Neuroanatomical signatures of dyslexia found in microstructural but not macrostructural features of the superior temporal plane

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Summary

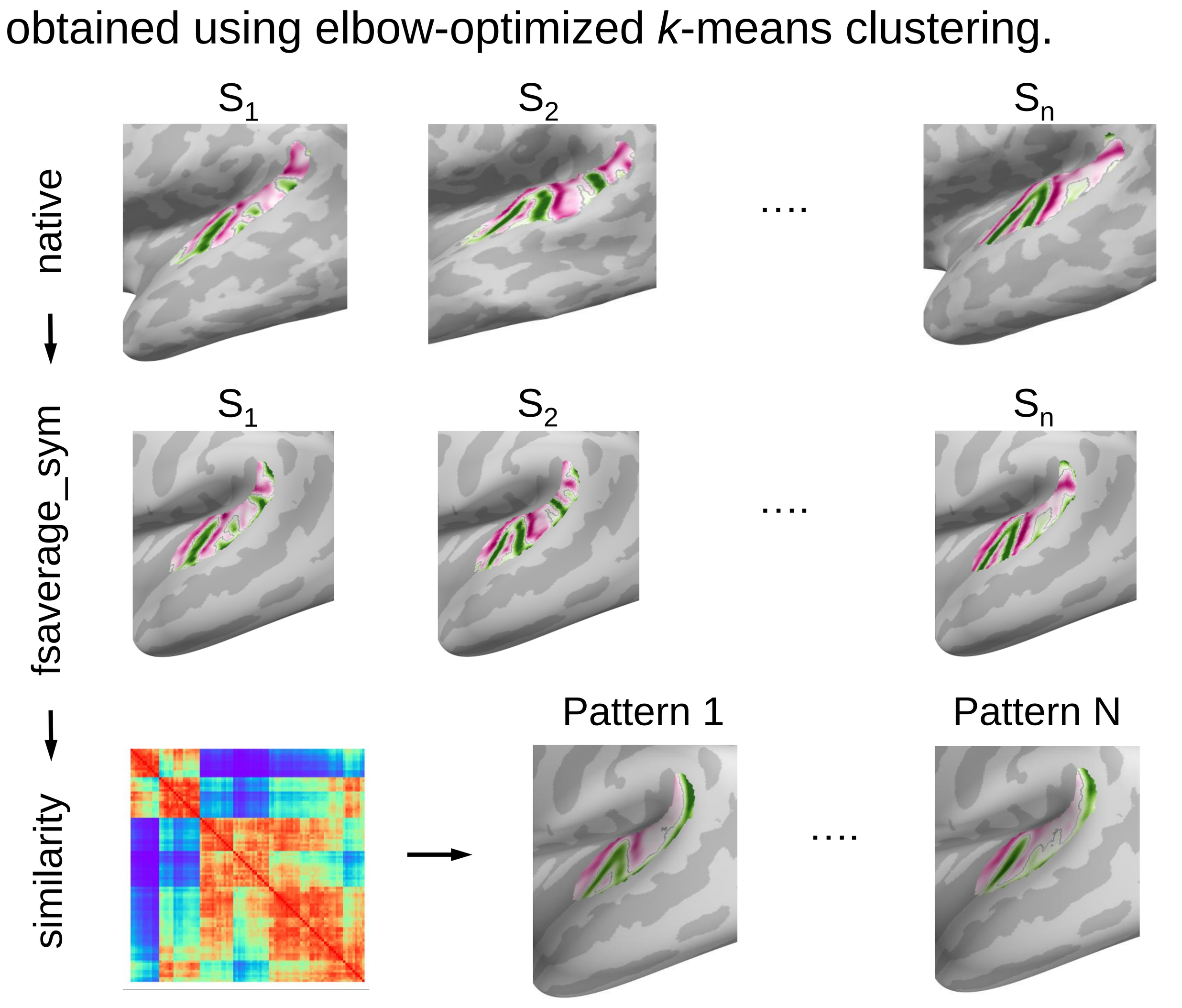
- Dyslexia is widely believed to have a neurological basis (Norton et al., 2015). Early neuroanatomical studies purported to find atypical gyrification of the superior temporal plane (STP, including Heschl's gyrus (HG) and planum temporale (PT)) in dyslexia.
- However, these findings were based on small samples that underestimate the enormous variation in these structures.
- We investigated whether features related to the cortical macrostructure (gyral configuration and local cortical curvature) or microstructure (intracortical myelination) of the STP differentiate the brains of adults with dyslexia.
- **Our results suggest neuroanatomical signatures of dyslexia may be present in microstructural, but not macrostructural, features of the brain.**

