

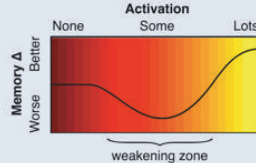
Briefly cueing memories leads to suppression of their neural representations

Jordan Poppenk¹ & Kenneth Norman¹

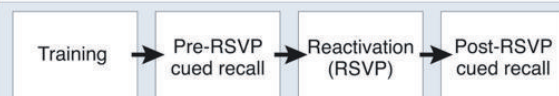
¹Princeton Neuroscience Institute, Princeton University

Introduction

- Partial reactivation appears to weaken reactivated memories (e.g., Detre et al., 2013)
- In the brain: how does partial activation change the neural pattern later elicited by a cue?



Experiment overview



- Learn word-scene pairs (over-training for strong signal)
- Cue memories by different amounts.
- Examine impact of (2) on recall:
 - using a classifier (quantitative)
 - using pattern similarity (qualitative)

Preparation

Training

- Ps were 16 healthy adults (5 F, mean age 20.9)
- We over-trained Ps on the "names" of 30 rooms.

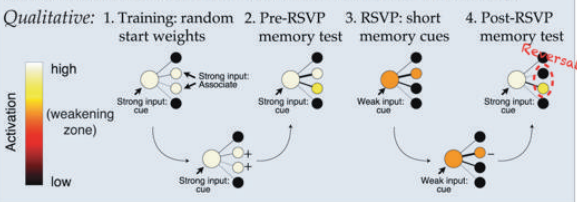


Classifier (fMRI)

- 1-back within blocks of room, face, car or word images.
- Ridge regression classifier; Inclusive FFG+PHG mask; $\lambda=10$; six cross-validation folds (mean accuracy = 0.83).

Predictions

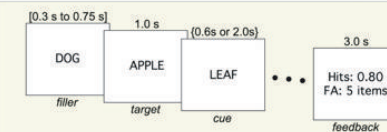
Quantitative: Behavioral and classifier evidence of weakening.



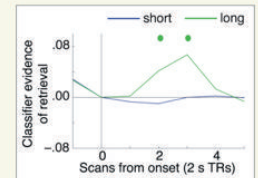
References & Acknowledgements

- This research was supported by a National Sciences and Engineering Research Council (NSERC) Post-Doctoral Fellowship to JP, and by NIH R01 MH069456 to KAN.
- Detre, GJ, Natarajan, A, Gershman, SJ, Norman, KA (2013) Moderate levels of activation lead to forgetting in the think / no-think paradigm. *Neuropsychologia*, 51, 2371-2388.

RSVP memory reactivation (fMRI)

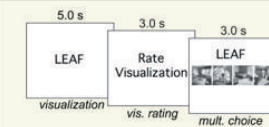


- Ps searched for fruit words among cues and filler words.
- Room cues (task-irrelevant) embedded within RSVP stream:
 - 10 "short" cues shown for 0.6s at eight separate times
 - 10 "long" cues shown for 2.0s at eight separate times
 - 10 "omit" cues not shown during this phase.

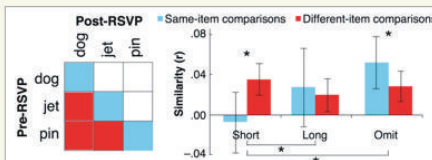


Classifier output distinguished short and long exposures.

Pre- and Post-RSVP memory test (fMRI)



- Before and after RSVP, Ps completed cued recall and 4AFC.
- We deliberately over-trained Ps to establish clean neural patterns

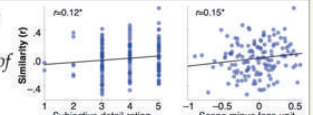


- After RSVP, short-cue items were less similar to their own initial state than they were to the initial states of other items.
- Similarity of these items was predicted by short-cue activity during RSVP, $r=0.07$, $P<0.05$

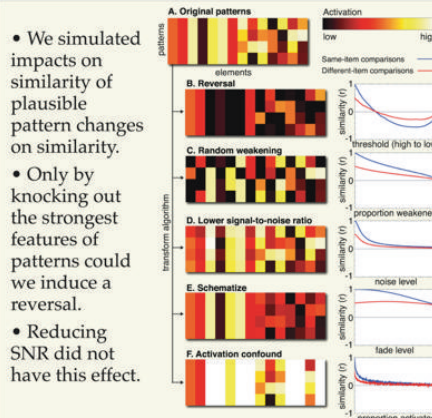
In the post-RSVP memory test, less evidence of retrieval was apparent for short-cue items.

* $P < 0.05$

Similarity predicted measures of recall integrity.



Simulation



- We simulated impacts on similarity of plausible pattern changes on similarity.
- Only by knocking out the strongest features of patterns could we induce a reversal.
- Reducing SNR did not have this effect.

Discussion

- We observed behavioral and neural evidence of memory weakening arising from weak cueing in a novel paradigm.
- Neural representations of briefly cued patterns (but not control patterns) bore less resemblance to their own initial state than those of other patterns.
- In simulations, this reversal pattern arose when the strongest features of the pattern were differentially weakened.
- This evidence constitutes an initial look at what "memory weakening" looks like in the brain: qualitative, not just quantitative, changes to neural patterns.