# Differential processing of semantic associates modulates memory in free recall

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**LONG TERM MEMORY LAB** @ the University of Virginia
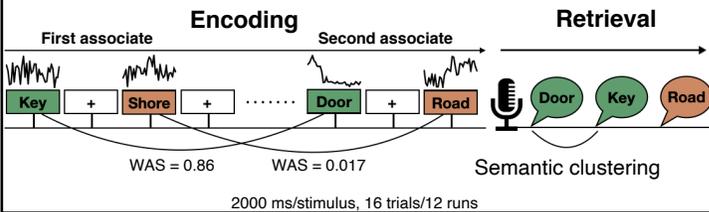
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## Introduction

-Semantic clustering is the tendency to consecutively recall words that share meaning Bousfield, 1953

-Semantically associated stimuli may act as "reminders" during encoding Greene, 1989; Hintzman, 2011

-Neural signals during memory formation predict subsequent organization Long & Kahana, 2017
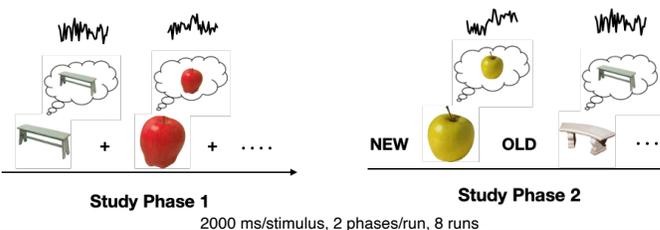
## Hypothesis

-Organization is driven by retrieving associates during memory formation

## Free recall task

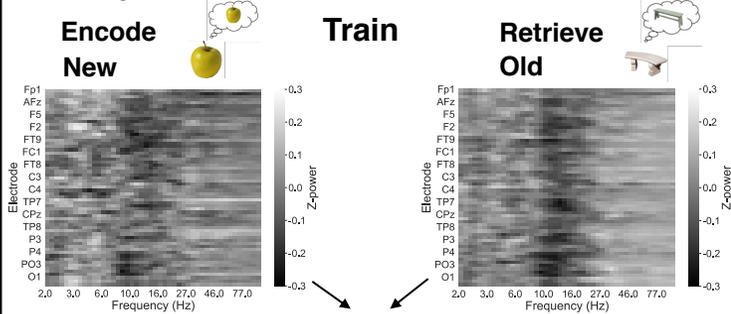Strong Semantic Association (WAS > 0.4)
Weak Semantic Association (WAS < 0.4)

**Encoding** First associate / Second associate — **Retrieval**

First associate: Key + Shore + ..... Door + Road → Door Key Road

WAS = 0.86    WAS = 0.017

Semantic clustering

2000 ms/stimulus, 16 trials/12 runs

## Mnemonic state task

Study Phase 1    NEW  OLD  Study Phase 2

2000 ms/stimulus, 2 phases/run, 8 runs
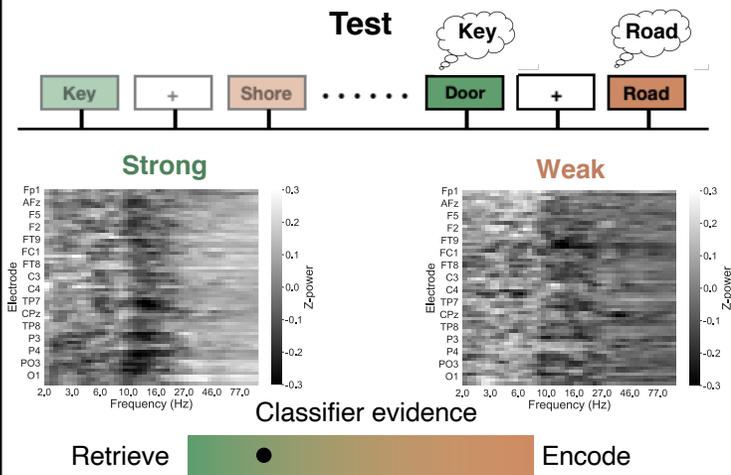
## Multivariate pattern analysis

Classifier trained on mnemonic state task and tested on encoding phase of free recall task

