

across Reading Disability and Autism Spectrum Disorder Margaret Kjelgaard¹, Kenneth Wexler¹, Helen Tager-Flusberg³, John Gabrieli¹

Transdiagnostic Neural Substrates for Impaired Phonological Working Memory Zhenghan Qi¹, Chunming Lu^{1,2}, Adrianne Harris³, Lisa Wisman Weil³, Michelle Han¹, Kelly Halverson¹, Tyler Perrachione^{1,3},

Introduction

Phonological working memory (PWM): capacity to maintain and manipulate phonological elements of words.



- PWM is measured by phonological awareness & verbal shortterm memory tasks.
- PWM is impaired in
- Poor readers (Wagner & Torgesen, 1987; Hulme & Snowling, 2014; Ramus et al., 2003; Szenkovits & Ramus, 2005)
- Individuals with autism spectrum disorder (ASD) (Gerdts & Bernier, 2011; Lindgren et al., 2009; Williams, Payne & Marshall, 2013)

Abnormalities in the left dorsal phonological route in poor readers (Klingberg et al., 2000; Schlaggar & McCandliss, 2007; Pugh et al., 2013)



Mixed findings in ASD: widespread changes (Kumar et al., 2010); specific abnormalities at the right ventral route (Koledewyn et al., 2014)



Does a common weakness in PWM reflect shared or disparate neural anomalies in reading disability and ASD?

Participants

	Poor Readers	ASD	Typically Developing (TD
Number	19	25	20
Age	11.8 (3.27)	11.3 (3.48)	10.3 (3.57)
IQ ¹	101.8 (13.99)	108.9 (15.28)	110.1 (14.27)
Girls: Boys	0.36	0.32	0.43
Autism Severity ²	1.78 (1.52)	6.08 (2.48) ***	1.33 (0.69)
Word Reading ³	83.45 (9.90) ***	99.33 (13.16) **	112.48 (10.25)
Sentence Reading ⁴	79.65 (11.54) ***	100.04 (15.82) ***	115.68 (9.67)
Language ⁵	92.47 (21.07) ***	94.21 (18.87) ***	113.15 (11.39)

Standard deviation in parentheses. Statistical significance compared with TD: ** P < 0.01; *** P < 0.001.

Footnote:

- Standard KBIT Non-verbal IQ
- 2. Calibrated Severity Score (1-10) (Gotham et al., 2009; Hus & Lord, 2014)
- 3. Average of the standard scores of 4 reading tests from TOWRE and WRMT
- 4. Standard score of sentence reading fluency from WJIII
- 5. Core language score of CELF-4

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6. Averaged Z-normed scores of standard scores of four CTOPP subtests (Blending words; Elision; Memory for Digits and Non-word repetition) and the raw score of CNRep.

7. 96 pseudowords in 2, 3, 4 and 5-syllable length; SOA = 6 seconds; event-related design. 8. DTI Acquisition: 10 baseline volumes and 30 diffusion-weighted volumes with 74 slices per volume. 9. DTI Analysis: Data quality screening: DTIPrep (Oguz et al., 2014); Diffusion data processing: Tracts Constrained by UnderLying Anatomy (TRACULA; Yendiki et al., 2011). Point-by-point ANCOVA with age as the covariate. P < 0.05 (Height P < 0.005, Extent cluster > 6 points, P < 0.05)

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10. fMRI Acquisition: TR = 6 sec, TA = 2 sec, FOV= 192x192, interleaved slice number = 32 slices, voxel size = $3.0 \times 3.0 \times 3$ 11. fMRI Analysis: Statistical Parametric Mapping (SPM12) 12. Definition of seeds: peak activation near group-level statistics, 6-mm sphere around the peak coordinates



> PWM is transdiagnostically associated with shared structural and functional neural abnormalities in reading disability and ASD \succ Left dorsal route and right ventral route play important roles in the development of PWM.