Moderately reactivating memories leads to weakening of those memories\(^1\).

Perceptual distraction (via Multiple Object Tracking, MOT) can control memory reactivation\(^5\).

Closed-loop fMRI neurofeedback can be used to adjust task difficulty in real time\(^6\).

In a pilot version of this paradigm, we found that moderate levels of reactivation lead to memory weakening, as evidenced by decreased pattern similarity to the item's previous representation\(^7\).

Goal: Adjust perceptual distraction in real time to evoke moderate activation & (through this) memory weakening.

### Design

<table>
<thead>
<tr>
<th>Task</th>
<th>Stimuli</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Learn word &amp; scene pairs</td>
</tr>
<tr>
<td>B</td>
<td>Recall 1</td>
</tr>
<tr>
<td>C</td>
<td>Real time MOT x 3</td>
</tr>
<tr>
<td>D</td>
<td>Scene description</td>
</tr>
<tr>
<td>E</td>
<td>Recognition</td>
</tr>
</tbody>
</table>

### Stimuli

- LEAF
- MOT
- OMIT
- LURE

### Closed-loop system

- Acquire data
- Measure memory reactivation (retention evidence)*
- \( E(t) = r(t) - \text{target} \)
- Dot speed
- \( \Delta \psi(t) = K_p \cdot \Delta r(t) + K_a \cdot \frac{dE(t)}{dt} \)
- Update display
- Change dot speed with PD controller
- Subject groups (n=32):
  - Real time (RT): n=16
  - Yoked control (YC): n=16

### Comparing results across groups → Analyzing within group variance

#### How effective is real time at correcting retrieval?

- RT group did not spend more time in target region
- RT group is better at correcting overly strong activation

#### Hypothetical memory results

- Expected results if RT group activation is moderate
- Use the nonmonotonic plasticity hypothesis (NMPH) to predict memory strength\(^1\)

#### Using retrieval evidence to predict memory

- Compute for each subject:
  - \( f_r(t) \): Retrieval during MOT
  - \( f_s(t) \): Memory score
  - Correlate across all stimuli

### Preliminary correlations with memory activation

- Post-Po MOT pattern similarity
- Post-Po MOT detail ratings
- Recognition RT to lure image

### Discussion

We did not accomplish our goal of promoting moderate activation in the real time group. The MOT task was effective at reducing high memory activation, but not at increasing low memory activation.

However, results of preliminary analyses relating retrieval evidence and subsequent memory support the NMPH, with moderate retrieval evidence levels around 0.15 being associated with worse memory performance.

Follow-up analyses will use PCIT\(^2\) to generate continuous estimations of the relationship between retrieval strength and subsequent memory.


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