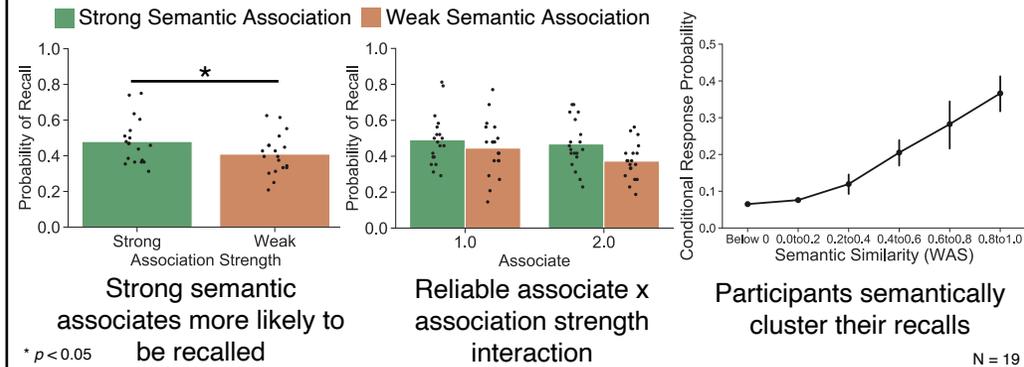**Encode New** — **Train** — **Retrieve Old**

**L2 Logistic Regression Classifier**

**Test**  Key  Road

Key + Shore ...... Door + Road

**Strong**    **Weak**

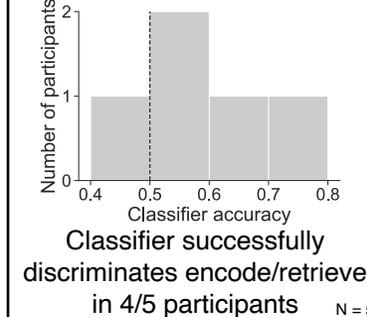Classifier evidence

Retrieve ⚫ Encode

## References

Bousfield, W.A. (1953). The occurrence of clustering in the recall of randomly arranged associates. *Journal of General Psychology, 49*, 229-240.
Hintzman, D.L. (2011). Research Strategy of Memory: Fads, Fallacies and the Search for the "Coordinates of Truth." *Perspect Psychol Sci, 6*(3), 253-271.
Greene, R.L. (1989). Spacing effects in memory: Evidence for a two-process account. *JEP: LMC, 15*(3), 371-377.
Long, N.M. & Kahana, M.J. (2017). Modulation of task demands suggests that semantic processing interferes with the formation of episodic associations. *JEP: LMC, 43*(2), 167-176.
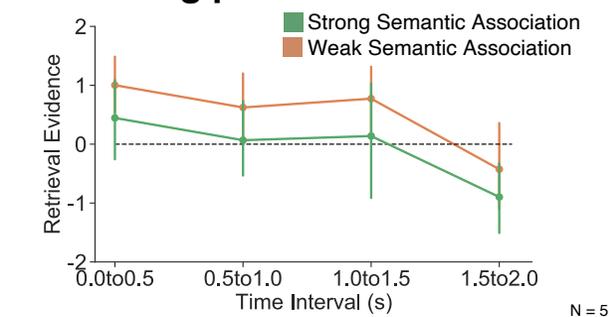
63 functional electrodes | 46 frequencies    |    ilm5fp@virginia.edu

## Probability of recall and semantic clustering

Strong Semantic Association    Weak Semantic Association

Strong semantic associates more likely to be recalled

* $p < 0.05$

Reliable associate x association strength interaction

Participants semantically cluster their recalls

N = 19

## Mnemonic state classification

Classifier successfully discriminates encode/retrieve in 4/5 participants

N = 5

## Retrieval state evidence during encoding phase of free recall

Strong Semantic Association    Weak Semantic Association

N = 5

## Summary

-Strongly semantically associated items are more likely to be recalled than weakly semantically associated items
-Recalls are semantically clustered, despite absence of semantic orienting task
-Greater retrieval evidence for weak compared to strong semantic associates

## Future Directions

-Investigate why retrieval evidence is greater for weak than strong associates