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Brain regions predicting subsequent episodic and implicit memory for words: a dissociation measured using fMRI

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Background

Event-related fMRI has enabled separation of BOLD responses to individual stimuli on the basis of whether or not subjects are subsequently able to recall those stimuli. It has therefore become possible to characterise the neuronal correlates of “encoding success”. The purpose of this event related fMRI experiment was to identify brain regions associated with different types of encoding and different subsequent measures of success.

Method

10 healthy volunteers were scanned (Bruker Medspec scanner operating at 3 Tesla). 144 words were presented visually, each with two of the letters underlined, and subjects were required either to make a semantic decision (pleasant/unpleasant?) or to identify whether the two underlined letters were in alphabetical order. After scanning, subjects underwent two retrieval tasks. In the first, they were shown 200 words and required to identify which they had seen during scanning. They were then shown all of the studied words and required to decide whether the same two letters were underlined as during the study phase. These retrieval data provided the basis for analysing the event-related data according to whether they were subsequently recognised and whether subjects were able to make the letter decision correctly, thus providing two different measures of encoding success. Data were analysed using SPM99, treating inter-subject variability as a random effect.

Results

Meaning-based versus letter-based decisions were associated, as predicted with left inferior prefrontal activation (figure 1). As was also predicted, subsequent successful recognition was associated with higher levels of left hippocampal activity during encoding (figure 2). Subsequent correct letter judgements were, however, predicted by right thalamic and left caudate nucleus activation at encoding.

Conclusions

The meaning versus letter based judgement effect in left inferior PFC, as well as the activation of left medial temporal cortex as a predictor of subsequent recognition success, are compatible with

previous studies. It is intriguing, however, that a different type of subsequent retrieval success, one that emphasises word form rather than meaning, was predicted by thalamic and caudate activation. The findings suggest that the consistent linkage between fronto-hippocampal systems and successful retrieval is specific to episodic memory whereas implicit memory for word form is associated with thalamic and caudate activation.