Different Patterns of Visual Cortex and Hippocampal Activation During Encoding and Retrieval of Face-Name Pairs

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INTRODUCTION: It is known that visual association cortex involves in memory processing. This study presents an fMRI study with a face–name pairs stimulation paradigm to investigate detailed activation patterns of the visual association cortex and hippocampus during the memory encoding and retrieval processes. Our data indicated that the visual association cortex presented a significant high level of activation during retrieval than that during the encoding process.

METHODS: The six adult subjects in the study each received the same fMRI paradigm twice, but with different sets of unfamiliar faces and names. During execution of the memory paradigm, 64 T_2*-weighted SENSE-EPI axial image sets were acquired from a transverse brain section of 10 cm. The fMRI paradigm consisted of four cycles of encoding-distraction-retrieval-distraction experimental stimulation conditions. The stimulation paradigm is a modification of the encoding and retrieval of face-name pairs by Zeineh et al (1). Briefly, during the encoding period, subjects were serially presented 4 sets of face-name pairs every 3.6 sec and pressed a button for each pair. The subjects were asked to associate the name with the face presented. During distraction, subjects focused on a fixation cross and pressed a button when the cross changed to a circle, which occurred randomly every 2-5 sec and lasted 250 msec. During retrieval period, subjects viewed the 4 faces serially for 3.6 sec each with three names. The subjects were asked to choose the associated name by pressing the corresponding button. Subjects performed two runs with unique face-name pairs in randomized order. After scanning, subjects were debriefed to confirm task performance and query for strategy. One axial 3D MP-RAGE acquisition (1×1×1 mm^3, matrix = 256×256×50) was acquired for high-resolution anatomical images. The time-course fMRI image data were processed with SPM99 (2). Three out of 12 runs were discarded because of subject's poor performance and severe head movement. Average activation maps for encoding and retrieval were generated separately ($p < 0.001$, uncorrected, extend threshold = 4), and comparison between encoding and retrieval was done with paired t-test ($p < 0.001$, uncorrected, extend threshold = 4).

RESULTS: Both encoding and retrieval induced significant activation in the middle portion of the hippocampus and inferior visual association cortices (Fig. 1 a & b). When directly compared, encoding showed stronger activation bilaterally in the region of the anterior hippocampus, while retrieval showed stronger activation in the inferior visual association areas (Fig. 1 c & d).

DISCUSSION: Previous reports suggest that memory encoding and retrieval may involve the anterior and posterior hippocampus, respectively, acting in concert with cortical association systems that mediate perception and long-term memory storage (3). Our data showed that although encoding induced stronger activation of anterior hippocampus, both encoding and retrieval also involved the middle portion of hippocampus. The stronger activation of inferior visual association cortices during retrieval may reflect the high degree of memory specificity demanded in this task and is consistent with the cortical storage model of memory. Results also demonstrate the sensitivity of this paradigm in differentiating the neural components of memory encoding and retrieval processes.

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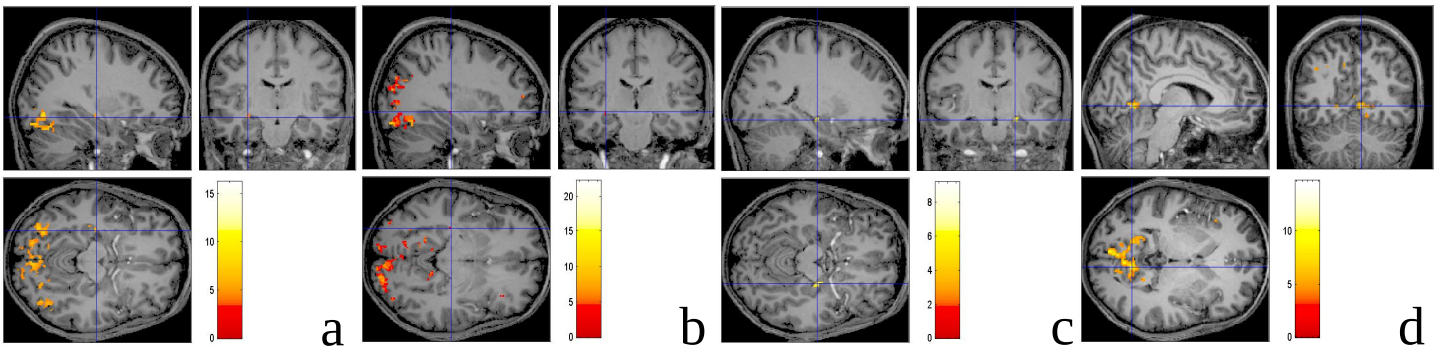

Fig. 1. (a) and (b) showing the activation of right hippocampus (CA2, 3) during encoding and retrieval respectively; (c) and (d) are the difference maps between encoding and retrieval using paired t-test ($p < 0.001$, uncorrected, extend threshold = 4), encoding showed stronger activation at left anterior hippocampus (c), while retrieval showed stronger activation at visual association cortices (d).