# Surface-Based Functional Neuroimaging of Working Memory in Schizophrenia

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A major challenge in fMRI work is correct alignment of brain structures across individuals. Additionally, traditional fMRI analyses are conducted in a 3D representation, however there are specific anatomical landmarks for which such a spatial domain is not optimal. Human cerebral cortex is a prime example – most fMRI studies of cortical function use a 3D volume-based (VB) representation, while the cortex is a two-dimensional folded sheet. Another issue in fMRI processing is spatial blurring. In most studies this step is routinely performed in a VB domain. This can result in blurring across inappropriate cortical boundaries. These challenges can be even more difficult to solve when dealing with patient populations that may show enhanced movement and volumetric or shape changes in cortical structures. In order to address these problems, we used a surface-based (SB) analysis strategy in a study of working memory (WM) in patients with schizophrenia (SCZ) and compared it to the traditional VB approach. We made these comparisons when no spatial smoothing was applied to the data and when the data were smoothed in either or both the VB and SB domains.

We administered a '2-back' version of the n-back WM task while participants underwent scans on a 1.5T Siemens VISION system. Cortical surface models were generated from participants' structural scans using the SureFit method [1]. 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 [1]. We conducted t-tests in both volume and surface representations. Results were compared using specific regions of interest (ROI), which were designed to avoid a biased advantage for either volume or surface representations [2]. Furthermore, we examined spatial shifts in activation location in VB analyses when compared to SB analyses.

For the patient group we found that when no spatial smoothing was applied to the data mean t-values in SB analyses consistently outperformed the VB analyses across hemispheres and WM conditions (Figure 1). Statistical analyses performed in the SB representation revealed a consistent localization of activation as the degree of spatial smoothing increased (Figure 2), whereas the VB results showed a spatial shift in the location of activations. This indicates that the smoothing manipulation performed on the surface preserved the original non-smoothed data

configuration, whereas the VB smoothing might have produced topographically inaccurate results. Lastly, comparisons of between group results across hemispheres and task conditions revealed a power advantage for SB analyses. Further, the pattern of group differences was very different for between-group SB analyses when compared to VB analyses, as shown for verbal WM on the left hemisphere (Figure 3), suggesting that inappropriate blurring across cortical boundaries can produce potentially inaccurate estimates of group differences.

References:

1. Van Essen DC (2005) A population-average, landmark- and surface-based (PALS) atlas of human cerebral cortex. NeuroImage 28:635–662.

2. Argall BD, Saad ZS, Beauchamp MS (2006). Simplified intersubject averaging on the cortical surface using SUMA. Human brain mapping 27(1):14.

**Figure 1.**

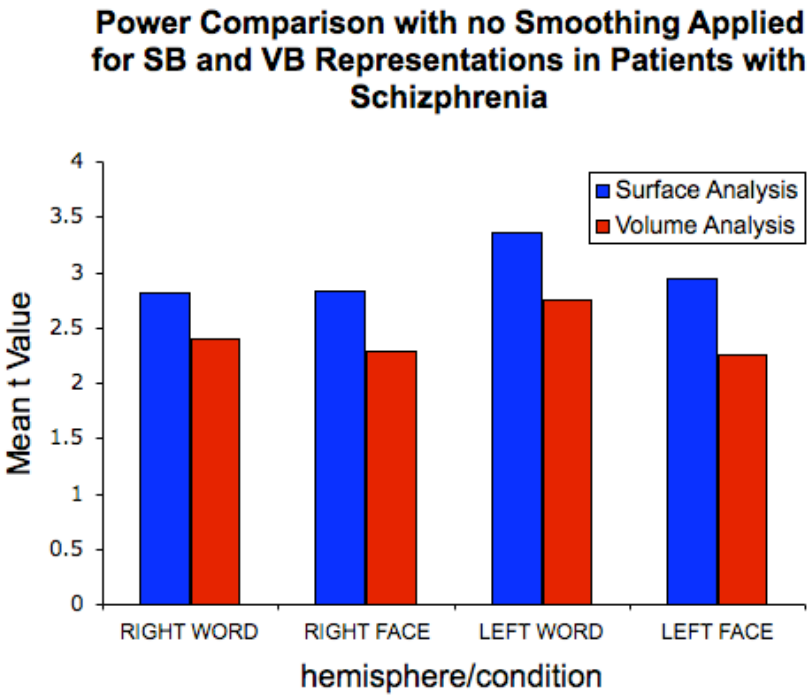

**Figure 2.**

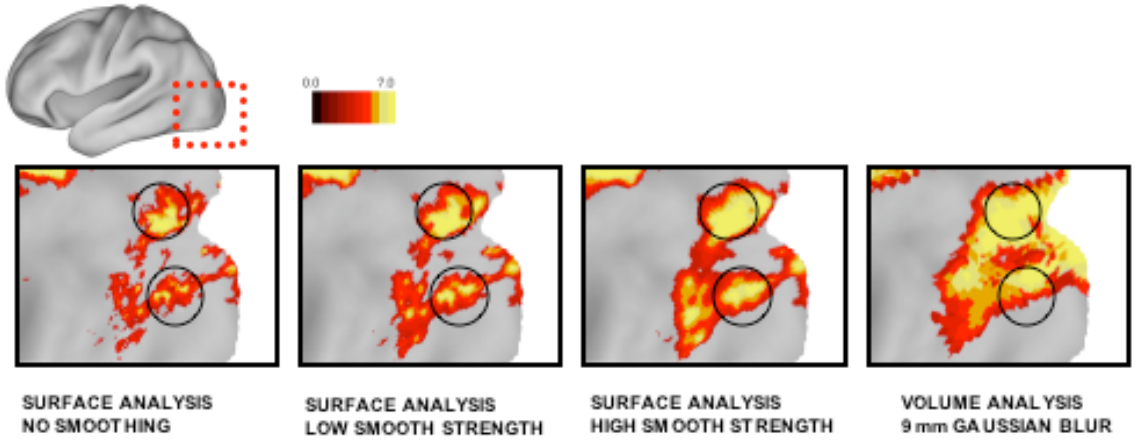


**Figure 3.**