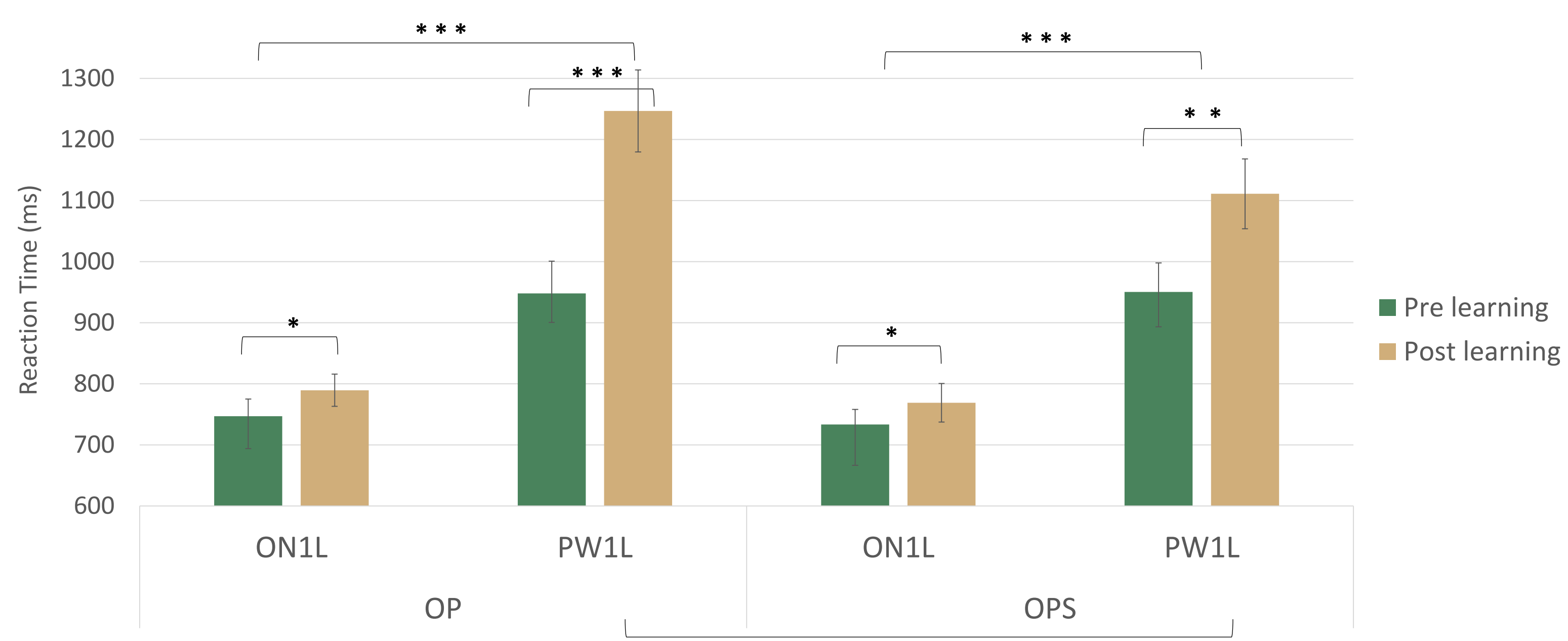
Lexical decision

❖ Average accuracy of words depending of the condition in pre and post test.



