Images support novel word learning paired with novel meaning: An EEG study

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Background

- Complementary Learning Systems theory: (1) novel words encoded as episodic memory traces in the hippocampal system, separate from the lexicon, (2) after a period of consolidation (e.g., during sleep), these memory traces gradually become lexicalized (integrated into the lexicon).[1]
- Lexicalization can be measured with an EEG recorded semantic priming task.
- N400 component: indexes automatic semantic access[2]
- LPC component: indexes more controlled and explicit process of semantic access[3-5]
- Liu and Van Hell (in press) found that on Day 2 of testing, novel words learned on Day 1 demonstrated semantic priming effects in the LPC time window. On Day 8 of testing, novel words from both Day 1 and Day 2 showed semantic priming effects in the LPC time window.[7]

Research Questions

1. **How does encoding novel words with definitions and images strengthen learning and consolidation after one night of consolidation (Test on Day 2)?**
2. **How does encoding novel words with definitions and images strengthen learning and consolidation after a week (Test on Day 8)?**

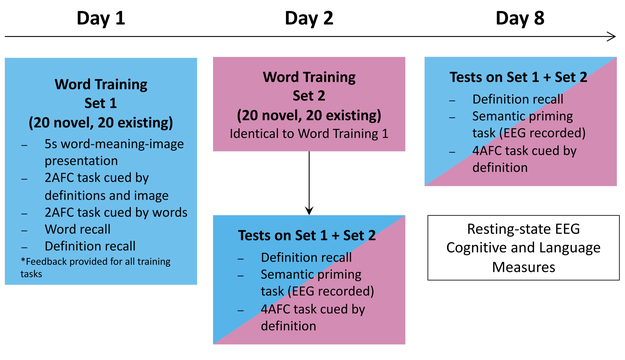
Hypothesis

- Images DOES impact learning and consolidation
  - Test on Day 2: LPC and N400 semantic priming effect in only Day 1 novel words
  - Test on Day 8: LPC and N400 semantic priming effect in both Day 1 and Day 2 novel words

Alternative hypothesis

- Images does NOT impact learning and consolidation
  - Replicate results in Liu and Van Hell (in press) [7].

Study Design



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Methods

Participants

- 31 right-handed monolingual native English speakers (*M* age = 19, range = 18 – 21)

Materials and stimuli

- 2 sets of 20 novel words and 20 existing words each (80 total) and their definitions, from[7]
- Images for all words*
- Novel words:
  - 40 non-derivational non-words (e.g., *hodit*), from[8]
  - Phonotactically legal in English with no orthographic neighbors

