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MEMORY

Remembering to forget

The process of remembering can strengthen memories, but it may also suppress unwanted or interfering memories, causing these to be forgotten. There has been no direct evidence of this 'adaptive inhibition' mechanism of forgetting — mostly because it is difficult to pinpoint and measure brain activity associated with individual memories. Now, however, Wimber *et al.* demonstrate a novel functional MRI (fMRI) technique to track the pattern of cortical activation associated with specific memories, and show that 'competitor' memories in the ventral visual cortex (VVC) are actively suppressed by remembering.

First, participants familiarized themselves with 144 pictures — each of a face, an object or a scene. They then learnt two sets of 72 word–picture associations. Each of the 144 pictures featured in only one of the sets, but the same words were used for both sets, such that two pictures (one in each set) were associated with the same cue word.

In the fMRI scanner, participants were presented with the cue words and were asked to remember the associated pictures from only the first set of word–picture pairs (the 'targets'). Participants had to indicate to which category (face, object or scene) the target pictures belonged, and this retrieval task was repeated four times. As expected, the participants' performance improved across the repetitions, and pictures from the second set of word–picture associations ('competitors') were remembered less often with each repetition.

To assess how strongly individual memories were represented in the brain through the retrieval repetitions, the authors used fMRI data from the VVC and hippocampus of each participant to create pattern templates of the cortical response associated with memory for each picture — like picture-specific 'signatures' of brain activity. Using these templates, the authors found that unlike target-memory activation, which became stronger in the VVC and hippocampus across retrieval repetitions, competitor-memory activation in the VVC diminished with each repetition. Indeed, competitor-memory activation in the VVC was lowered below that of 'baseline' pictures (which had been associated with words but that had not presented in the retrieval tests), suggesting competitor memories were actively inhibited.

The prefrontal cortex (PFC) has been previously proposed to exert top-down inhibition of memories during retrieval-induced forgetting. Here, the authors found that increased activity in the PFC during retrieval was associated with reductions in the strength of competitor-memory activation in the VVC with repeated retrievals. By contrast, activity in the PFC was not associated with the increase in target-memory activation. These findings provide further evidence for a role of the PFC in actively inhibiting interfering memories.

Next, to test the participants' memory of individual pictures, participants discriminated target, competitor or baseline pictures from a pair of images that were closely matched to each other. Interestingly, whereas participants' ability to recognize target and baseline pictures was the same, recognition of competitor pictures was worse than that of target or baseline pictures. Thus, the retrieval task had induced forgetting of the competitor pictures. Moreover, reductions in competitor-induced VVC activation during retrieval predicted forgetting, suggesting that decreased activation of memory-specific patterns is important for forgetting.

Together, these findings indicate that retrieving memories causes forgetting by inhibiting memory-specific activity in the VVC. Furthermore, the PFC may actively and selectively suppress these unwanted representations to prevent competition between memories.

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> "the retrieval task had induced forgetting of the competitor pictures"

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