Feature-based Clustering

Participants: N = 49 adult participants (24 control, 25 dyslexic; 34 female, 15 male; age 22.60 ± 3.53 years).

MRI Processing: Local measures of curvatures were obtained from the surface reconstructions. T1w/T2w maps were computed after N4 bias correction and intensity calibration (Ganzetti et al., 2014).

Feature-based Clustering: We registered individual surfaces to *fsaverage_sym* and calculated the Gaussian similarity separately for local curvature and T1w/T2w within the STP between all pairs of subjects in sample 2. Common patterns of curvature or myelination were obtained using elbow-optimized *k*-means clustering.

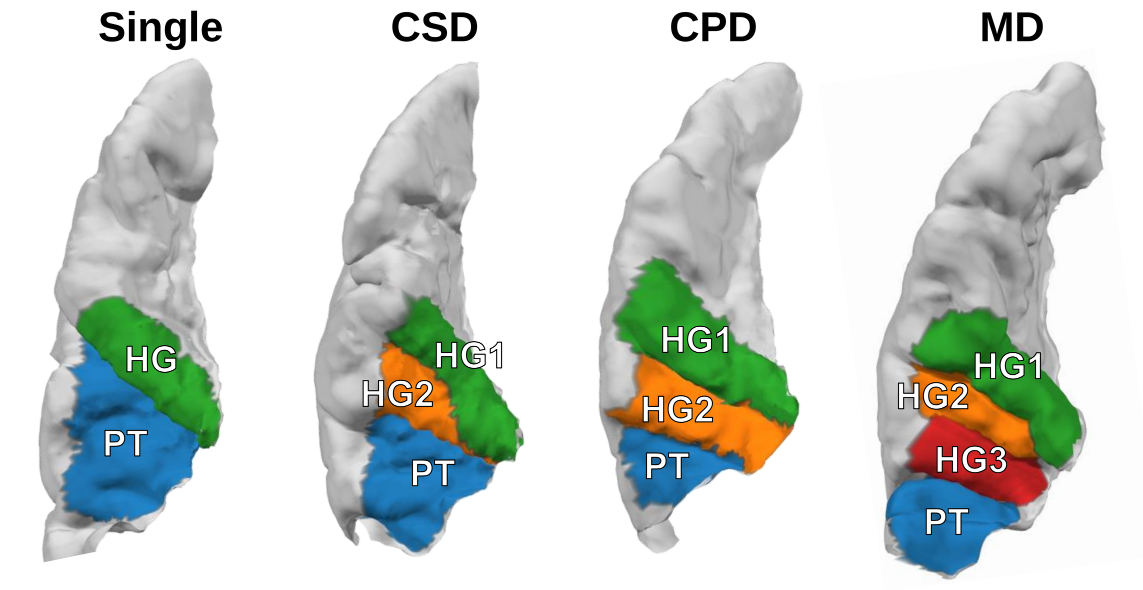


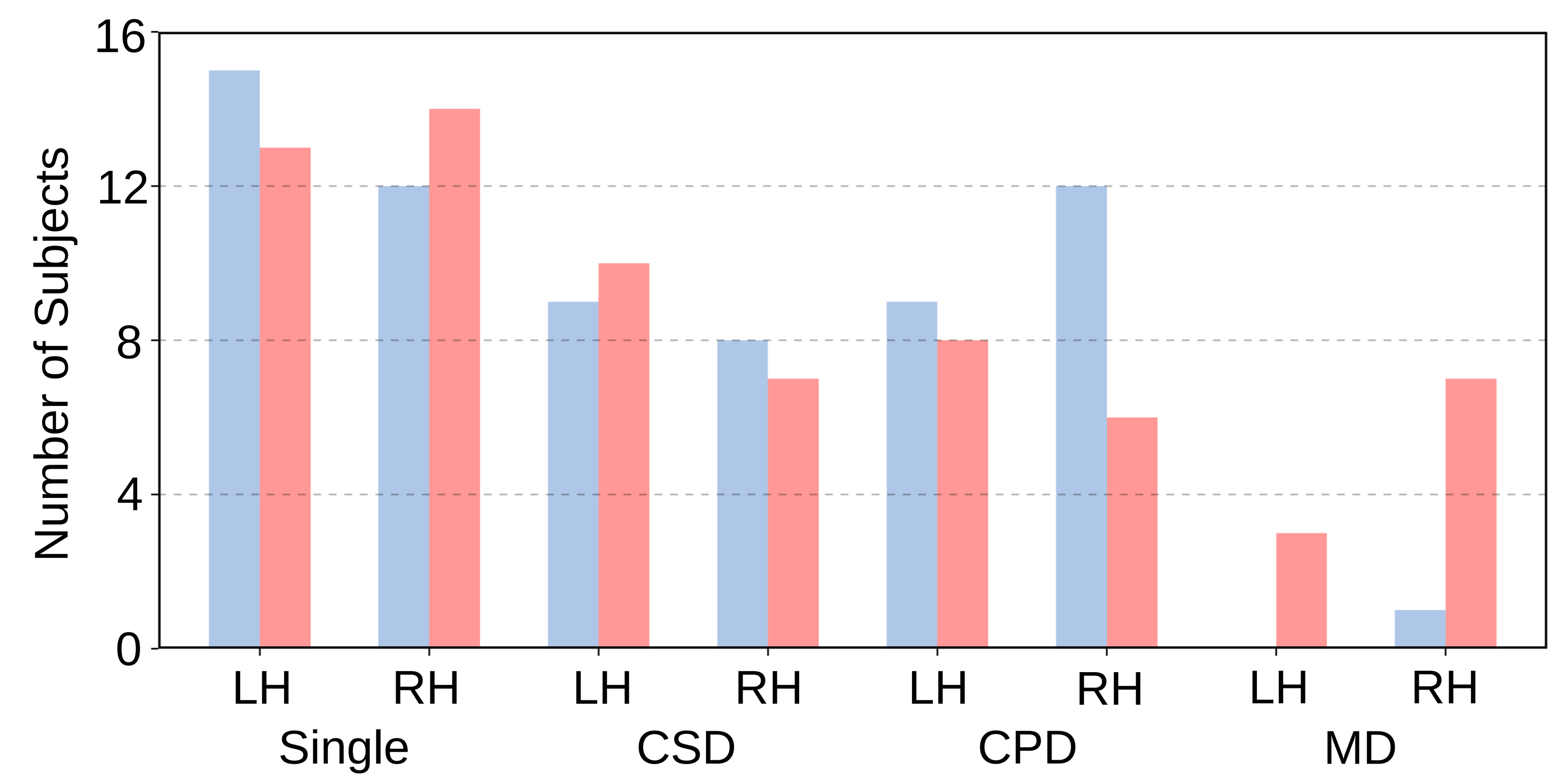
Manual Labeling

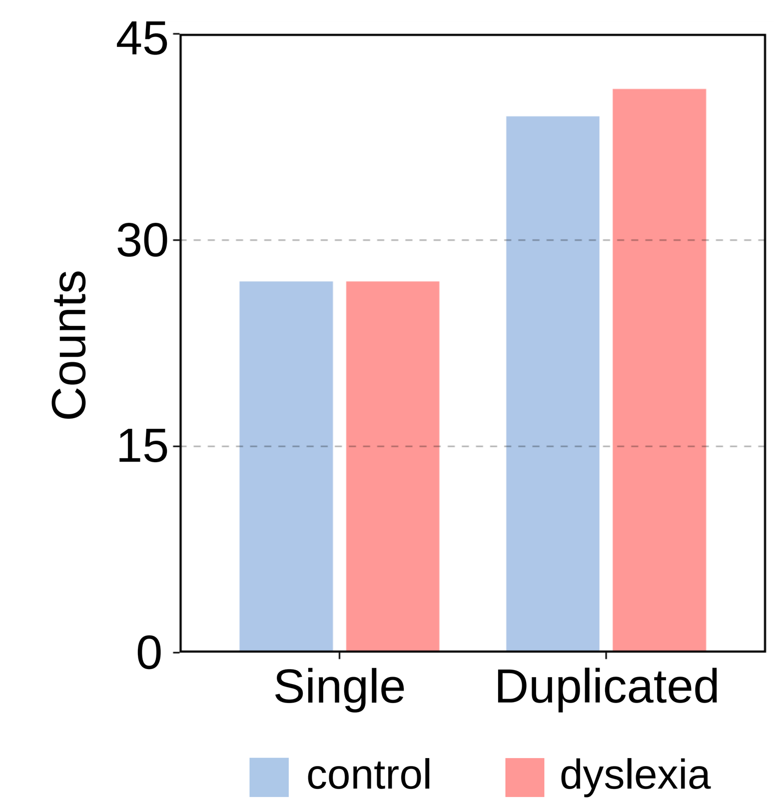
Participants: N = 67 adult participants (33 control, 34 dyslexic; 42 female, 25 male; age 22.86 ± 4.49 years).

MRI Processing: T1-weighted (T1w) and T2-weighted (T2w) anatomical volume were used to perform cortical reconstruction using the default processing stream *recon-all* in FreeSurfer v6.0.0.

Manual Labeling: We manually classified HG gyrification patterns into single gyrus (Single), common stem duplication (CSD), complete posterior duplication (CPD), and multiple duplication (MD) for each subject.