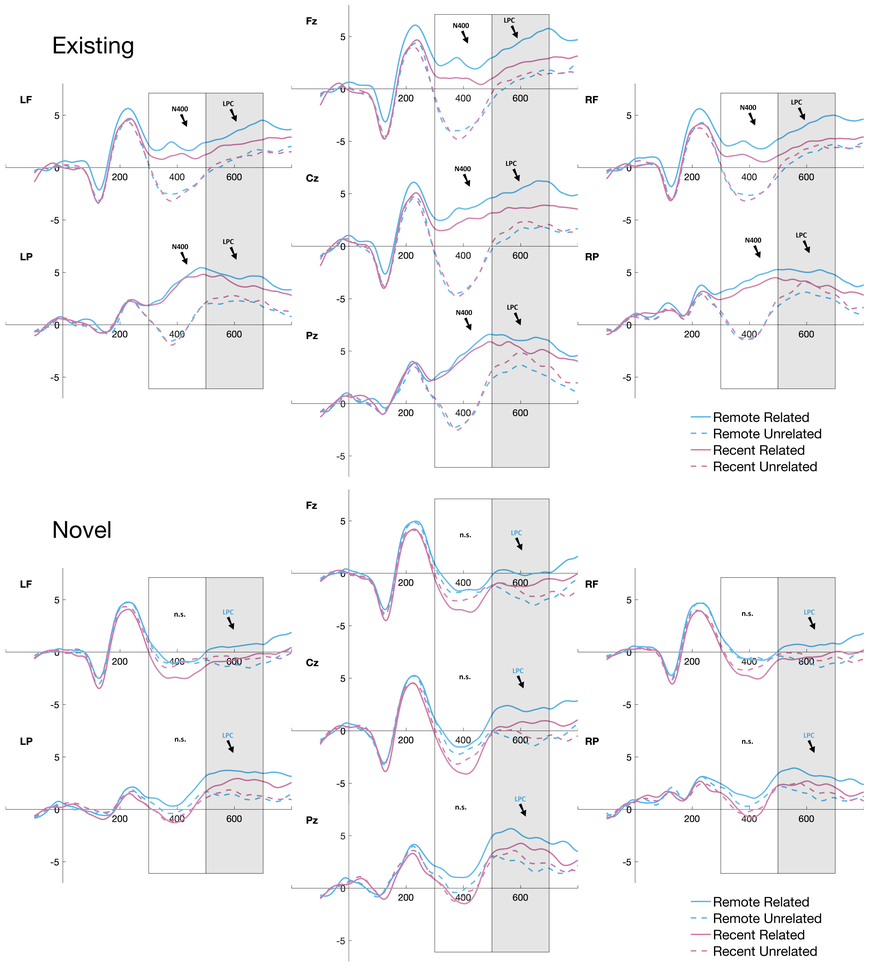
hodit

a car with two wheels that can move under water

ANOVA Analyses

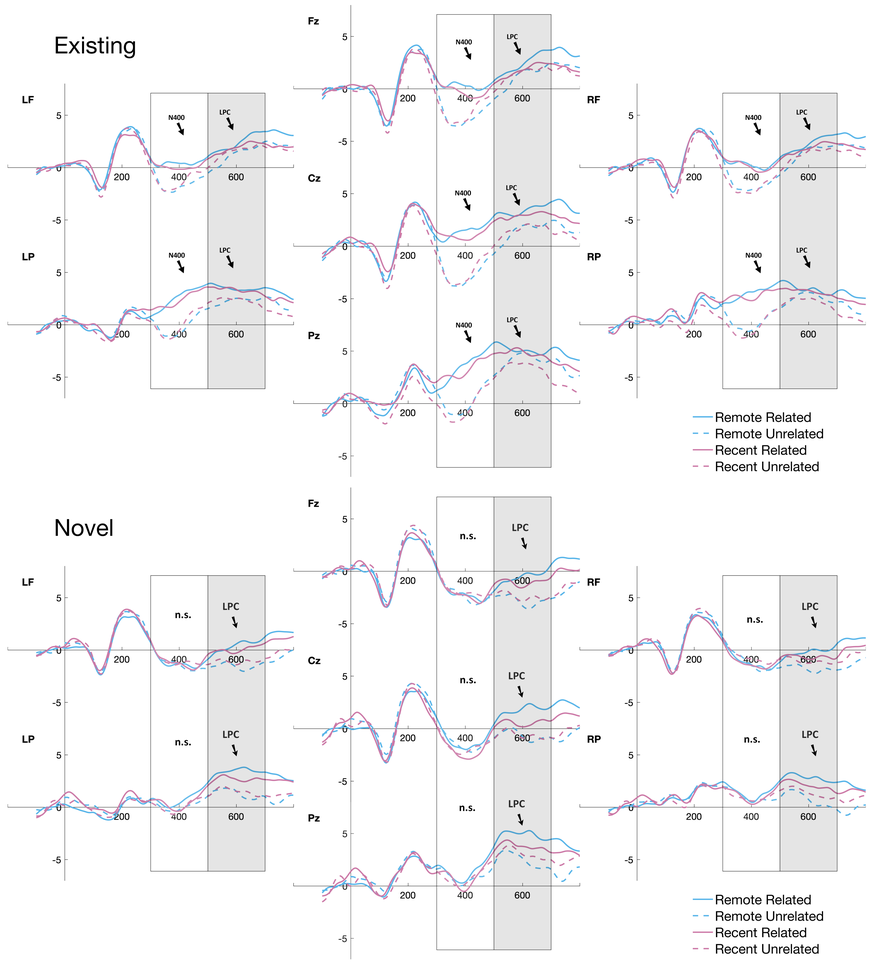
- 2 (Day Learnt: Day 1, Day 2) * 2 (Relatedness: Related, Unrelated) * 3 (Midline: Fz, Cz, Pz)
- 2 (Day Learnt: Day 1, Day 2) * 2 (Relatedness: Related, Unrelated) * 2 (Laterality: Left, Right) * 3 (Anteriority: Anterior, Posterior)

ERP Results: Test on Day 2 (*N* = 31)



- Day 1 novel words: LPC semantic priming effect across the 3 midline channels and all lateral ROIs.
- Day 2 novel words: No semantic priming effect.

ERP Results: Test on Day 8 (*N* = 23)



- Day 1 novel words: LPC semantic priming effect across the midline and all ROIs.
- Day 2 novel words: LPC semantic priming effect across the midline and all ROIs.
- No N400 semantic priming effect were found.

Conclusion

- Novel words paired with definition *and images* demonstrate an LPC semantic priming after a night of offline consolidation for novel words learned on Day 1.
- After a week of offline consolidation, novel words learned on day 2 also demonstrate an LPC semantic priming effect (larger in the left regions).

Images strengthen the learning and consolidation of novel words.

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