

Neurophysiological Correlates of Combining Learning Strategies During Second Language Vocabulary Learning

Nicole H. Skieresz^{1,2,3}, Sandy C. Marca^{1,4}, Thomas P. Reber^{1,5}, Nicolas Rothen¹

¹ Faculty of Psychology, UniDistance Suisse, Brig, Switzerland;

² The LINE (Laboratory for Investigative Neurophysiology), Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland;

³ The Sense Innovation and Research Center, Lausanne and Sion, Switzerland;

⁴ Faculty of Psychology, University of Geneva, Geneva, Switzerland;

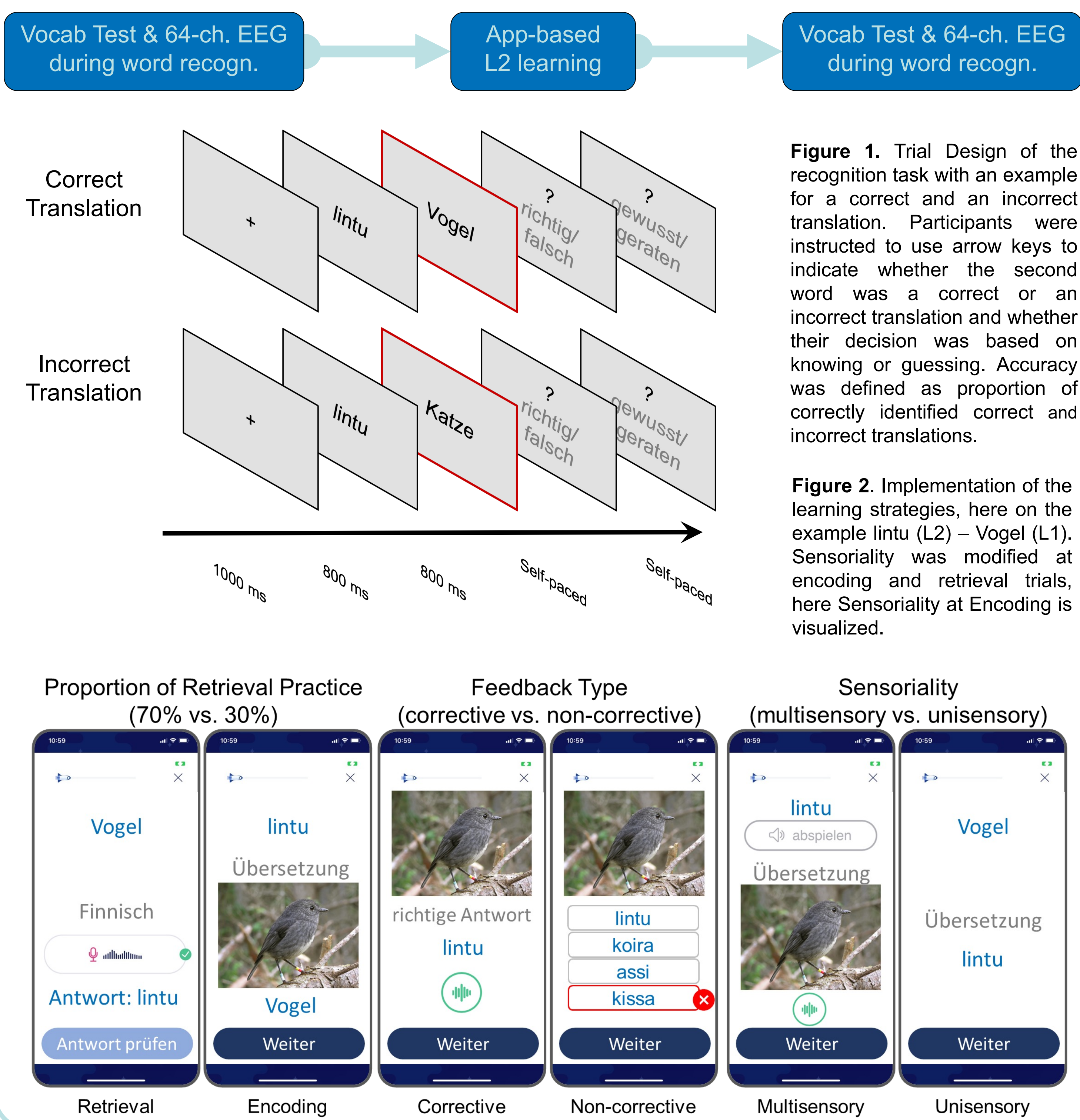
⁵ Department of Epileptology, University of Bonn Medical Center, Bonn 53127, Germany;

