Structural MRI analysis of the brains of patients with dyslexia

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1. Introduction

The minicolumn is generally considered an elementary unit of the neocortex in all mammalian brains. Enlargement of the cortical surface is believed to occur through an addition of minicolumns rather than a single neuron \cite{1}. The aims of this study are two fold: 1) to investigate the difference between normal and dyslexic patients vis-a-vis the minicolumns; 2) to quantify the difference as volumetric measures using MRI data.

2. Methods

In Dyslexia, the brain is proved, pathologically, to have less number of minicolumns than in normals. The converse is true in autism. In the normal brain minicolumnar interconnectivity is on the order of 1000. If connectivity were fixed as the brain size increased, the number of connections (white matter) would scale as the number of minicolumns squared. The study of Herbert et al. \cite{2} showed that the volume of the white matter in the autistic brain is larger than in normals. Our study aims to prove the converse in dyslexic patients: that the volume of the white matter is reduced. The study uses MRI data from 16 dyslexic patients and 14 controls matched for gender, age, educational level, handedness and general intelligence.

The general frame work of the study is as follows: 1) volumetric measurements of the white matter for dyslexic normal subjects will be calculated through image segmentation; 2) A parcellation algorithm is applied to separate the white matter into inner and outer compartments according to the distance from the gray matter cortex; i.e., the outer contour of the gray matter is allowed to move inwards to get an artificial contour parallel to the former one. This contour parcels the white matter into inner and outer compartments, and then the volume of each compartment is calculated for normals and dyslexic patients. The parcellation step focuses the volumetric measurements towards the outer compartment --closer to the gray matter—hence, enlargement in the white matter would be attributed to communications between minicolumns.

3. Results and conclusion

The preliminary volumetric measures show significant difference between normal and dyslexic people. Further statistical analysis will be provided in the future work.

4. References


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