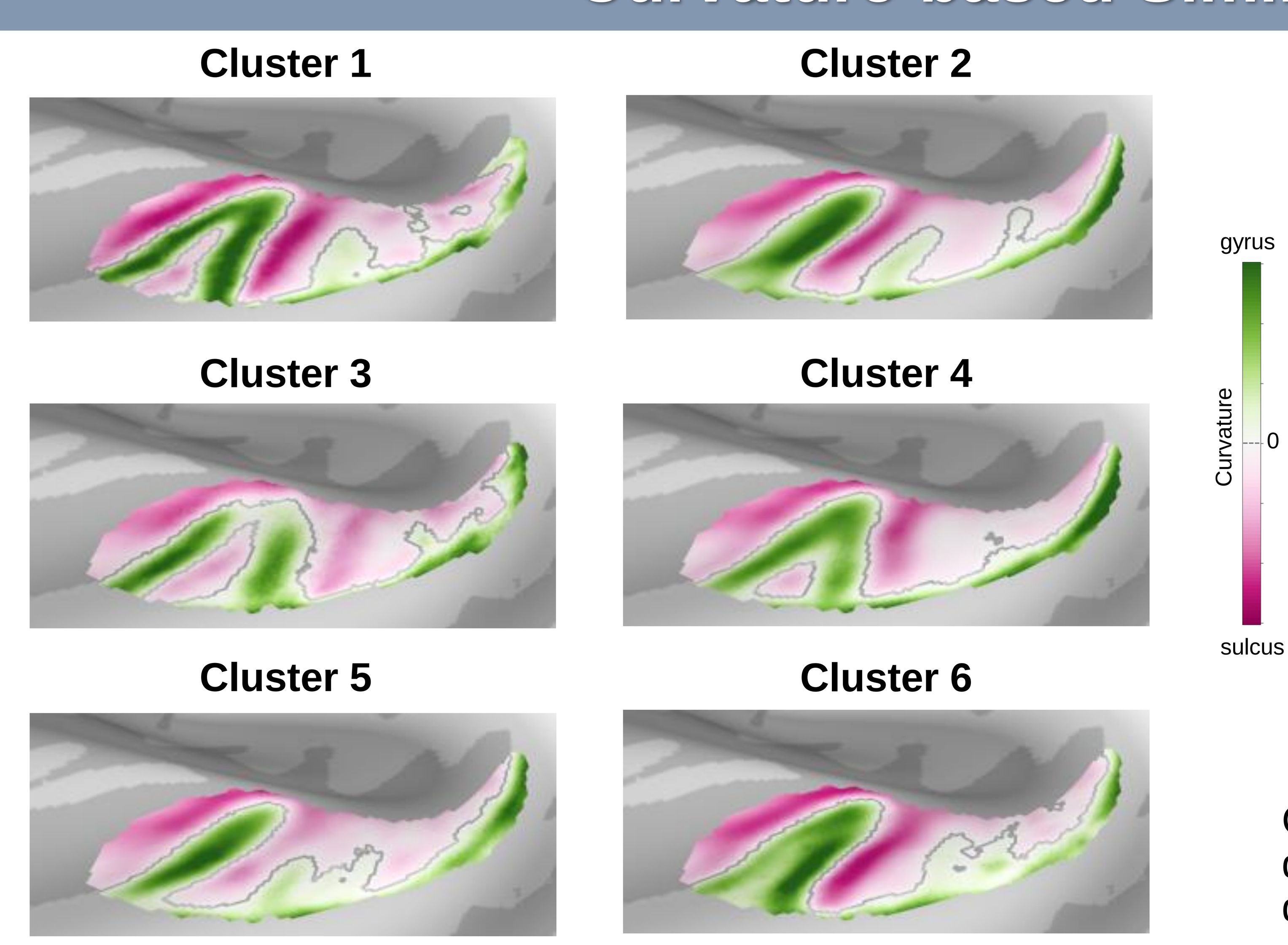


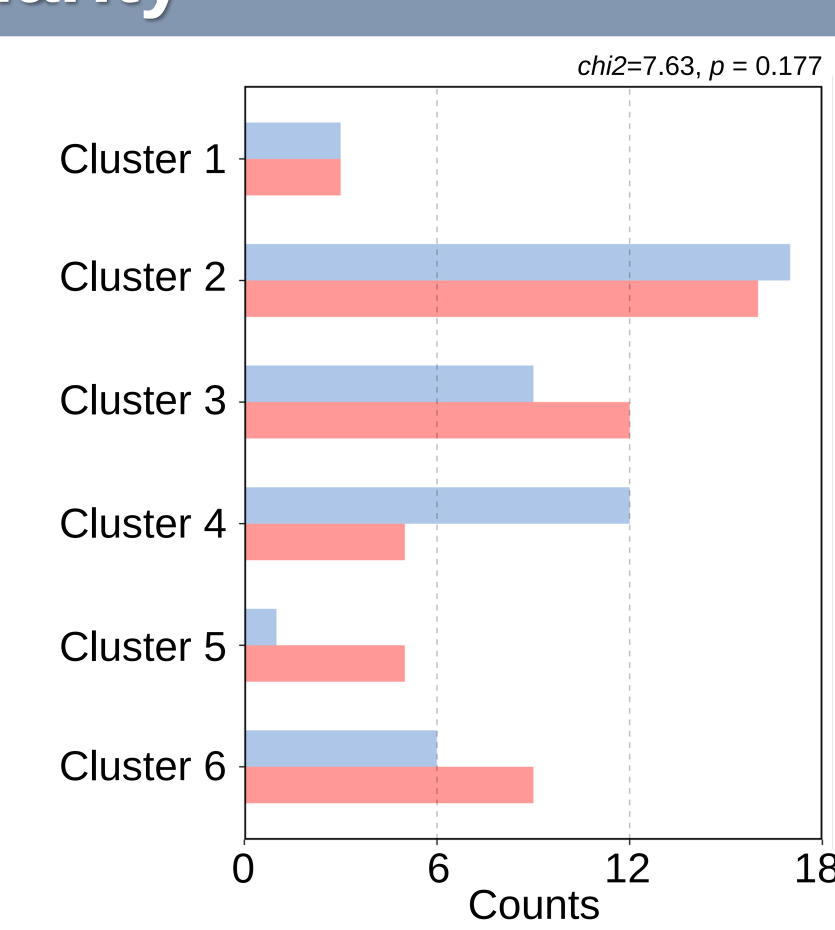




No difference in the likelihood of finding different morphotypes of HG in control vs. dyslexia.

