



Structural neural correlates of reading development in children with early language delay



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Introduction

Language delay in toddlerhood (early language delay; ELD) is one factor known to predict later language-based learning disabilities.^{1,2}

Gray matter volume (GMV) differences in frontal and middle temporal regions have been observed among children with ELD (ELD+), relative to those without ELD.³⁻⁴

Preschoolers with a parental retrospective report of ELD exhibit greater GMV in frontal regions and less GMV in middle temporal regions compared to children without ELD.⁵

- The trajectory of GMV differences in ELD+ children as they learn to read remains unknown.

Research question: How do previously observed brain regions associated with ELD change over the first year of formal reading instruction and relate to subsequent reading outcomes at the end of the first year?

Methods

Participants retrospectively selected from the Boston Longitudinal Study for Dyslexia

- Administered behavioral assessments, scanned longitudinally

Y1

Y2

Pre-school
(ages 4-5)

Kindergarten
(ages 5-6)

	Pre-school (ages 4-5)		p-values Sig. 2-tailed ELD+ vs. ELD-	Kindergarten (ages 5-6)		p-values Sig. 2-tailed ELD+ vs. ELD-
	ELD+ Mean ± SD	ELD- Mean ± SD		ELD+ Mean ± SD	ELD- Mean ± SD	
Sample size	17	18	--	17	18	--
Expressive Language	101.8 ± 9.4	113.17 ± 14.0	0.009 **	103.9 ± 10.4	109.9 ± 12.9	0.153
Receptive Language	99.4 ± 12.1	107.5 ± 7.6	0.026 *	105.1 ± 8.3	106.1 ± 10.8	0.755
Untimed Word Reading	96.7 ± 19.4	93.8 ± 20.8	0.682	96.4 ± 13.1	96.8 ± 12.3	0.922
Timed Pseudoword Reading				107.8 ± 15.7	108.8 ± 14.3	0.835
Untimed Pseudoword Reading				99.1 ± 10.1	100.8 ± 8.6	0.623
				106.8 ± 11.6	106.0 ± 14.6	0.871

