

From hippocampus-dependent to independent: Imaging the neural networks underlying recent memories and remote memories

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Abstract

Patients with hippocampal/parahippocampal damage lose access to the recent past more readily than to the remote past; and memory for the very remote past is intact. This finding suggested the role of hippocampal formation was time limited: with the passage of time, a memory trace gradually develops independently of the hippocampal formation. Previous neuroimaging researches failed to observe the effect of study-test interval on hippocampal region and the parahippocampal gyrus. It may be because the time span sampled in study was too short. In this fMRI research, a longer time span of more than 5 years was adopted, and results proved that recent memories relayed more on hippocampal formation than remote memories did.

Method

9 healthy, right-handed volunteers aged from 20 to 33 participated in experiment. They gave informed consent that followed the MRI ethics committee in ETL, and interviewed one day before the fMRI experiment. They were asked to provide 4 places that they had visited more than seven years ago and 4 places that he/she had visited recently (within 2 years). The average number of years of remote autobiography is 10.326 and that of recent autobiography is 0.621. During the scanning, the name and five landmarks/scenes of each place were presented to the subjects one by one, at a rate of 10 seconds per item (3 seconds for text presentation, 7 seconds for cross presentation). Subjects were asked to recall their experiences of the places they visited, following the prompted names of the places and landmarks/scenes.

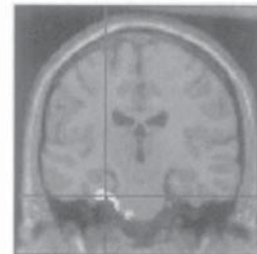
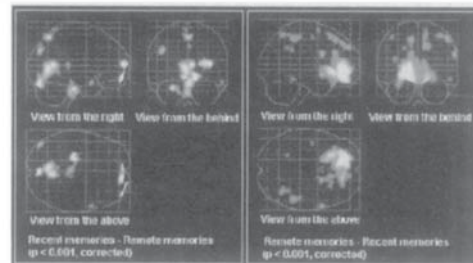
Scans and analysis:

All scanning was performed on a 3.0-T MRI Scanner (GE 3T Signa) equipped with EPI capability. 18 axial slices (5.7 mm thick, 1 mm spaces, interleaved) were prescribed to cover the whole brain. A T2* weighted gradient echo EPI was employed. The imaging parameters were TR = 2 sec, TE = 32 ms, FA = 70 degrees, FOV = 20--20 (64--64 mesh). Images were pre-processed (timeslice adjusted, realigned, normalized and smoothed) by SPM99. Then, the image data of 9 subjects were estimated to establish a fixed model in which 2 types of blocks, the recent memory block and the remote memory block, were defined. The threshold were set at $p < 0.001$, corrected for multiple comparisons.

Results:

When retrieval of recent memories was contrasted with retrieval of remote memories, there were significant activations in left parahippocampus, left anterior frontal lobe, posterior cingulate gyrus, precuneus, and superior parietal. The majority of these activations had been previously associated with episodic topographical memory retrieval. Theoretically, episodic memory could gradually become semantic memory with the passage of time. Our results imaged this kind of changing and implied the retrieval of recent memories enrolled episodic memory process whereas retrieval of remote memories enrolled semantic memory process.

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Recent memories vs. Remote memories
($p < 0.001$, corrected)

