Inter-item distraction dissociates temporal and semantic organization in free recall

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Introduction

Memory of a list of words can be improved by forming links betwen items that appear near in time to one another (Sederberg et al. 2010) or by organizing recall in terms of existing semantic relations between the words (Cohen 1963). These influences are exhibited in free recall in the form of temporal clustering (successive recall of items presented adjacent to one another) and semantic clustering (grouping of semantically related items during recall).

Morton et al. (2013) found that patterns of oscillatory EEG activity reflect stimulus category and predict clustering by category during recall. They proposed that sustained category-specific oscillatory activity at encoding reflects construction of a cue that is used during recall to guide memory search, resulting in category clustering.

We examined whether a distracting task between studied items can disrupt the construction of a semantic retrieval cue. Based on previous results (Howard & Kahana 1999), we predicted that temporal clustering would not be affected by the addition of inter-item distraction. In contrast, we predicted that the addition of an interitem distraction task would disrupt formation of a category-specific retrieval cue, resulting in decreased category clustering.

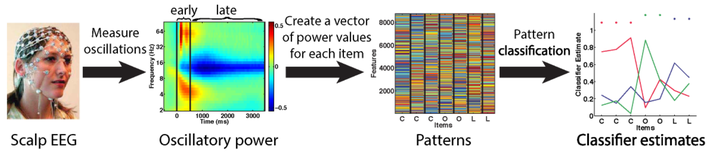
Paradigm

Immediate free recall (IFR): 24 items from 3 categories (celebrities, landmarks, and objects) presented, immediately followed by free recall.

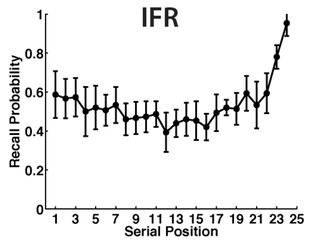
Continual distraction free recall (CDFR): 8.5 s of math task distraction added before and after each presented item, followed by free recall.

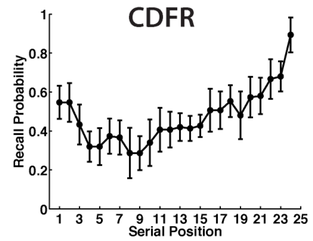
10 participants each studied and recalled 30 lists, 15 from each condition.

Scalp EEG Methods



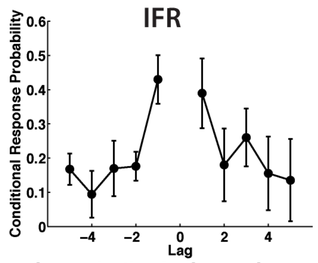
We recorded scalp EEG using a 128 electrode cap. Independent components analysis was used to remove eye, muscle, and ECG artifacts. Wavelets were used to measure oscillatory power. Using pattern classification, we decoded category-specific oscillatory activity, and examined whether this activity predicted subsequent recall performance.

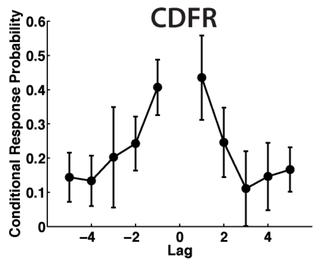




Recall performance is decreased by interitem distraction.

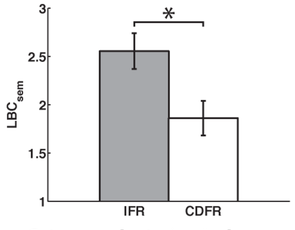
The recall advantage for the last few items in the list is similar between conditions. Math distraction mainly decreases recall of early list items.





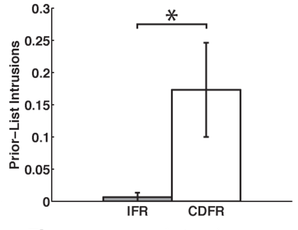
Temporal organization is observed regardless of distraction.

