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Brain activity during simple and sequential movements as revealed by event-related fMRI

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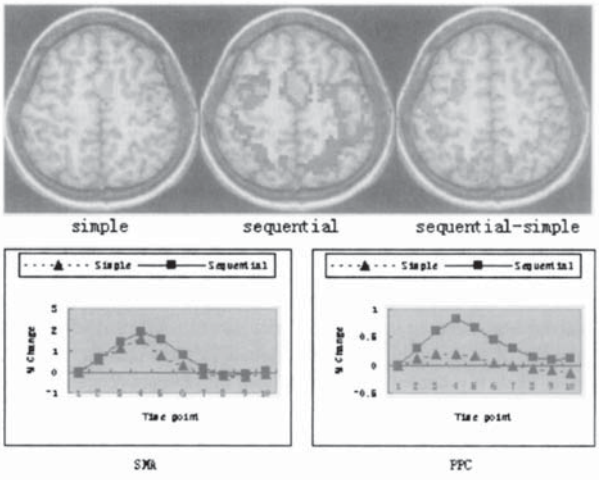
INTRODUCTION

A number of functional imaging studies have compared brain activation during simple and sequential finger movements. However, these studies have used PET or block-designed fMRI in which the sequence of movements was fixed across different conditions. In the current study, we used event-related fMRI, thus allowing the movement sequence to vary from trial by trial.

METHODS

9 right-handed subjects (5 males, 4 females, mean of age: 22 years) were scanned with EPI (1.5T GE Signa, TR = 1500ms, TE = 60 ms, Flip Angle = 90, in plane resolution = 3.75*3.75 mm, thickness/skip = 6/1 mm). Following the cue signal, the subjects were instructed to tap the right thumb and index finger four times on Simple trials and to tap the right thumb and each of the four fingers on Sequence trials. In the latter, the cue indicated the order of finger taps which varied across trials. The duration of each trial was 15 seconds. Each scanning run consisted of 8 simple and 8 sequential trials, with the order of the trials randomized within a run. Functional images co-aligned with high-resolution whole-brain structural images were motion-corrected, linearly de-trended and spatially normalized and smoothed with a 4 mm FWHM Guassian filter. The deconvolution procedure was used to estimate the hemodynamic response function and to generate the activation maps. A voxel-based Student t-test was used to compare the area under the hemodynamic response function in the Simple and Sequence conditions.



RESULTS

Activation foci identified by the deconvolution procedure were limited to the supplementary motor area (SMA) and contralateral primary sensory-motor area (SM1) in the Simple condition. For the Sequence condition, activation was observed in these areas and bilateral premotor cortex (PMC) and posterior parietal cortex (PPC). When the two tasks were directly compared based on the area under the hemodynamic response function, significant differences were seen in bilateral PPC and ipsilateral PMC.

Discussion and Conclusion

Our results demonstrated that the bilateral PPC and ipsilateral PMC were only activated during sequential movements, while SMA and contralateral SM1 were engaged during both simple and sequential movements. Whether PPC and PMC are specialized for sequential movement needs to be further confirmed. It is also possible that these areas reflect the greater demands on response selection in the Sequence condition as well as the processing demands involved with analyzing the instruction cues.