The encoding and retrieval neural mechanisms supporting temporal and semantic clustering in free recall

Nicole M. Long, Michael J. Kahana

Computational Memory Lab
University of Pennsylvania

Introduction

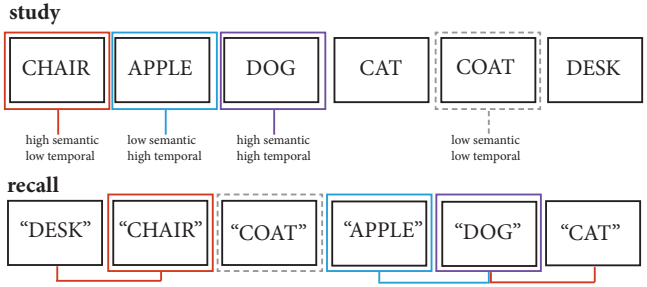
Organizational processes correlate with successful recall (Tulving, 1962; Thompson, 1972)

Temporal clustering: consecutive recall of nearby study items (Kahana, 2006)

Semantic clustering: consecutive recall of items related in meaning (Bousfield, 1953)

How do neural mechanisms of temporal and semantic clustering relate to those associated with recall success? What mechanisms are shared/different between temporal and semantic clustering?

Methods

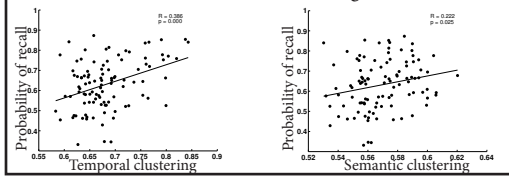


Free recall task where words vary in temporal and semantic relatedness
Temporal relatedness determined by lag (difference in serial position)
High temporal: lag = 1, Low temporal: lag > 2
Semantic relatedness determined by word association score (Nelson et al., 2004)
High semantic: WAS > .6, Low semantic: WAS < .2

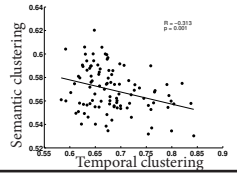
EEG Methods: 102 participants | 7 sessions | 16 lists per session | 16 words per list | Scalp EEG, 129 electrodes

Behavioral results

Probability of recall positively correlated with temporal and semantic clustering

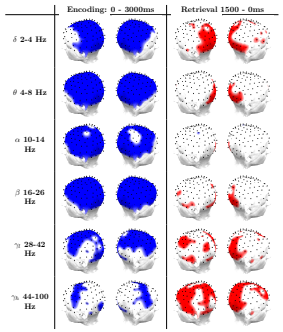


Temporal and semantic clustering are negatively correlated

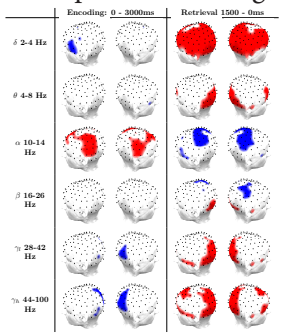


EEG Oscillatory Power

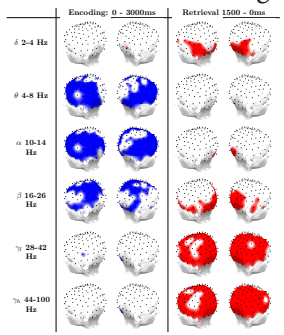
Recalled - failure to recall

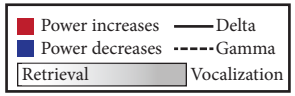


High - Low Temporal Clustering

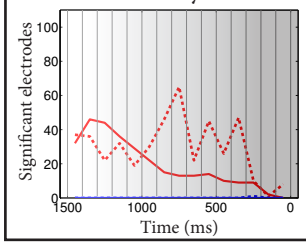


High - Low Semantic Clustering

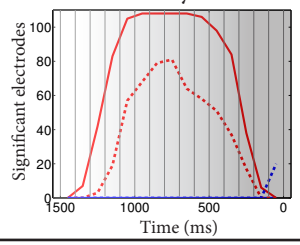




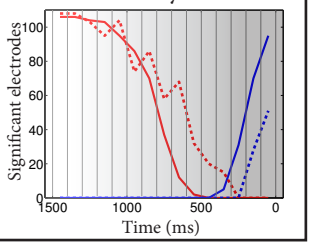
Retrieval dynamics



Retrieval dynamics



Retrieval dynamics



Summary

- Encoding and retrieval mechanisms differ across all three measurements
- SME: power decreases across frequencies
- Recall items have greater low and high frequency power prior to vocalization
- Alpha power increases for items subsequently temporally clustered, alpha power decreases during retrieval of temporal associates
- Low frequency power decreases for items subsequently semantically clustered, power decreases prior to vocalization

References

Bousfield, WA (1953) The occurrence of clustering in the recall of randomly arranged associates. J. Gen. Psych 49: 229-240
Kahana, MJ (1996) Associative retrieval processes in free recall. Memory & Cognition 24: 103-109
Nelson, DL & McEvoy, CL (2004) The University of South Florida free association, rhyme and word fragment norms. Beh. Res. Methods 36 (3): 402-407
Tulving, E (1962) Subjective organization in free recall of "unrelated" words. Psych Review 69 (4): 344-354
Thompson, CP (1972) Organization in memory: Multitrial free recall of categorized word lists. In RF Thompson & JF Voss (Eds.), Topics in learning and performance (pp. 241-263). San Diego, CA: Academic Press