Multivoxel pattern analyses of brain structure to classify dyslexia

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• Previous research has shown inconsistent results on neuroanatomical differences between control and dyslexic groups.
• Studies have used various morphometric measures and small sample sizes.

Research question:
Do local differences in gray matter density (GMD) or white matter density (WMD) across the whole brain characterize dyslexia?

• Using univariate voxel-based morphometry analyses, we found no significant difference in GMD or WMD between control and dyslexia.
• We used two machine learning models to classify WMD and GMD maps into two groups.

Summary
• Nested cross-validation procedure for parameter optimization with Extra trees classifier and shuffle-split cross validation.

Data acquisition
Siemens Trio 3T; 32-ch coil; T1 ME-MPRAGE; 1mm³ voxels

Data preprocessing
• Each subject’s T1 image was segmented into gray matter, white matter and CSF; then the GMD and WMD were calculated, all using Atropos in ANTs.
• Each subject’s GMD and WMD maps parcellated using Freesurfer.
• Mean GMD and WMD within each parcel was calculated.
• Parcellated GMD and WMD maps were normalized to MNI template.

Subjects

<table>
<thead>
<tr>
<th></th>
<th>Control (n=56)</th>
<th>Dyslexia (n=52)</th>
</tr>
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<tbody>
<tr>
<td>Mean age (range)</td>
<td>22.83 (18-32)</td>
<td>23.84 (18-38)</td>
</tr>
<tr>
<td>Sex</td>
<td>F 31 / M 25</td>
<td>F 38 / M 14</td>
</tr>
<tr>
<td>Non-verbal IQ (WASI)</td>
<td>116 ± 9.5</td>
<td>111 ± 12.4</td>
</tr>
<tr>
<td>WRMT ID</td>
<td>105 ± 13.4</td>
<td>96 ± 11.5</td>
</tr>
<tr>
<td>WRMT WA</td>
<td>103 ± 14.9</td>
<td>89 ± 13.0</td>
</tr>
<tr>
<td>TOWRE SWE</td>
<td>101 ± 16.0</td>
<td>87 ± 16.2</td>
</tr>
<tr>
<td>TOWRE Decoding</td>
<td>100 ± 16.5</td>
<td>85 ± 13.6</td>
</tr>
</tbody>
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Control (n=56) Dyslexia (n=52)  

Non-verbal IQ (WASI)  

WRMT ID  

WRMT WA  

TOWRE SWE  

TOWRE Decoding  

Discussion
• No significant difference was found in GMD or WMD between control and dyslexia groups.
• A large number of subjects and multiple different approaches are necessary to explore neuroanatomical difference between control and dyslexia groups.
• The results suggest no evidence that dyslexia is characterized by macro-morphological features of the whole brain.
• This is a preliminary study of a larger future study involving more than 1000 brains.

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References