Left Planum Temporale Cortical Thickness Variation in Schizophrenia

Anqi Qiu, Marc Vaillant, Patrick Barta, Michael I. Miller, J. Tilak Ratnanather

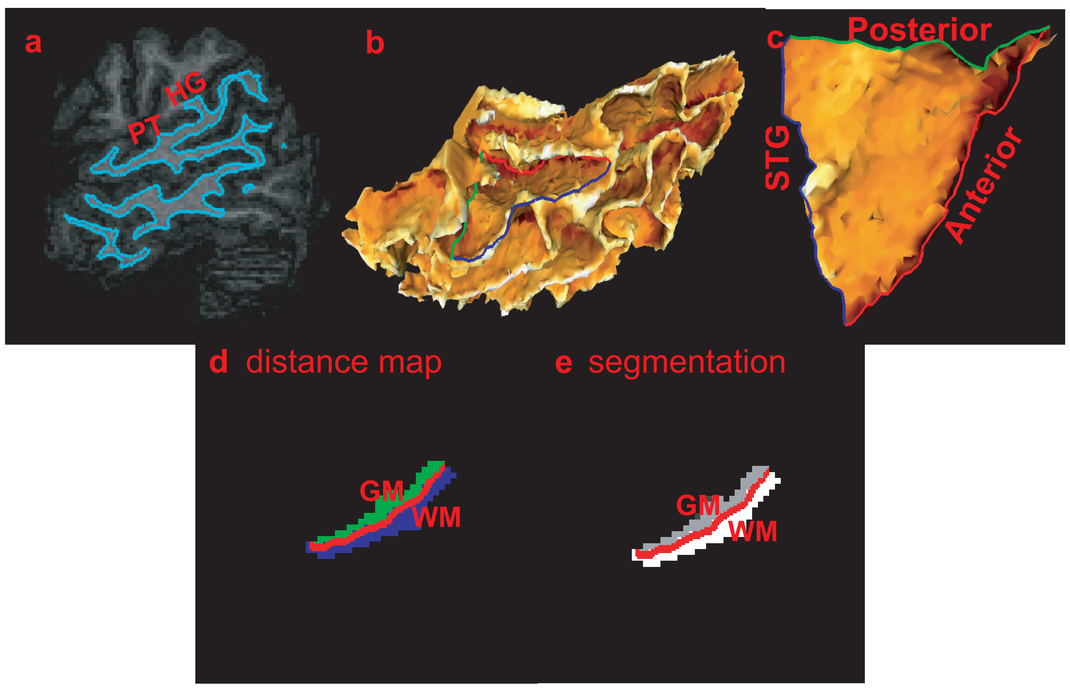
Introduction

Schizophrenia may involve dysfunctions in the posterior regions of the superior temporal gyrus (STG) and the planum temporale (PT) which is associated with complex speech and language processing. Several neuroimaging studies have shown negative correlation between PT gray matter volume and auditory hallucination in the left hemisphere. The cortical structure of the PT suggests that volume is influenced by the cortical surface area and cortical thickness. In this study, we examine the effect of schizophrenia on the cortical thickness of the left PT using cortical surface matching [1] and statistical testing on Gaussian random fields constructed from the bases of the Laplace-Beltrami operator for the cortical surface [2], we examine the effect of schizophrenia on the cortical thickness of the left PT.

