CORTICAL COMPLEXITY MEASURED VIA REGIONAL SURFACE SHAPE

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Introduction

Few empirical studies have examined individual differences in the frequency of cortical gyrification/fissuration. Existing approaches only provide complexity measures for the whole brain or for specific lobes or brain hemispheres. Here we present a new regional shape measure to evaluate cortical complexity at each point on the cortical surface.

Methods

3D cortical surface models were created from MRI brain scans of 60 healthy adults (30M/30F) in ICBM stereotaxic space. To calculate a local measure of surface convolution, a curvature map was computed on each surface: negative maxima correspond to sulci while positive maxima are associated with gyri. The L2-norm of the computed curvature yielded high values for highly convoluted (folded) areas regardless of whether these areas represent sulci or gyri. We applied a smoothing kernel to locally integrate the L2-norm of the curvature, producing a smooth local measure of the degree of convolution at each cortical surface point. Complexity maps were compared statistically in men and women.

Results

Cortical complexity was higher in females than in males (Fig. 1; right hem.; complexity values are shown in color). Our recent frequency space analysis of cortical complexity computed global fractal dimension measures for the five different lobes in each hemisphere (Luders et al., Nature Neuroscience, 2004). In contrast, the present method provides detailed measures of cortical convolution at each point of the 3D surface in the same set of data. Interestingly, both approaches revealed higher complexities in females compared to males.