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Neural Correlates of Perceptual/Semantic Encoding and Implicit/Explicit Retrieval: An fMRI Study

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The important distinction between implicit and explicit memory tests is based on intentional effort and conscious recollection experience during retrieval process (Schacter, 1987), which have been suggested to be associated with increased activity in prefrontal and medial temporal regions, respectively (Schacter & Buckner, 1998). The present study investigated brain areas activated during tasks involving implicit and explicit memory retrieval, and examined neural correlates of conscious recollection and intentional effort during memory retrieval.

Methods

Whole-brain functional MRI was used to examine 8 subjects during retrieval in a block-designed fMRI experiment (Fig. 1). Two incidental study conditions were manipulated: Semantic and perceptual word encoding conditions. This manipulation of level of processing (LoP) was expected to yield two retrieval conditions that differed with regard to intentional retrieval effort and successful conscious recollection: Semantic encoding yielding low level of retrieval effort with high level of retrieval success and perceptual encoding yielding high level of effort with low level of retrieval success. After studying, word fragment completion (WFC) task was presented and then cued recall (CR) task was presented with word fragment cues.

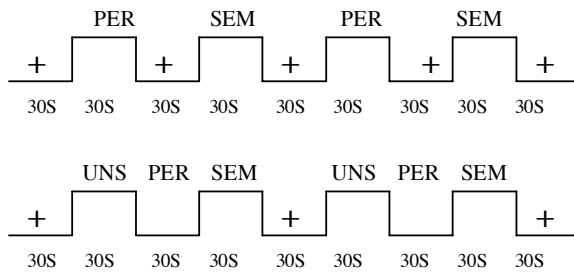


Fig. 1. A schematic illustration of study (above) and retrieval (below) paradigm. Critical study blocks (Semantic Encoding and Perceptual Encoding) were 30-s long separated by 30-s blocks of fixation (+). Critical retrieval blocks (Unstudied, Perceptually studied, Semantically studied) were also 30-s long separated by 30-s blocks of fixation in each of WFC and CR tasks.

Results

During explicit retrieval (CR) of the semantically encoded words, right inferior frontal regions (Brodmann Areas 45, 47) were activated but right anterior frontal regions (BA 10) were deactivated. These results suggest different roles of different prefrontal regions during explicit (episodic) memory retrieval: BA 45/47 involved in conscious recollection and BA 10 in intentional effort (McIntosh et al., 1997). Also, parahippocampal gyrus was activated during explicit retrieval of the semantically encoded words, and this result supports the idea that medial temporal lobe is a neural correlate of conscious retrieval success.

During implicit retrieval (WFC), occipital lobe (BA 17, 18 including fusiform gyrus) showed reduced activation when word fragments were primed, and this result supports the view that posterior areas are neural correlates of perceptual priming. Unexpectedly, right parahippocampal gyrus showed increased activation during implicit retrieval of the semantically encoded words. This result suggests that LoP effects which were often observed in studies of implicit memory retrieval could be the result of involuntary recollection (explicit contamination).

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