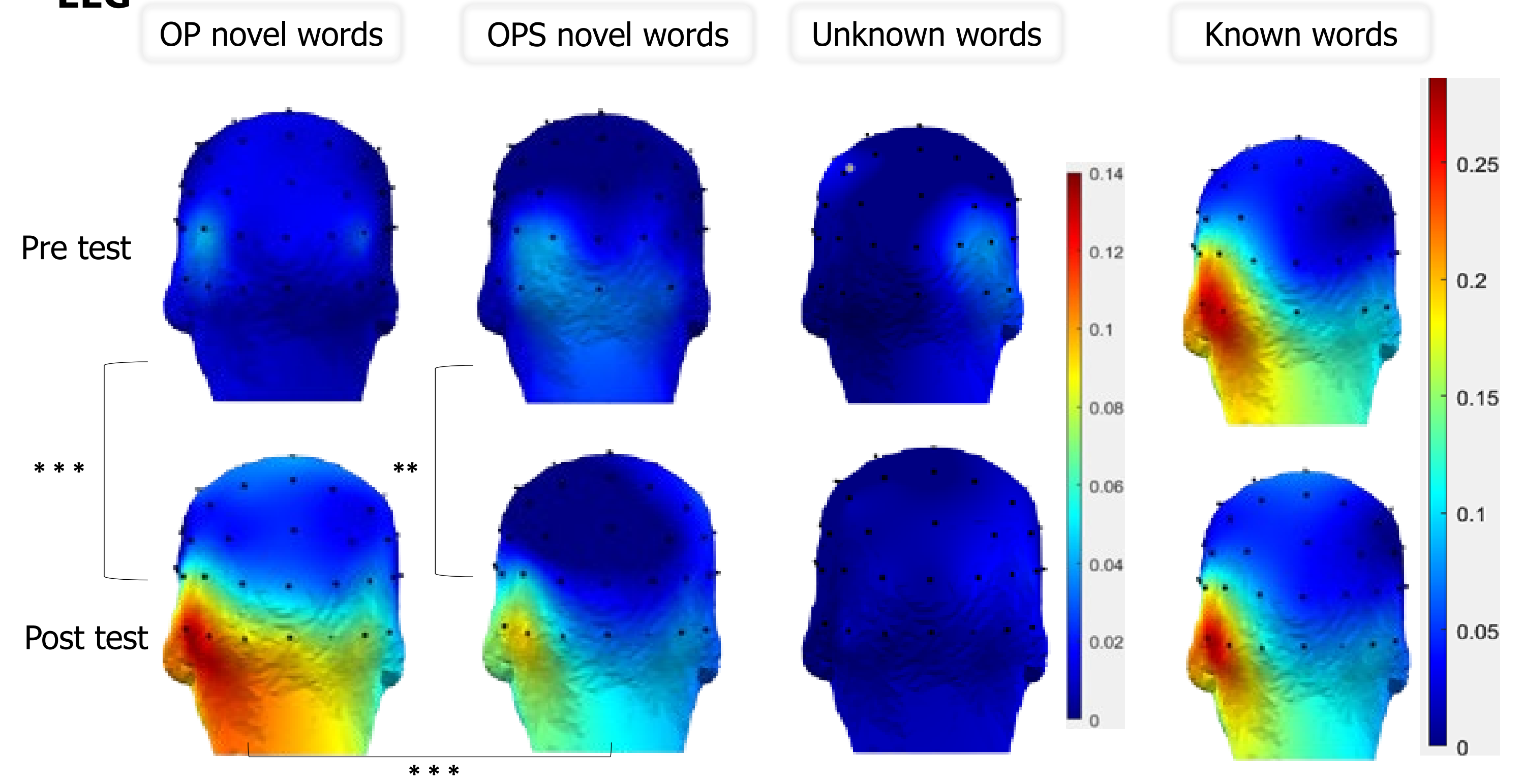
- **Learning Effect:** 7% to 90% for learnt words with no impact of method.
- No effect on control, and no effect of method.

❖ Impact of novel words on average reaction times (RTs) (3 Standards Deviation) of pseudo words (PW1L) and orthographic neighbors (ON1L)



- Main effects of:
 - **Type of stimulus**, with slower RT for PW1L than ON1L
 - **Session**, with slower RTs for both types in post test with both methods
 - **Methods**, with slower RTs for items matched to OP novel words (944ms) than OPS novel words (887ms)
- Triple interaction:
 - Increase of RTs for PW1L is stronger when matched to OP novel words than OPS novel words whereas no difference for the orthographic neighbors.

EEG



• Strong EEG activation in the left occipito-temporal cortex suggests a **rapid integration of the visual word**. However, EEG responses are stronger with the OP than with the OPS method.

Discussion

- Slower reaction times (RTs) on ON1L reveal a **competitive effect** suggesting a lexicalization of new words effect with both methods.
- We have also an interference effect for pseudo words at post-test with both methods but even stronger with the OP method.
- Is it an open question whether this interference effect shows a **new lexicalization of words** or traces of **episodic memory**
- Moreover, slower RTs in a decision lexical task may reflect the **uncertain status** of the new words learned.

References

- Gaskell, M. G., & Dumay, N. (2003). Lexical competition and the acquisition of novel words. *Cognition*, 89(2), 105-132.
- Lochy A, Van Belle G, Rossion B (2015). A robust index of lexical representation in the left occipito-temporal cortex as evidenced by EEG responses to fast periodic visual stimulation. *Neuropsychologia* 66:18-31.
- Lochy, A., Jacques, C., Maillard, L., Colnat-Coubois, S., Rossion, B., & Jonas, J. (2018). Selective visual representation of letters and words in the left ventral occipito-temporal cortex with intracerebral recordings. *Proceedings of the National Academy of Sciences*, 115(32).