Using Fnirs and 3-d Digitizer to Investigate the Modality Effect in the Executive Function of Working Memory

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Intro.:
This study uses functional near-infrared spectroscopy (fNIRs) to inspect the modality effect in the executive function of working memory. With 52 fNIRs channels covering the prefrontal cortex, both oxy- and deoxy-hemodynamic signals are recorded during the memory-updating tasks for tones, digits, and letters.
Method:
Each task contained 20 sessions, and each session was divided into resting and execution periods. In the control session, subjects received the same material stimuli without responding to the stimuli. The raw fNIRs recordings first underwent band-pass filtering, artifact removal, and baseline correction. Afterwards, the peak values of the oxy-hemodynamic recordings were extracted during each execution period, and the anatomic positions of all channels were mapped onto a standard brain according to the 3-D digitizer. The oxy-hemodynamic levels per unit area in each Brodmann region were then derived, and the modality effects in different regions were identified by t-test.
Results:
Digits activate the brain on both central and left prefrontal cortex, especially for left BA21 and BA40. Activation for letters is balanced between left and right regions. Tones activate mostly the central area and have relatively higher value on the central-right side.
Implications:
With standard signal-processing flow and registration to the standard brain, the fNIRs recordings indicate significant different activation of the prefrontal cortex during different memory-updating tasks. The dynamical changes of the oxy-hemodynamic levels will be further explored to investigate the signal-processing flow in the prefrontal cortex.

Keywords: fNIRS, Working memory

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