Studying Familiarity of Different Stimulus Types

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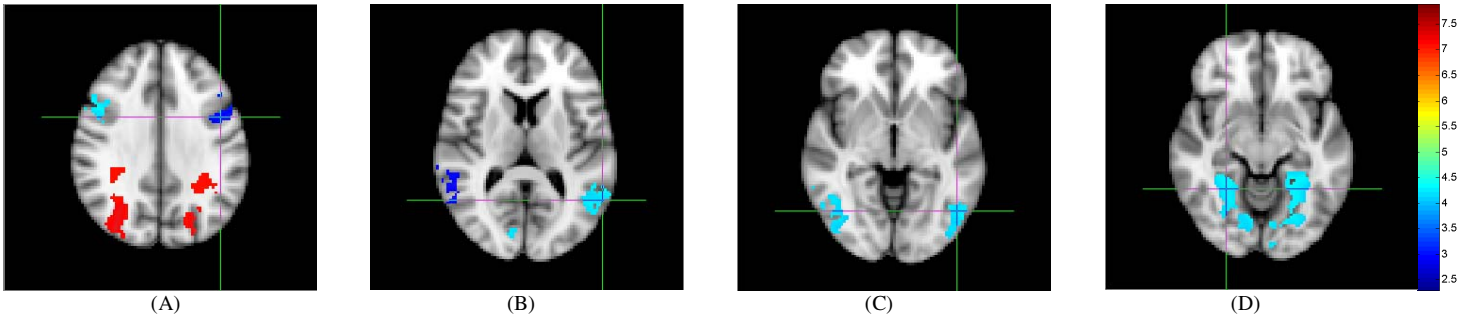
Introduction People give different neural responses to familiar and unfamiliar stimuli in their environment. Distinct brain regions related to recognition of familiar and unfamiliar faces, sounds or scenes have been widely demonstrated in the fMRI studies [1-3]. We aim to explore how previous job related experience about a specific stimulus type affects the extend and location of fMRI response regions.

Materials and Methods: 10 healthy radiologists and 11 normal volunteers (aged 20-40 years, mean age 28) with no history of neurological or psychiatric disorders participated in the experiment. Data from two subjects in radiologists group were discarded due to unsuccessful registration because of high motion artifacts. Stimuli consisted of four different natural scenes and four different brain MR images given in two separate boxcar block paradigms in two unconnected functional scanning sections. In all sessions, a block consisting of natural scenes or brain MR images alternated with a rest block. Each block lasted 21 s with four on-states and four off-states. While displaying brain MR images radiologists were told a priori to try to diagnose the presented image. A Siemens 1.5T MR system (Siemens, Erlangen, Germany) was used to acquire T_2^* weighted images (TR / TE / FA = 4130ms / 50ms / 90°, matrix size = 64 × 64, 36 axial slices, voxel size = 3.125 × 3.125 ×3.175) with a gradient echo (GE) planar imaging (EPI) sequence. fMRI data preprocessing and analysis were performed using FSL software (FMRIB's Software Library, http://www.fmrib.ox.ac.uk/fsl). For all subjects, these pre-processing steps were applied: motion correction, spatial smoothing using a Gaussian kernel of FWHM 5mm, and high-pass temporal filtering. Functional images were registered to a standard template (MNI152, 2mm). Statistical analysis of the time series data were performed using a boxcar model convolved with Gamma function. Statistical parametric maps of the first level were fed into a fixed effect group analysis for each group where thresholded with using cluster $Z < 2.3$ ($P = 0.05$) for significant brain activation to contrast two sessions. Coordinates of local maxima of each cluster were converted to Talairach space by using Talairach Daemon Client version 1.1 (Research Imaging Center; University of Texas, Health Science Center, San Antonio, TX)[4].

Results: We compared activation maps that belong to brain MR images and natural scenes in each individual group to examine whether visualization of two different stimuli were associated with different patterns of neural activity. In the radiologists' group, "brain MR image > natural scene contrast" demonstrated strong activation in fusiform gyrus (-49, -60, -12) (z = 7.94), inferior frontal gyrus (-45, 3, 32) (z = 4.65), precental gyrus (44, 6, 35) (z = 4.58), middle frontal gyrus (25, -12, 55) (z = 4.23), medial frontal gyrus (-10, 14, 42) (z = 3.47) whereas "natural scene > brain MR image contrast" revealed activation in supramarginal gyrus (59, -39, 33) (z = 4.7), middle temporal gyrus (-56, -56, 8) (z = 4.44), middle occipital gyrus (19,-85,14) (z = 5.24) and precuneus (8, -69,22) (z = 4.94). (Fig. 1 A&B)
The group analysis that contrasted the radiological images and natural scenes conditions performed within the volunteer group showed stronger response in inferior occipital gyrus (-41,-72,1) (z = 5.05), posterior cingulate (-1, -53, 20) (z = 3.6) during radiological image type of visual stimuli and parahippocampal gyrus (25, -48, -9) (z = 6.74) and middle occipital gyrus (-33, -76, 18) (z = 5.66) during natural scene type of visual stimuli. (Fig. 1 C&D)

Discussion: Visual stimuli that is familiar to the subject through job related experience induced bilateral activation in frontal lobe (inferior frontal gyrus, precentral gyrus, middle frontal gyrus and medial frontal gyrus) and left fusiform gyrus. These areas are known to be activated during the visual imagery of famous faces which suggests that these regions may be involved in general neural tasks, such as long term memory [6]. Although inferior occipital gyrus and posterior cingulate regions of brain are suggested to be involved in familiarity perception, we have found that these areas are activated in volunteers' group while they are viewing radiological images [5]. In the volunteer's group it has been found that natural scene stimuli leads activation in parahippocampal gyrus which confirms this area selectively activated by scenes over faces [6]. We currently explore further the fMRI activity among other professions using different types of familiar stimuli.



(A) (B) (C) (D)

Fig. 1 Group activation maps of radiologists during radiological scene (A) and natural scene (B) visualization, and of volunteers (C and D, respectively).

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