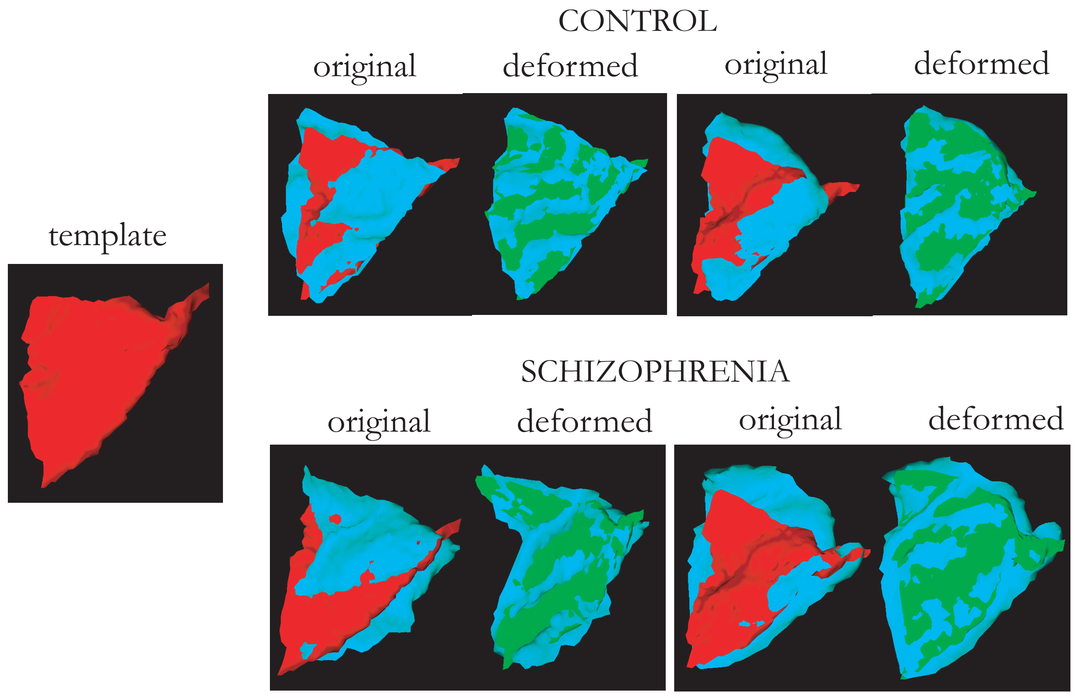
Subjects

Twenty healthy controls (10 men and 10 females, age: 36.5±11.2) and twenty schizophrenia patients (10 men and 10 females, age: 36.5±7.82) were selected. Subjects were scanned using MPRAGE with 1mm^3 resolution.

