Multivoxel pattern analyses of brain structure to classify dyslexia

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Summary

- Previous research has shown divergent 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.

Subjects

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

Data acquisition

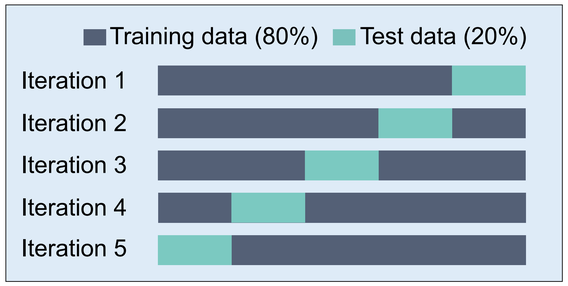
Siemens Trio 3T; 32-ch coil;
T1 ME-MPRAGE; 1mm^3 voxels

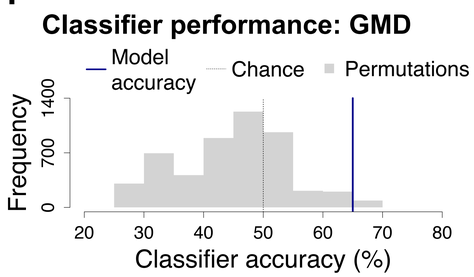
Data preprocessing

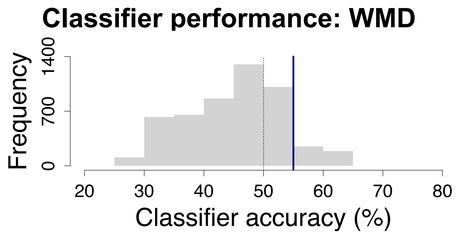
- Each subject's T1 image was segmented into gray matter, white matter and CSF; then the GMD and WMD were calculated, all using Atropos in ANTs.
- Each subject's GMD and WMD maps parcellated using Freesurfer.
- Mean GMD and WMD within each parcel was calculated.
- Parcellated GMD and WMD maps were normalized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

Model 1

- 5-fold cross-validation with SVM classifier
- GMD was classified with accuracy of 65.5%; Classification accuracy for WMD was at 55.2%

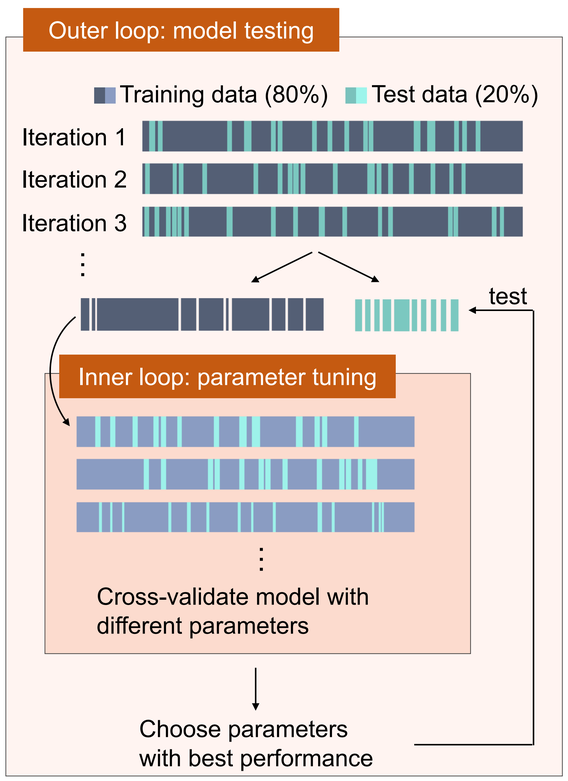




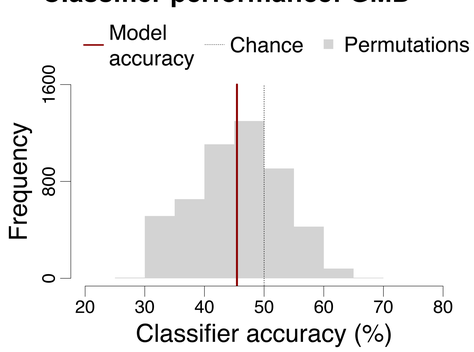


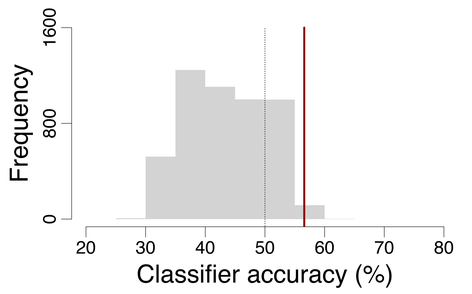
Model 2

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



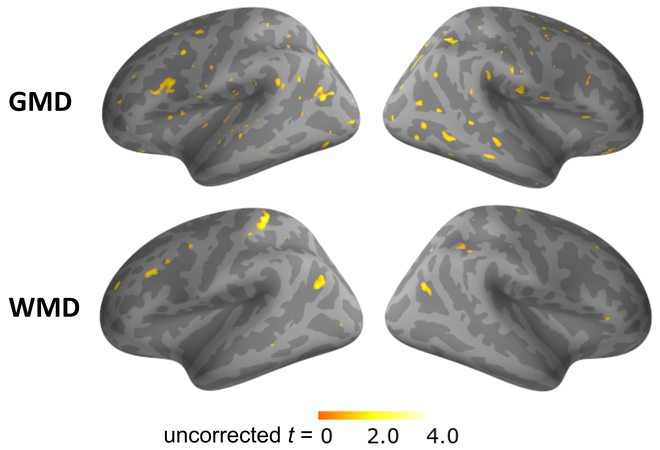
- Classification accuracy for GMD was at 45.5%, not significantly better than bootstrapping.
- Classification accuracy for WMD was at 56.6%.





VBM

- There was **no significant difference** in GMD or WMD between control and dyslexic groups.



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.

Acknowledgments

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