Differences in left fusiform gyrus morphometry in adults with dyslexia: Voxel- and surface-based analyses

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Introduction

Dyslexia is a neurological disorder that impairs the development of reading skills. Structural neuroimaging has not converged on reliable neuroanatomical signatures of reading impairment.

Research Questions

- Are there whole-brain group differences in **N=107** adults with and without dyslexia for gray matter density, cortical thickness, and surface area?
- Do these morphometry measures correlate with reading ability in dyslexia?

Methods

Participants

Dyslexia group: Native English adults with prior dyslexia diagnosis or history of reading difficulties; n=55

Control group: Native English adults with history free from reading difficulty; n=52

Test	Subtest	*Control* Standard Score	*Dyslexia* Standard Score
WRMT	Word ID	111.0	92.1
	Word Attack	108.1	86.3
TOWRE	Sight Word Reading	108.2	82.5
	Decoding	107.4	80.2
Non-verbal IQ		116.7	110.8
Age (years)		22.7	23.2
Sex (M/F)		47%:52%	21%:78%

Neuroimaging Data Acquisition

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

Structural Neuroimaging Analyses

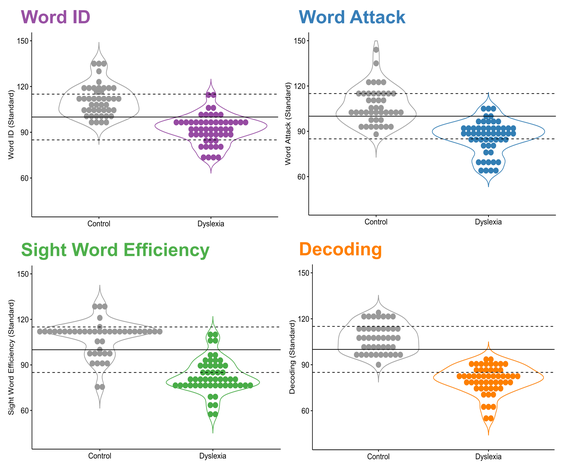
Preprocessing:

- Gray matter density: SPM12 using VBM pipeline.
- Cortical thickness and surface area: Freesurfer v6.0.0. Manual editing determined by Qoala-T.

Modeling:

- Gray matter density: GLM with nuisance (sex, age) factors.
- Cortical thickness and surface area: GLM with fixed (group, sex) and nuisance (age) factors.

Reading skills

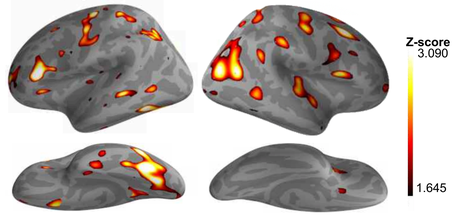


Two-tailed t-tests of WRMT and TOWRE reading measures between groups; all p < .0001.

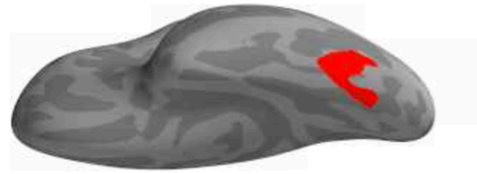
Cortical thickness

Group Differences

Uncorrected differences (p<.05) in left precentral gyrus, left fusiform, right SMG, bilateral IFG, and bilateral parietal lobe.



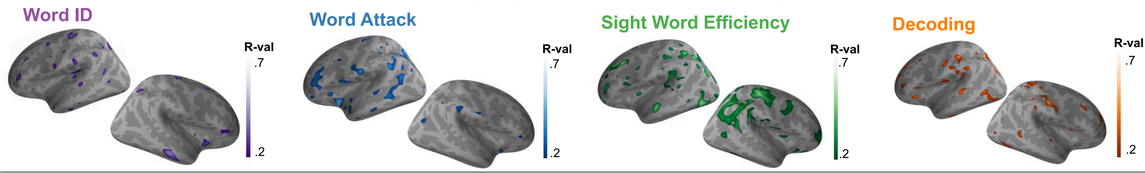
Group differences in left fusiform gyrus; corrected (Monte-Carlo null-z simulation, p < . 0005).