Data Processing

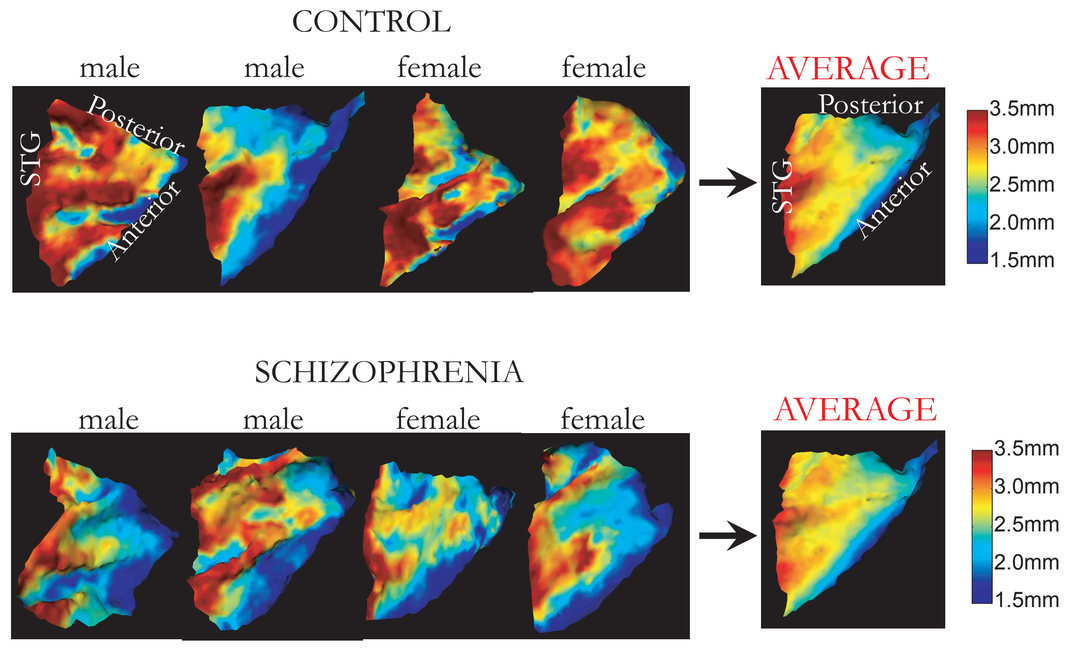


LDDMM-Surface Matching

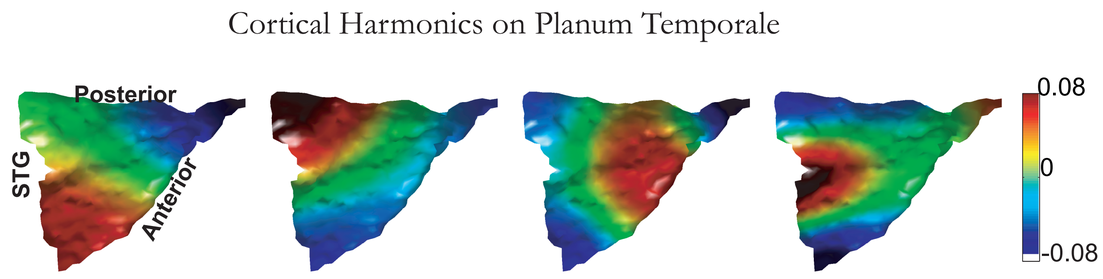


Large Deformation Diffeomorphic Metric Mapping (LDDMM).

Cortical Thickness Maps



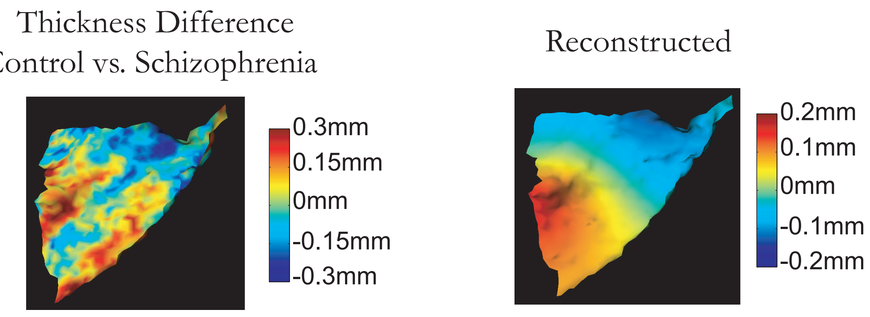
Gaussian Random Field Model



Gaussian Random Field Model :

$$f = f_0 + \sum_{i=1}^{\infty} C_i \cdot \varphi_i,$$

where C_i are Gaussian random variables .



Conclusion

Surface representation of cortical thickness maps combined with surface matching and Gaussian random field theory permits analysis of the non-uniform change in cortical thickness. Hotelling's T2 test on coefficients of the Laplace-Beltrami expansion revealed that the first four components are significantly different between the two groups. The reconstructed difference map in thickness from the first four harmonics of the Laplace-Beltrami operator suggests that the posterior regions of left PT is thicker in the schizophrenia group and the Heschl's sulcus is thicker in the control group. This suggests sensory and hetero-modal variation in cortical thickness may be associated with auditory hallucination in schizophrenia.

References:
[1] M. Vaillant and J. Glaunès, "Surface matching vis currents", IPMI, 3565:381-392, 2005.
[2] A. Qiu, et. al., "Smooth functional and structural maps on the neocortex via orthonormal bases of the Laplace-Beltrami operator", IEEE TMI, submitted.

Center for Imaging Science http://www.cis.jhu.edu

Research supported by NIH under grants: P41-RR15241, R01-MH064838, R01-MH060590, and R01-EB00975.