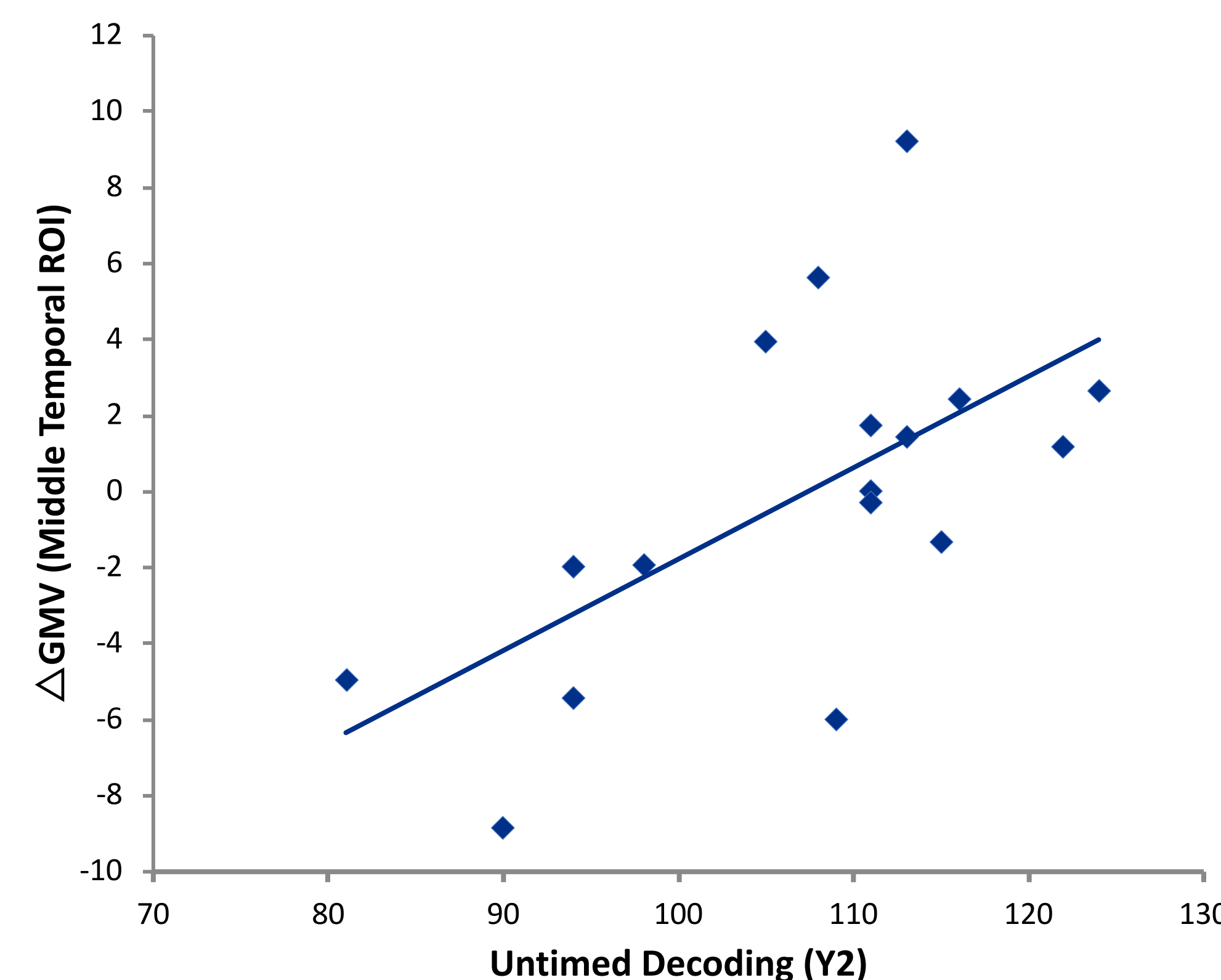
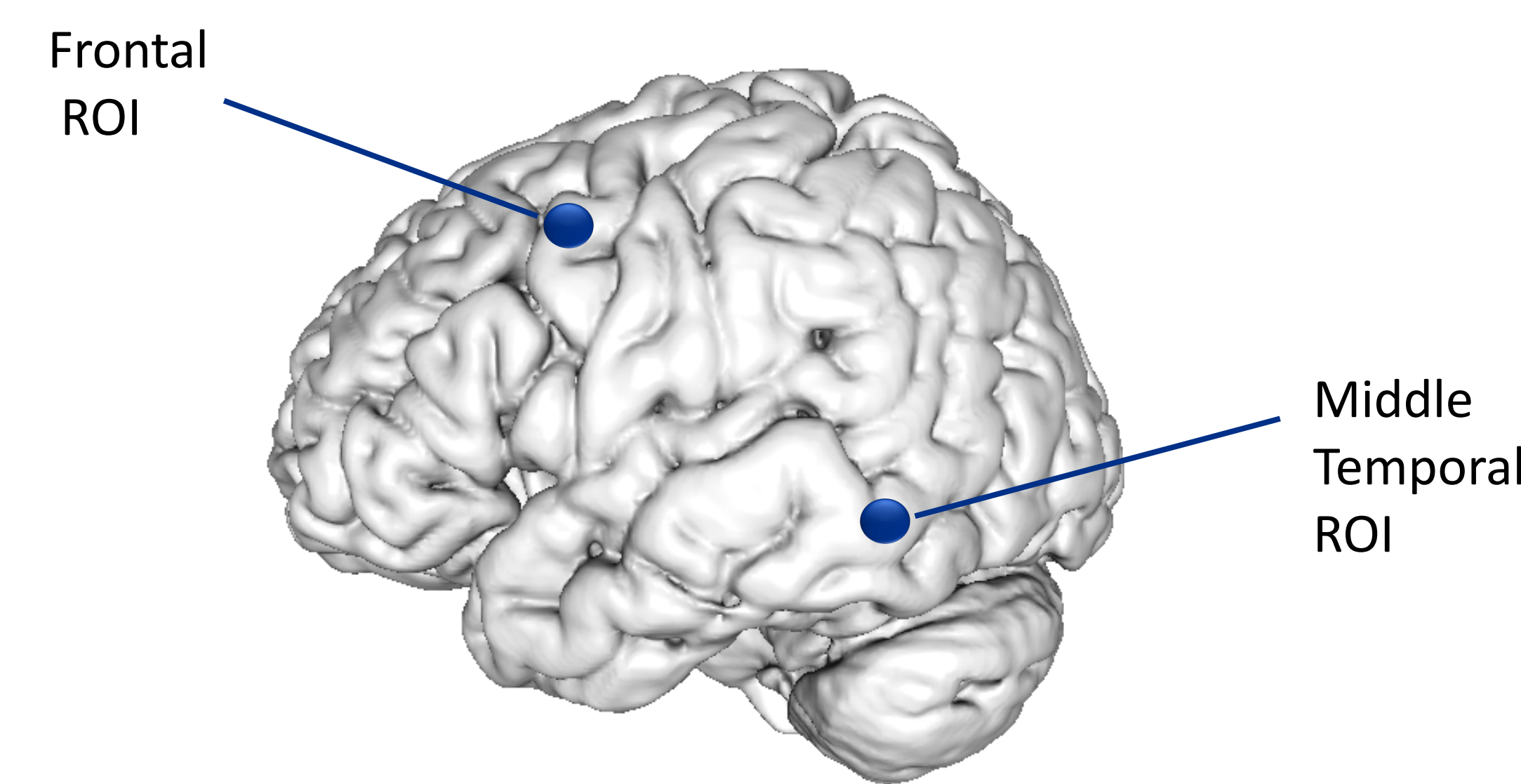
** p < 0.01; * p < 0.05; two-tailed t-test
Standard scores are reported.

