Cortical Surface-Based Analyses in Functional Neuroimaging: Focus on Working Memory in Schizophrenia

Alan Anticevic[1], Donna Dierker[2], Sarah K. Gillespie[3], David C. Van Essen[2], John G. Csernansky, Deanna M. Barch[1]

[1]Washington University in St. Louis, Department of Psychology
[2]Washington University in St. Louis, Department of Anatomy and Neurobiology
[3]Washington University in St. Louis, Department of Psychiatry

A consistent problem in functional neuroimaging is accurate alignment of structural as well as functional data. Many approaches have been used, however most analyses of cortical activation still center on a volume-based representation of the data. Consequently, spatial smoothing as well as alignment is done in the volume domain. This approach can have limitations. Spatial smoothing in the volume domain does not respect spatial topography and cortical organization. Additionally, alignment can be inadequate if inappropriate target atlases are used. Although these issues might present themselves in healthy participants, they can possibly emerge as even bigger problems when examining different patient populations (i.e. movement issues as well as potential structural cortical abnormalities). We attempt to address these limitations through surface-based group analyses in a study of working memory (WM) in patients with schizophrenia. Mounting evidence points to WM deficits and abnormal patterns of dorsal lateral prefrontal cortex (DLPFC) activation as key features of schizophrenia. We administered a '2-back' version of the n-back WM task while participants underwent scans on a 1.5T Siemens VISION system. Each participant's structural scan was used for cortical surface reconstruction using the SureFit method. Participants' fMRI data were mapped directly onto their cortical surface models. Six standard landmarks were used for alignment of cortical surface models to the population-average PALS-B12 atlas. We compared statistical results obtained from the surface-based methodology to results obtained from volume-based analyses in both patients and healthy participants. Furthermore, we demonstrate the importance of spatial topography when performing spatial smoothing of fMRI data.