Analysis of fcMRI data in Schizophrenia

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October 5, 2015

For this project, we seek to understand and analyze the data from the fMRI studies conducted by Repovs *et al.* on the manner in which brain network connectivity is related to schizophrenia [2, 3]. As reported, Repovs *et al.* used a number of brain regions, selected *a priori*, to examine the manner in which connectivity, as measured by correlation in voxel activity across regions, differed across and between controls and individuals with schizophrenia. The cited papers examine the alterations in functional connectivity within brain networks in order to provide evidence that schizophrenia partially reflects a disconnection syndrome. Specifically, resting state fMRI data was collected on 40 individuals with schizophrenia as well as 31 siblings of individuals with schizophrenia, as well as 15 healthy controls and 18 siblings of controls [2]. With data from the experiment, the paper concludes that individuals with schizophrenia showed reduced distal and enhanced local connectivity between the cognitive control networks. Moreover, greater connectivity between the frontal-parietal and cerebellar regions was highly correlated with better cognitive performance across groups. In performing a few basic sanity checks, we found that we were successful in downloading the data and properly loading it into R and Python to perform basic data manipulations, including verification that we did have the right number of subjects and that labeling was correct within the data set as provided.

As a first step in our analysis, we wish to reproduce the basic patterns and assumptions noted in the paper (e.g. we want to identify brain regions that correspond to the Default Mode Network (DMN) and the differences between healthy and schizophrenic individuals at resting state). At this early step, we will leverage only summary statistics (mean, variance) averaged across regions of the brain at arbitrary time steps. We should be able to

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detect differences in fMRI data between the two groups of individuals using this naive approach. We will likely need to perform Talairach coordinate system transformation and potentially motion correction in order to perform valid inference. Using domain-specific knowledge from the literature to guide us, we hope to devise techniques for detecting known patterns in the fMRI data. Since this is an analytic study in statistics, we will perform pre-processing steps on the data only with proper justification as to their effects on the analysis results. As an example, to compensate for slice-dependent time shifts, we will simply remove the first five images from each run during which BOLD signal was allowed to reach steady state. In addition, we may need to perform Talairach coordinate transformation and motion correction if necessary when we are further in the analytic process. To reproduce the results noted in [2], we will compute the average connectivity, through correlations and the Fisher r-to-z transformation; we will then apply separate repeated measures of ANOVAs to compare the groups within and between network connectivity. In order to ensure that the analyses provide valid inference, the False Discovery Rate will be applied to control for multiple comparisons. As a final step in our analysis, we hope to use simple machine learning methods to predict whether a subject is schizophrenic by training a classifier using cross-validation to achieve enhanced predictive value [1].

References

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[3] ———, *Working memory related brain network connectivity in individuals with schizophrenia and their siblings*, Frontiers in Human Neuroscience, 6 (2012), pp. 1–15.