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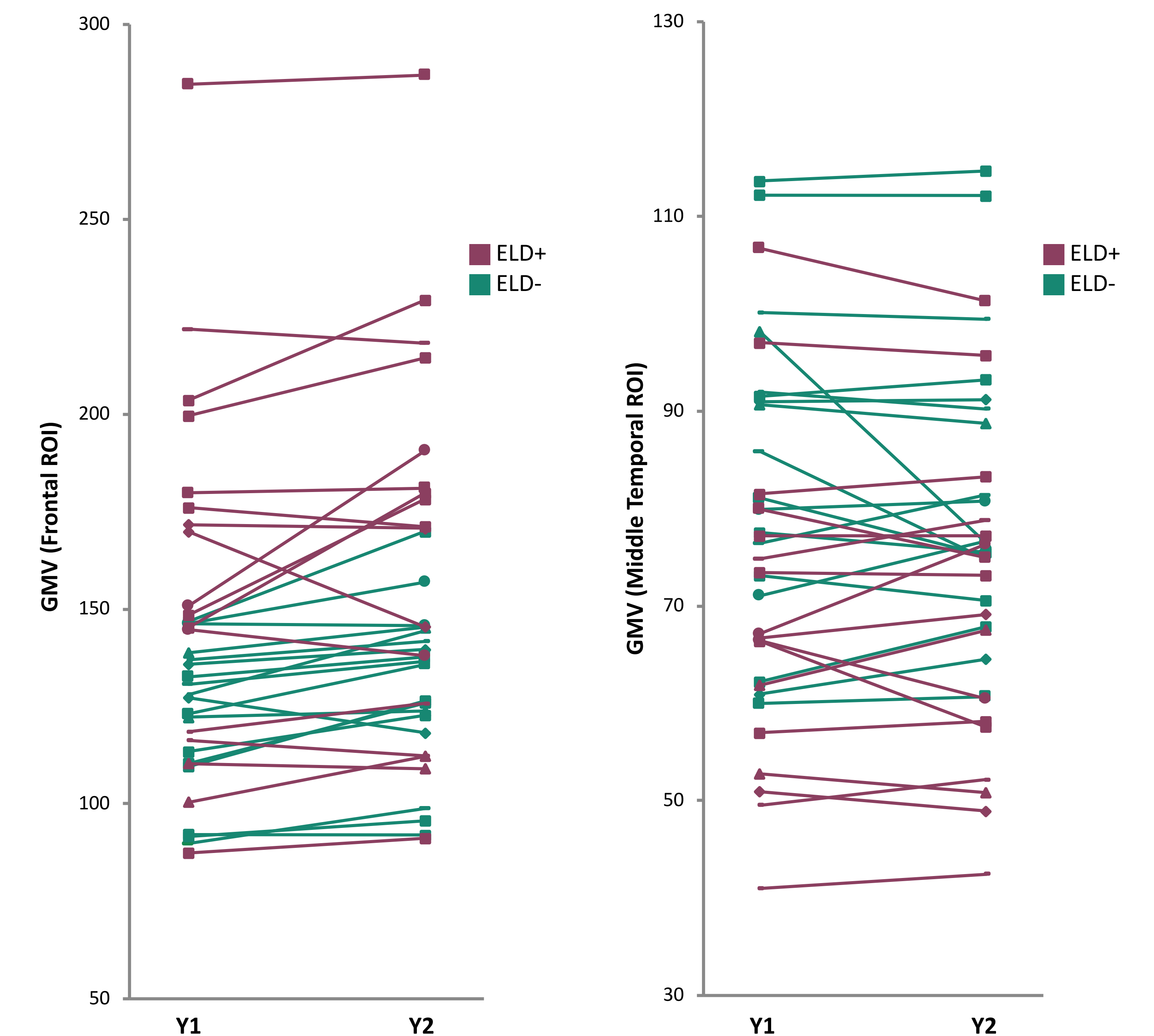
Structural Neuroimaging Acquisition and Analysis

- Standard pre-processing in CAT12
- Grey matter volume (GMV) estimated with voxel-based morphometry (VBM) toolbox in SPM8/CAT12
- GMV analysis
 - F-tests (p < 0.005, uc); follow-up t-tests
 - 6 mm spherical ROIs: peak coordinates of cortical areas with significant main effect of ELD
- Repeated Measures analyses in SPSS

Results



Middle temporal ROI: Change in GMV associated with better decoding outcomes at Y2 for ELD+



Frontal ROI: Significant increase over time (F = 11.60, p = 0.002)

Middle temporal ROI: No significant change over time (F = 0.57, p = 0.454)

Summary & Conclusions

Analysis across all participants

- Main effect of group on GMV over time in both the frontal and middle temporal ROIs, characterized by lower GMV in both ROIs in the ELD+ group
- Main effect of time in the frontal ROI, indicating a developmental increase over time

Analysis of ELD+ group

- Significant time point by decoding skills interaction in the middle temporal ROI
- Developmental increase over time within the middle temporal ROI was associated with better decoding outcomes at the beginning reading stage

Conclusions

- Findings point toward neural mechanisms underlying reading development among ELD+

References

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Acknowledgements

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