

# Mapping Control of Attention Switching Within Vision and Between Auditory and Visual Modalities with FMRI

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These experiments examine the localization of attentional control. Attentional control appears to be spatially localized in specific cortical regions including parietal, frontal and cingulate cortex and subcortical thalamic and superior colliculus regions (1). Corbetta (2) has demonstrated superior right parietal cortex activation when attentionally tracking a moving stimulus within a hemifield. These experiments examine attention switching with functional Magnetic Resonance Imaging (FMRI) to determine the spatial distribution of related attentional switching operations within subject. The goal was to determine the number, location and specialization of attentional control regions when switching attention between visual locations, auditory locations, and between visual and auditory modalities within subject.

**Method.** Subjects performed a sequential monitoring task following series of characters for an out of sequence character (e.g. the letters A, B, C, D, E, R, G, H...). The characters occurred either in the lower left visual field, lower right visual field, left ear, or right ear. The to-be-monitored sequence occurred either in a fixed location (e.g., all in lower left position) or switched locations (switched visual alternated between left and right visual field; switched auditory alternated between left and right ear; or switched modality alternated between auditory and visual modality). The to-be-ignored channel included distracting stimuli with similar sensory characteristics (digits). For example in the visual condition the subject would see the character sequence A5 2B C3 9D E4 7R G9 with the two characters separated across the visual midline spaced several degrees apart. The subject switched between the first and second position detecting the error in the letter sequence. In the sequential condition attention was maintained in a single location (e.g., A5 B2 C3 D9 E4 R7 9G). Behavioral studies were run to practice subjects and determine the stimulus rate providing good detection (75%-90%) for all conditions. FMRI was performed on a GE 1.5T scanner with a BOLD contrast imaging sequence using a multi-slice spiral k-space pulse sequence(3) utilizing an oscillatory paradigm (4).

**Results.** The within visual spatial attention switching results revealed a region lateralized to the right superior parietal cortex as active when attention switched between spatial locations and independent of visual field location. This area was less active when attention remained fixed at one location. Areas in the left superior parietal and right inferior parietal cortices were also implicated. These results were similar to those reported in a PET regional blood flow study conducted by Corbetta (2). Initial results from the between modality conditions showed greater behavioral deficit than within modality switching. The FMRI results illustrating the to co-localization of auditory and visual attentional control regions will be presented.

<sup>1</sup>Schneider, W., Pimm-Smith, M., & Worden, M. (1994). The neurobiology of attention and automaticity. *Current Opinion in Neurobiology* 4, 177-182.

<sup>2</sup>Corbetta, M., Miezin, F.M., Dobmeyer, S., Shulman, G.L., & Peterson, S.E. (1993). Selective and divided attention during visual discriminations of shape, color, and speed: Functional anatomy by positron emission tomography. *The Journal of Neuroscience*, 11: 2382-2402.

<sup>3</sup>Noll, D. C., Cohen, J. D., Meyer, C. H. & Schneider, W. (1994). Spiral k-space MRI of cortical activation. *Journal of Magnetic Resonance Imaging*, 5, 49-57.

<sup>4</sup>Worden, & Schneider, (1995) Cognitive task design for FMRI. *International Journal of Imaging Science & Technology*, 6, 253-270.