Correlations with Reading Skills

No significant correlations with reading in dyslexia when corrected.

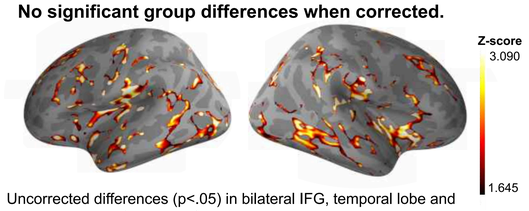
Uncorrected correlations (p<.05) between cortical thickness and reading skills in dyslexia



Gray matter density

Group Differences

No significant group differences when corrected.

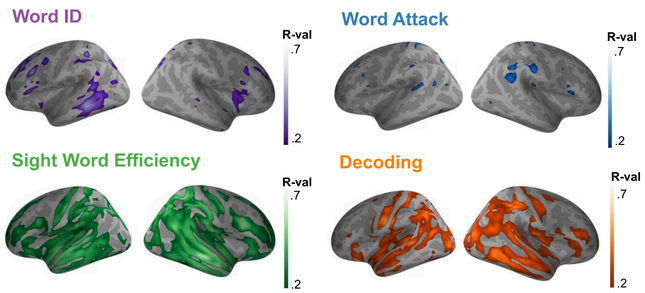


Uncorrected differences (p<.05) in bilateral IFG, temporal lobe and (not shown) bilateral cerebellum.

Correlations with Reading Skills

No significant correlations with reading in dyslexia when corrected.

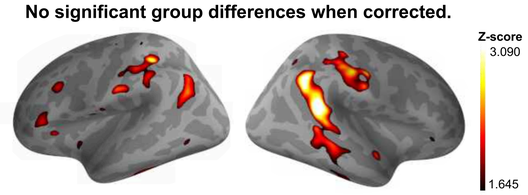
Uncorrected correlations (p<.05) between GMD and reading measures.



Cortical surface area

Group Differences

No significant group differences when corrected.

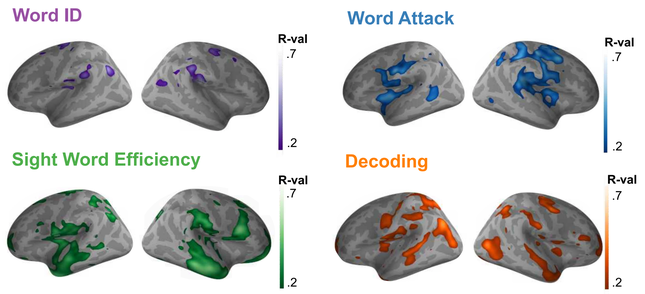


Uncorrected group differences (p<.05) in left SPL, left SMG, right IPL, and LOC.

Correlations with Reading Skills

No significant correlations with reading in dyslexia when corrected.

Uncorrected correlations (p<.05) between GMD and reading measures.



Discussion

- Prior reports of morphometry differences in dyslexia may not generalize to larger samples or disorder heterogeneity.
- This may especially be the case for regions outside of left fusiform gyrus, which may mature differently during reading development in dyslexia.
- It is unclear whether morphometry differences in left fusiform gyrus are a cause or consequence of dyslexia.
- This is a preliminary report from a sample of more than 1000 brains of adults and children with and without dyslexia.

References

[1] Altarelli et al., (2014). *Human Brain Mapping, 35*(12): 5717-35. [2] Eckert et al., (2016). *eNeuro,3*(1): ENEURO.0103-15.2015. [3] Ramus et al., (2018). *Neuroscience and Biobehavioral Reviews, 84,* 434-452. [4] Jednorog et al., (2015). *Human Brain Mapping, 36*(5): 1741-54.

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