✉ nicole.skieresz@fernuni.ch
@n_skieresz

Background

- Various learning strategies, e.g., retrieval practice, corrective feedback, and multisensory learning have proven to be effective in knowledge acquisition.
- Three theoretical viewpoints have been summarized on behavioral performance in a cued recall task when combining a learning strategy with retrieval practice:
 - Complementary view:** there are main effects of both strategies and an additive effect when combining them (Morris et al., 2005)
 - Redundancy view:** there are main effects of both strategies, but no additive effect as multiple cognitive mechanisms have overlapping effects (Fritz et al., 2007)
 - Catalytic view:** there is no testing effect, adding another strategy catalyzes subsequent retrieval (Miyatsu & McDaniel, 2019)
- The N400 can reflect both automatic and controlled lexical-semantic processes, therefore, it is a potential neurophysiological marker of vocabulary learning.
- Research on the interactions between learning strategies, and their neurophysiological correlates has been scarce (Belardi et al., 2021).
- We investigated interactions between learning principles on L2 vocabulary learning and their neurophysiological correlates.

Design



Methods & Processing Pipeline

- N=36 healthy, adult participants ($M_{age} = 28.83$ years; range = 18-40 years; 21 female)
- Stimuli: 48 Finnish (L2) – German/French (L1) translations
- Within-subject factorial design: 2 Proportion of Retrieval Practice × 2 Feedback Type × 2 Sensoriality at Encoding × 2 Sensoriality at Retrieval
- EEG data were downsampled (1000 to 250Hz), filtered, re-referenced to average, epoched -200 to 1500ms around translation onset, pre-stimulus baseline corrected-
- Cluster-based permutation test (CBPT) (Maris & Oostenveld, 2007): dependent-samples T-statistic (channels × time points), cluster-alpha = 0.001, cluster-statistic = maxsum criterion, number of permutations = 1000, alpha = 0.025 (two-sided permutation test)

Conclusions

- The N400 is a neurophysiological correlate for successful L2 vocabulary learning.
- No evidence was gathered for either the complementary, redundancy or catalytic view.
- The N400 showed a dosage dependency of Sensoriality at Encoding. Multisensory encoding was beneficial at low doses, with no reliable differential effect over Unisensory encoding at a higher dose.

Results

- Participants' accuracy on the vocabulary test and recognition task improved significantly after the intervention but was not influenced by learning strategy.
- CBPT revealed an N400 (312-428ms) with a significant cluster of 16 channels at centro-parietal sites after L2 vocabulary learning, not before.
- Mean amplitudes of difference waves (post - pre) of the 16 channels in the significant time window served as dependent variable for a 2x2x2x2x3 ANOVA.
- There was a main effect of Sensoriality at Encoding ($F(1,1647) = 4.23, p < 0.05$), but no main effect of Proportion of Retrieval Practice ($F(1,1647) = 0.22, p > 0.05$).
- There was a significant interaction of Sensoriality at Encoding and Proportion of Retrieval Practice ($F(1,1647) = 4.98, p < 0.05$).

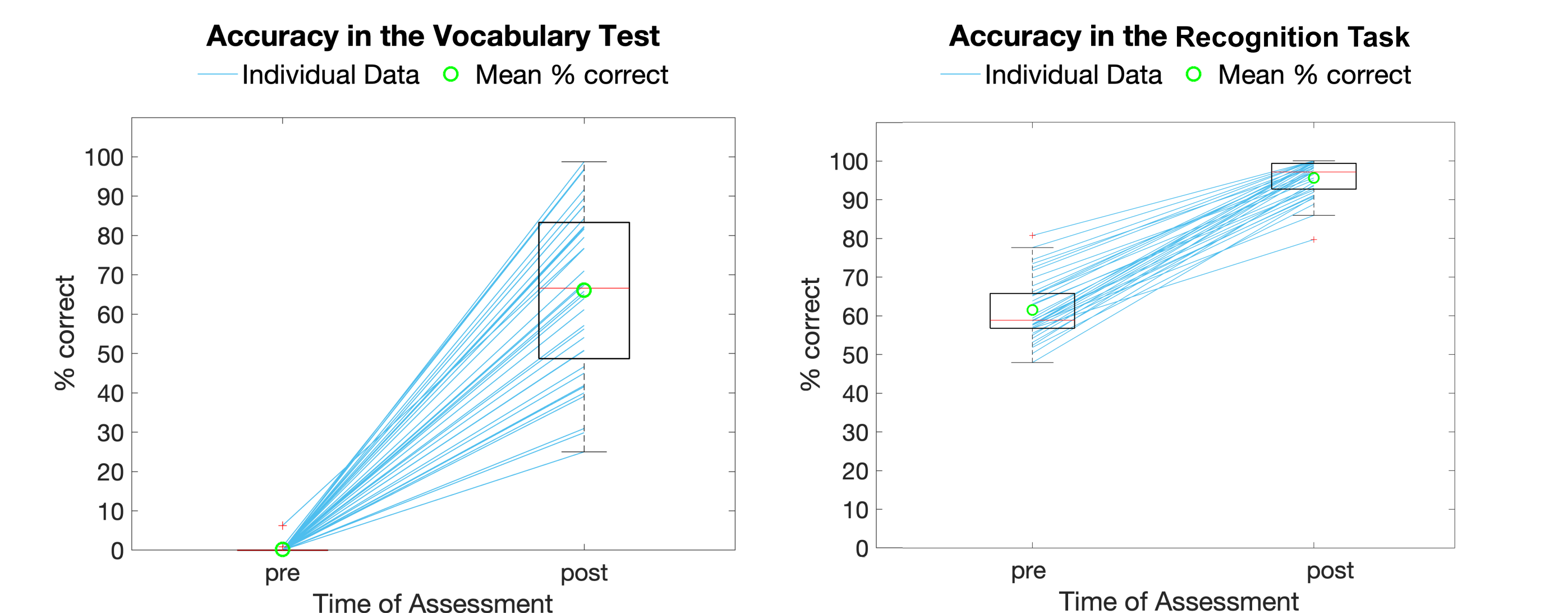


Figure 3. Participants' accuracy in vocabulary test and recognition task before and after app-based L2 learning.

