Evaluation of fMRI Sensitivity Across Multiple Sites

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INTRODUCTION: The Functional Imaging Research in Schizophrenia Testbed Biomedical Information Research Network (FIRST-BIRN) project is one part of an NIH-NCRR initiative that aims to bring advances in computer sciences and informatics to biomedical science. The FIRST-BIRN project links eleven collaborating sites together with high speed internet and shared hardware and software to database, share and analyze fMRI data collected at the participating sites for the purpose of overcoming technical and sociological obstacles to performing multi-institutional large-scale fMRI studies of schizophrenia. The first step toward this goal is to characterize the sources of variability in the fMRI data introduced by collection across sites. These include differences in field strength (1.5T, 3T, 4T), echo time, readout time, k-space trajectory (spiral and EPI), k-space reconstruction strategies, and scanner manufacturer (GE, Siemens, Picker). This abstract begins to characterize variation in the sensitivity of fMRI data collected across the FIRST-BIRN sites (see also HBM abstract by Zou, et al, for a related analysis).

METHODS: Five subjects were scanned with the same protocol twice at each site. Each visit consisted of ten fMRI runs (TR=3s, 85 time points, 64x64x35, 3.4x3.4x5mm). In two of the runs, there was no task (REST). In two other runs, the subject performed a periodic breath hold (BH) task. Each run was motion corrected and smoothed at 5mm. The BH and REST were analyzed using a Fourier model, and each voxel was assigned a significance (no temporal whitening performed). The True-Positive Rate (TPR) was assessed by examining cortical grey matter voxels [1,2] from the BH task under the assumption that breath holding activates all grey matter [3]. The False-Positive Rate (FPR) was assessed by examining the same voxels from the REST condition. The significances for a site were pooled across all subjects, visits, and runs (BH and REST separately pooled) in order to compute the FPR and TPR for that site. The Receiver-Operating Characteristic (ROC) was then determined by plotting the TPR vs the FPR for each member of the consortium.

RESULTS AND DISCUSSION: the FPR, TPR, and ROC curves are shown in Figures 1, 2, and 3. As can be seen, there is a wide range of sensitivities across the sites. For all three figures, the ranking of the sites is almost perfectly predicted by field strength, with stronger fields, in general, being more sensitive but with higher FPR. Increasing FPR with field strength is expected because there is more temporally correlated noise relative to white noise. The variation may also be explained by other factors, including inherent spatial smoothness and misregistration with the cortical ribbon due to B0 distortion.

REFERENCES:
[1] Kwong, et al, MRM, 33: 448-452, 1995.
[2] Dale, et al, NeuroImage, 9: 179-194. 1999.

[3] Fischl, et al, NeuroImage, 9: 195-207. 1999.

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Figure 1:

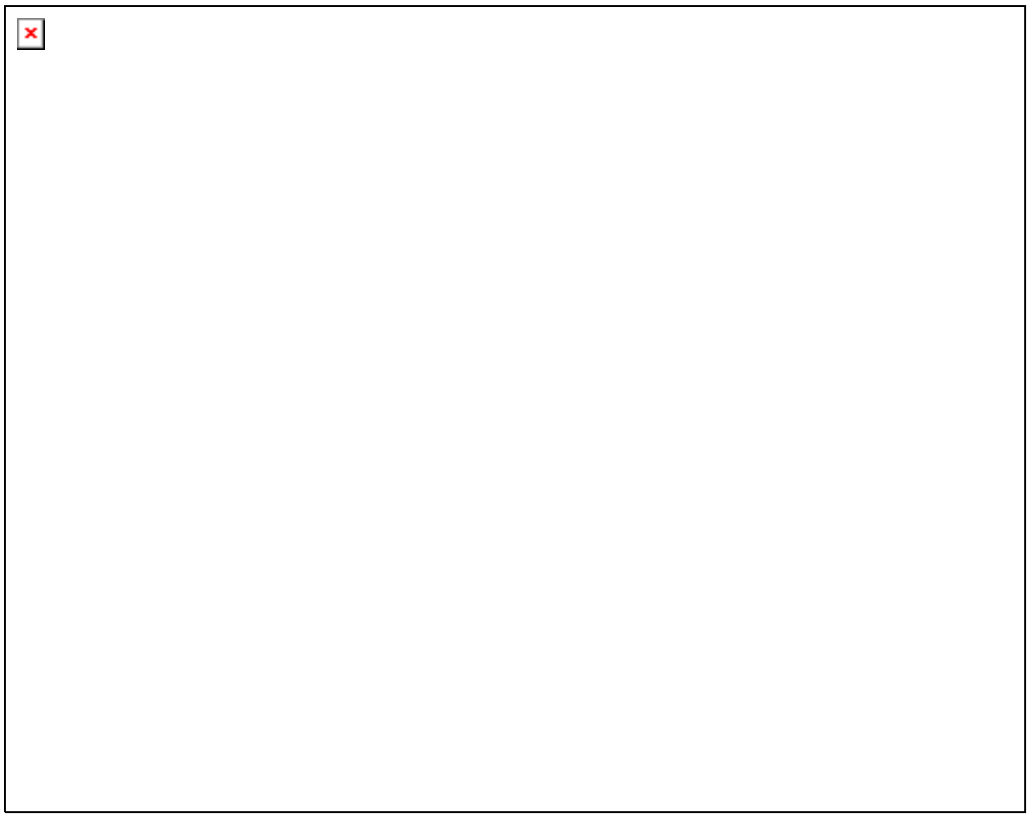

Figure 2:

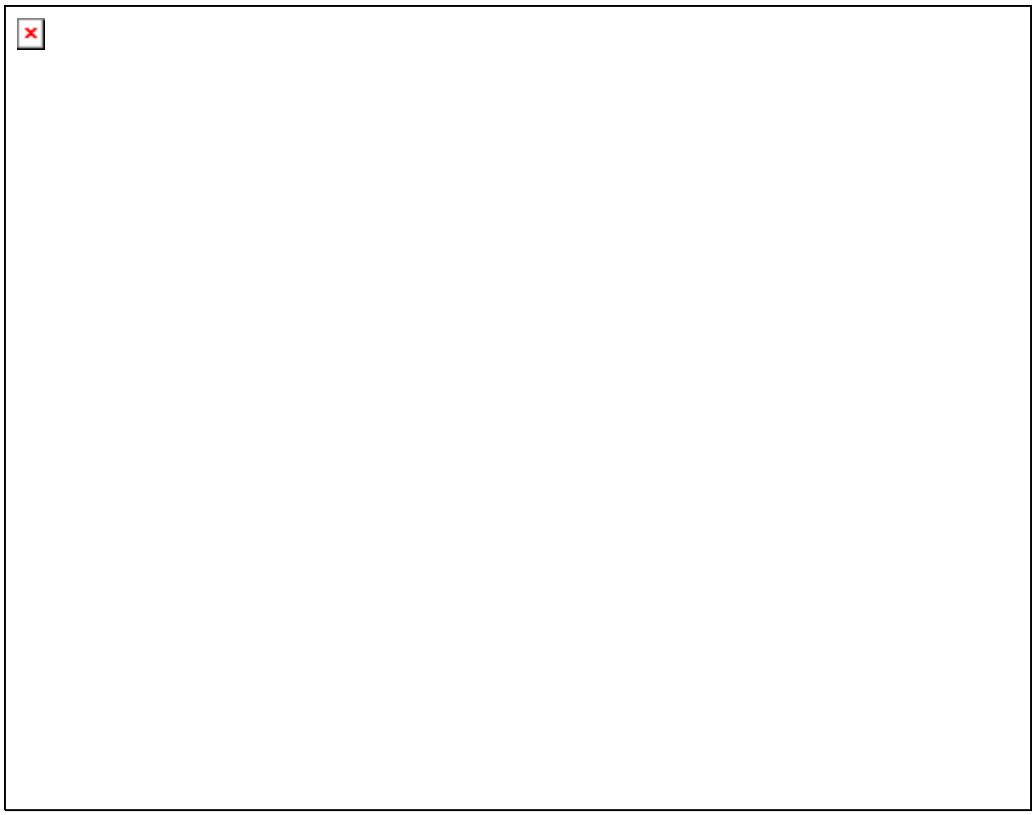

Figure 3: