Medial Temporal Lobe Activation in Episodic vs. Familiarity-Based Memory Retrieval

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Introduction

We investigated the role of medial temporal lobe (MTL) in declarative memory retrieval. It has been proposed that the hippocampus selectively supports retrieval of events (episodic memory retrieval) while surrounding MTL structures support conscious recognition of previously encountered items (familiarity-based memory retrieval) (1). Eldridge et al. (2) used standard whole-brain voxel-based statistical analysis to demonstrate that the left hippocampus is selectively activated in episodic memory but not familiarity-based memory retrieval in humans. This finding supported the hypothesis of the unique role of the hippocampus in episodic memory. We applied a novel anatomically guided region-of-interest (ROI) analysis of episodic and familiarity-based memory retrieval to show that various MTL structures (i.e., amygdala, hippocampus, and cortical areas, including entorhinal, perirhinal and parahippocampal cortex) contribute to episodic memory retrieval.

Methods

Fifteen male subjects with no history of major medical, neurological or psychiatric illness were recruited. We employed an established paradigm (2) for comparison of episodic and familiarity-based memory retrieval. Structural and functional images were acquired on a 1.5T Siemens Sonata MRI scanner. Six MTL regions-of-interest were defined on each subject's structural image: amygdala, uncus of the hippocampus, body/tail of the hippocampus; entorhinal, perirhinal and parahippocampal cortices. fMRI data from each subject were preprocessed and analyzed using SPM99. For whole-brain voxel-based analysis, contrast images of episodic vs. familiarity-based memory retrieval were entered as random effects into a one-sample t-test. For ROI analysis, statistical activation maps were obtained in each of the 12 ROIs (6 left, 6 right). In each ROI, voxels were considered significantly more active in episodic than familiarity-based memory retrieval at p-value of 0.05 following Constable et al. (3) and entered into an analysis of variance (ANOVA) to determine main effects of hemisphere and region or hemisphere-by-region interactions.

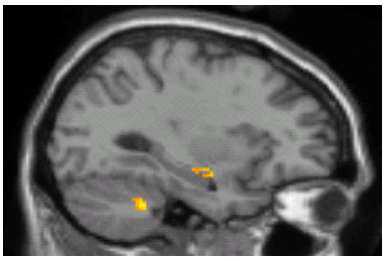
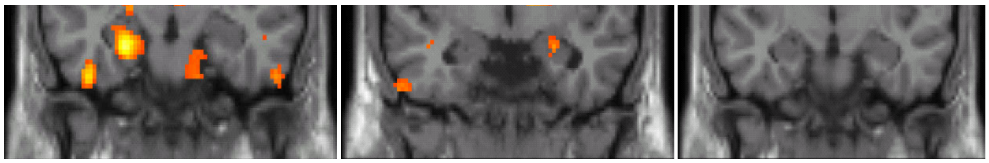


Figure 1

Figure 2



Results

Whole-brain voxel-based analysis revealed one significant activation in the MTL in the left anterior hippocampus (Figure 1). The ROI analysis, however, revealed that the different MTL structures do not differ in their significantly greater activation during episodic memory retrieval (no main effects of region or hemisphere). Moreover, we found a high degree of variability in the degree of MTL activation during episodic memory (Figure 2), including a lack of significant left hippocampal activation in three subjects with normal episodic memory retrieval performance.

Conclusions

The results contribute to the ongoing debate about the role of the MTL in declarative memory, with implications for studies of neurological and psychiatric patients. The previous hypothesis of a unique role of the hippocampus in episodic memory retrieval (2) was not confirmed. On the contrary, it was found that the MTL as a whole contributes to episodic memory retrieval. The present study also highlights the greater detail of functional information derived from anatomically guided region-of-interest analysis as compared with whole-brain voxel-based techniques.

References

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