Deactivation of Items in Working Memory Can Weaken Long-Term Memory

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Introduction: Nonmonotonic Plasticity

Key prediction: Forgetting will happen when an item gets “stuck” in the moderate activity range while it is being deactivated from working memory.

Strategy for testing this prediction: Use fMRI pattern classifiers to read out the deactivation of an item following the cue in a modified Sternberg task.

Use this neural measure to predict recall of the item on a final memory test.

Hypothesis and Experimental Approach

Predictions from nonmonotonic plasticity hypothesis:

If the scene memory is deactivated efficiently, resulting in low scene activity, the memory will be mostly unharmed.

If the scene memory gets “stuck” in the moderate activity range while it is being deactivated, this will lead to weakening of the memory, and (consequently) poor recognition memory for that item on the final test.

Background: Modified Sternberg Task

Oberauer (2001) demonstrated the working memory unloading effect: You are faster to respond to a memory probe if given enough time (1 – 5 sec per item) to remove your attention from a subset of items in working memory.

Lewis-Peacock, Drysdale, Oberauer & Postle (2011) adapted this task for fMRI to test the hypothesis that deactivated items in working memory become neurally deactivated.

Approach: Use pattern classifiers to track sustained activity of two items being held in working memory. Assess neural fate of the unattended item.

Results (shown at left) demonstrate that unattended items in working memory are deactivated, but can be reactivated, and are not forgotten after a brief delay.

Question: Can deactivation of an item in working memory weaken long-term memory for that item?

1. Use a pattern classifier (applied to fMRI) to track scene and face activity throughout the switch trials.

Analysis Strategy:

2. Measure how efficiently participants deactivate the scene on switch trials -- how much scene activity is there after the switch cue?

3. Relate this residual scene activity to the subsequent memory for that scene (in the Phase 3 recognition test).

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