Transitions between adjacent items are more likely than transitions between distant items. Response probabilities are shown as a function of the lag between the serial position of the previous recall and the current recall. To control for category clustering, only transitions between same-category items are included.



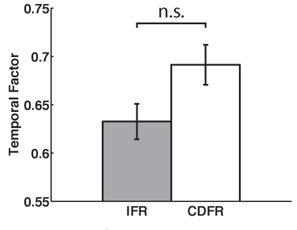
Category clustering is decreased in the interitem distraction condition.

A similar result is observed when only examining transitions between items not neighboring during study.



There are more intrusions from prior lists in the distraction condition.

This may reflect increased proactive interference in CDFR, which involves targeting a larger temporal interval, which may be easier to confuse with previous lists. Participants may rely less on category cues in order to reduce interference.



Temporal organization is not affected by interitem distraction.

There is a trend toward temporal organization actually *increasing* in the distraction condition.

Only within-category transitions are included.

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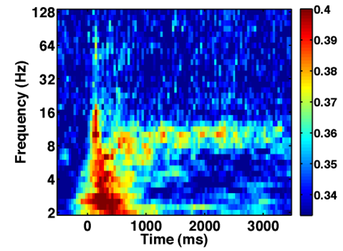
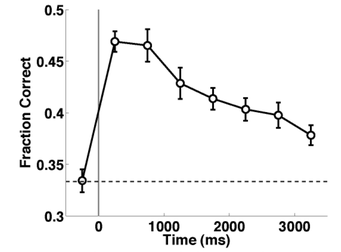


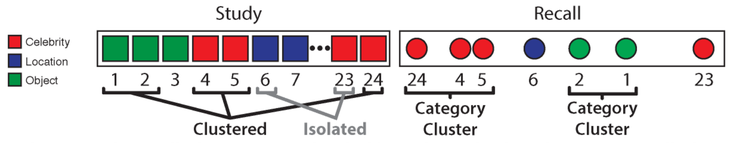
Stimulus category can be decoded from oscillatory activity during encoding.

Patterns of oscillatory power over the scalp discriminate between categories. Deep blue indicates chance performance (1/3).

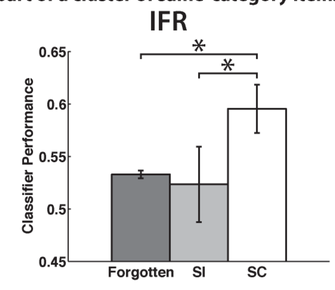


Category discriminability peaks early during item presentation.

Performance is significantly above chance throughout stimulus presentation.

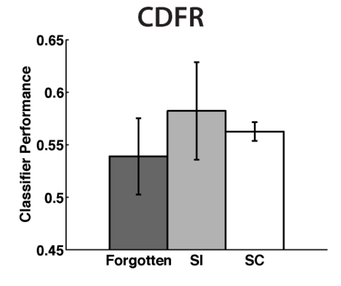


Subsequently recalled items were divided based on whether they were recalled as part of a cluster of same-category items.



During IFR encoding, classifier performance predicts subseqent category clustering.

This suggests that category-specific representations active during encoding influence subsequent memory search. SI: subsequently isolated. SC: subsequently clustered.



During CDFR encoding, classifier performance does not predict recall organization.

This may reflect a decreased use of category-specific cues during recall.

Conclusions

As predicted, inter-item distraction attenuated semantic organization without affecting temporal organization. Furthermore, we replicated the finding of Morton et al. (2013) that category-specific oscillatory activity during encoding predicts subsequent semantic organization in the absence of distraction. In contrast, category-specific activity at encoding does not predict recall performance in the inter-item distraction condition. This may reflect a decreased use of category-specific cues at retrieval in the inter-item distraction condition, in order to decrease interference from previous lists. Future work will examine whether there is neural evidence for disruption of cue-construction processes during encoding in the inter-item distraction condition.