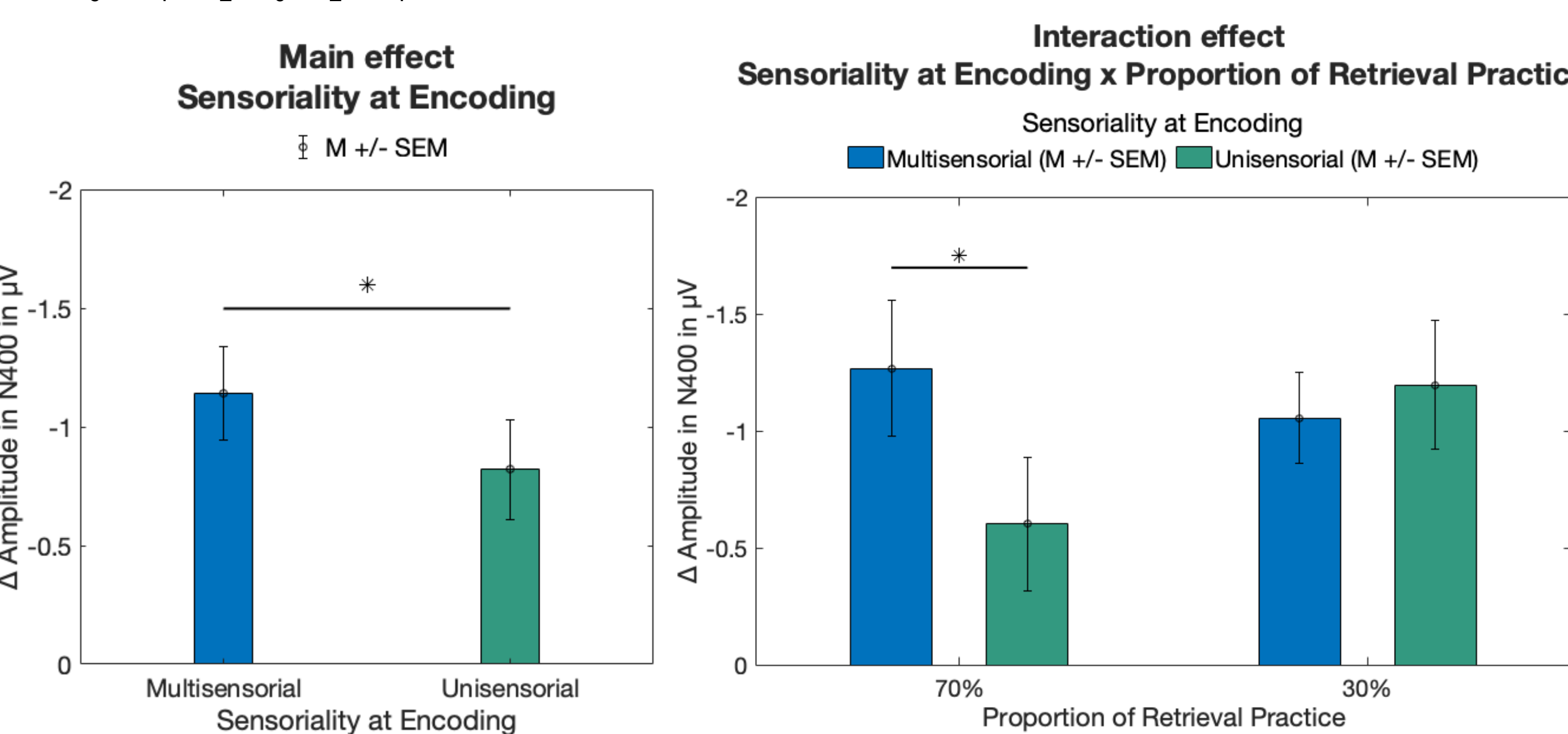
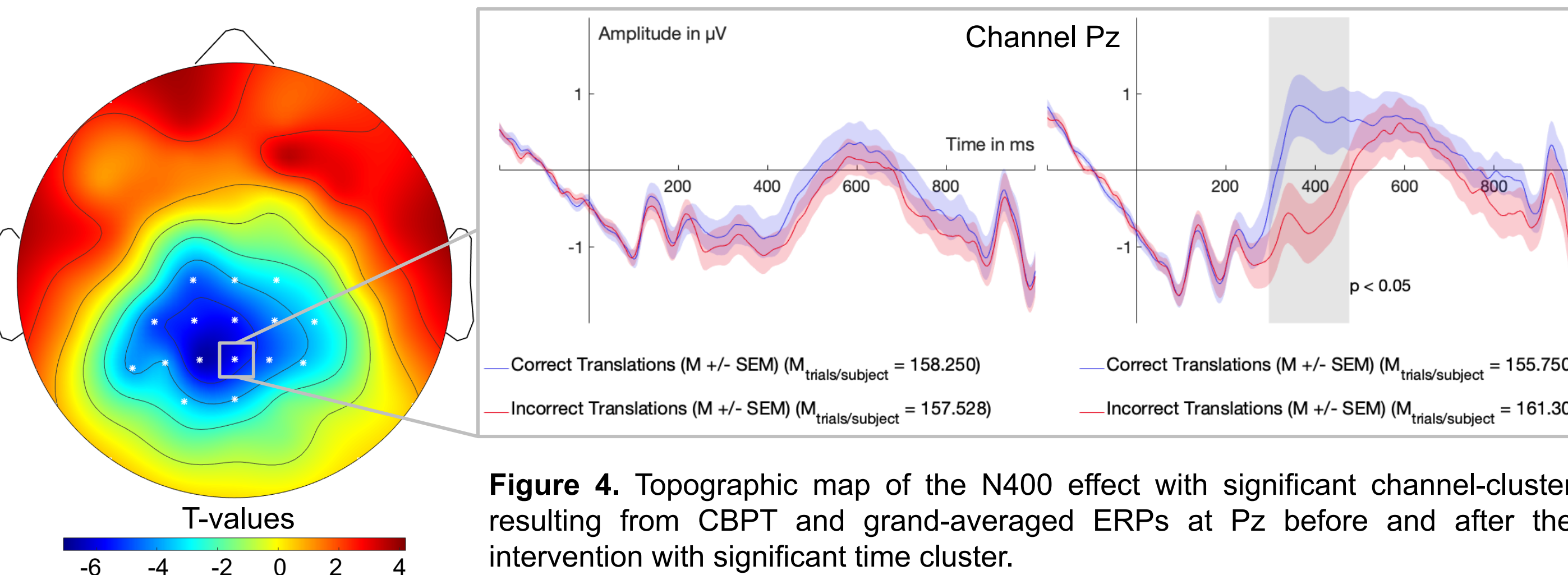


Figure 5. A main effect of Sensoriality at Encoding indicated that words learned multisensorial at encoding elicited a larger N400 after the intervention than words learned unisensorial at encoding. This effect persisted at a high Proportion of Retrieval Practice (corresponding to a low proportion of encoding) but not at a low proportion (high proportion of encoding).

References

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