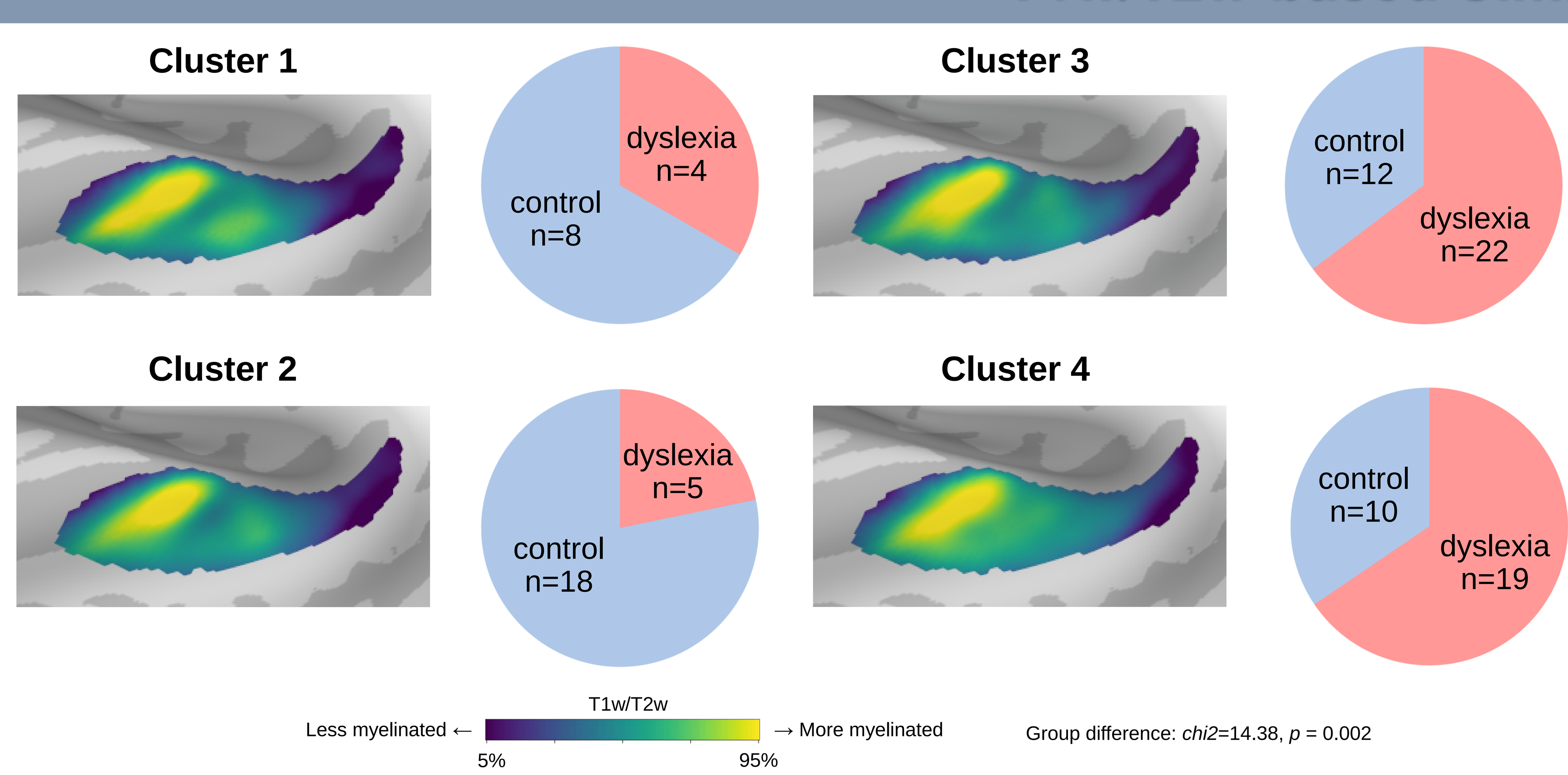
Curvature-based Similarity

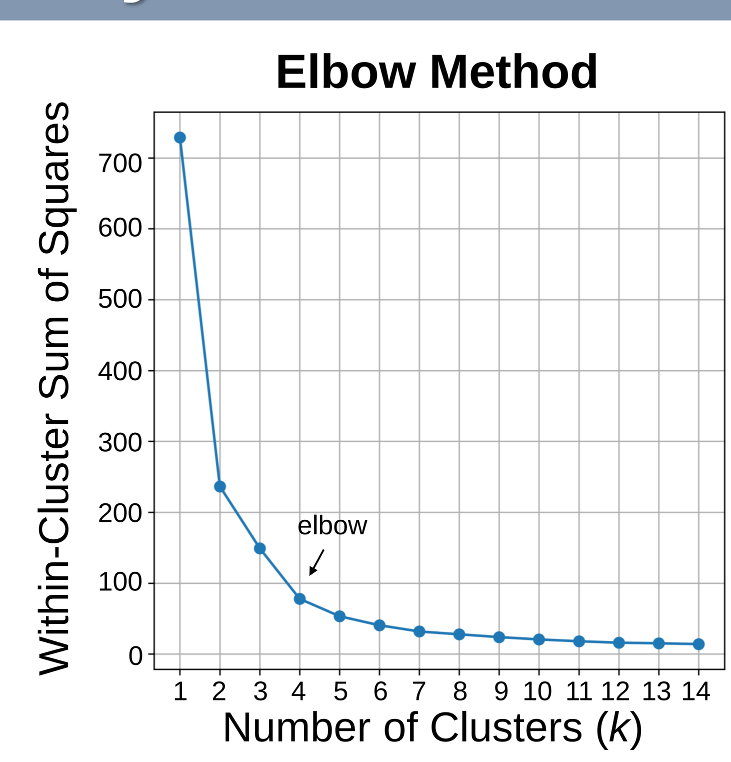


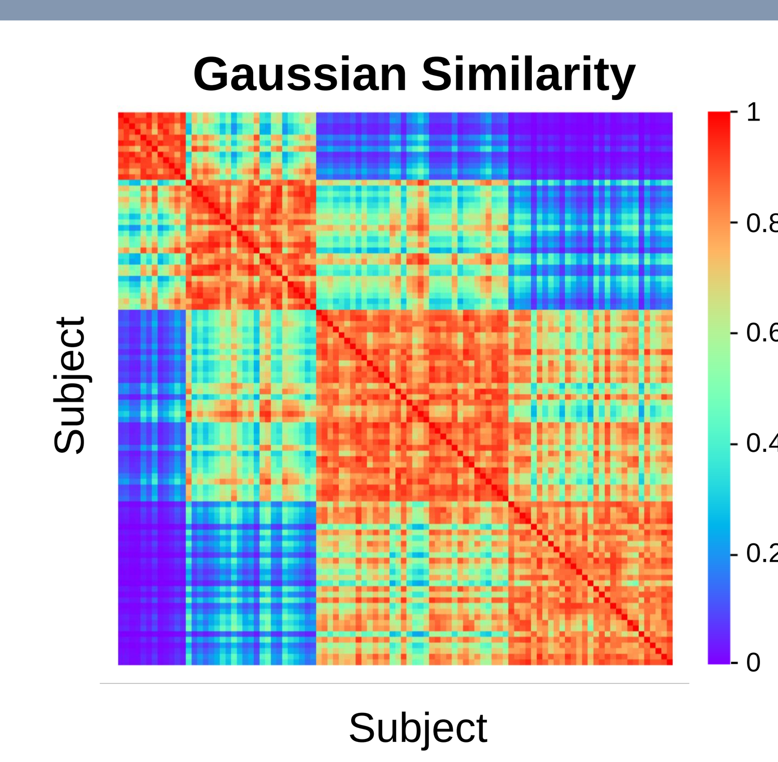


Clustering based on curvature revealed distinct configurations of HG but did not differentiate the groups.

T1w/T2w-based Similarity







Clustering based on local intracortical myelination patterns did significantly distinguish dyslexia from control brains.

Future direction: Integrated depictions of the macrostructural differences in dyslexia brains.

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References: [1] Duan et al., *Human Brain Mapping*. [2] Ganzetti, Wenderoth, & Mantini, 2014, *Frontiers in Human Neuroscience*. [3] Glasser & van Essen, 2011, *J of Neuroscience*. [4] Marie et al., 2015, *Brain Structure & Function*.