Transdiagnostic Neural Substrates of Phonological Deficits in Autism Spectrum Disorder and Reading Disability

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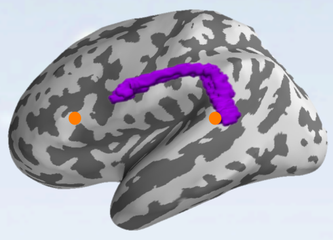
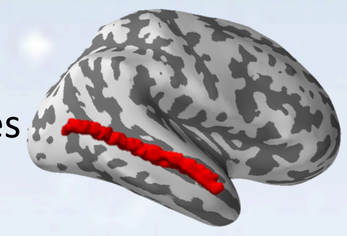
BACKGROUND

- Impaired phonological awareness & verbal short-term memory tasks 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)

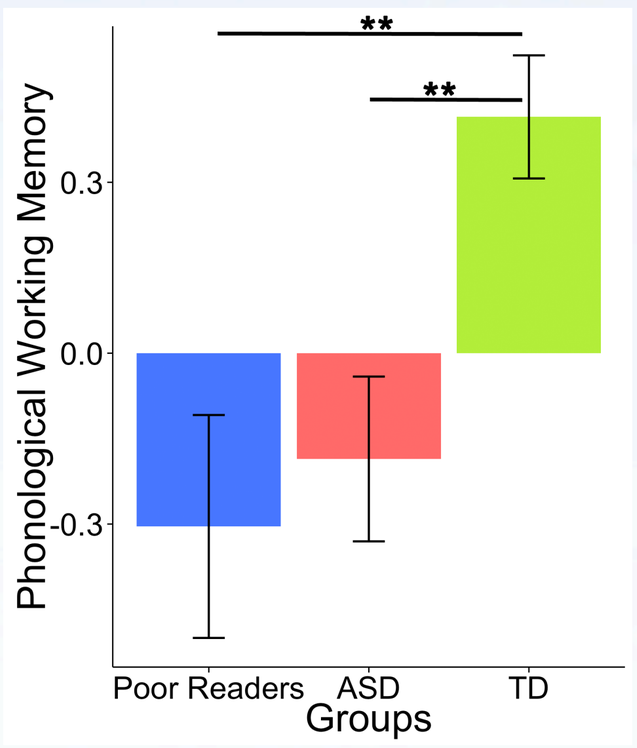


PARTICIPANTS

	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)

BEHAVIOR RESULTS

Phonological working memory [6]

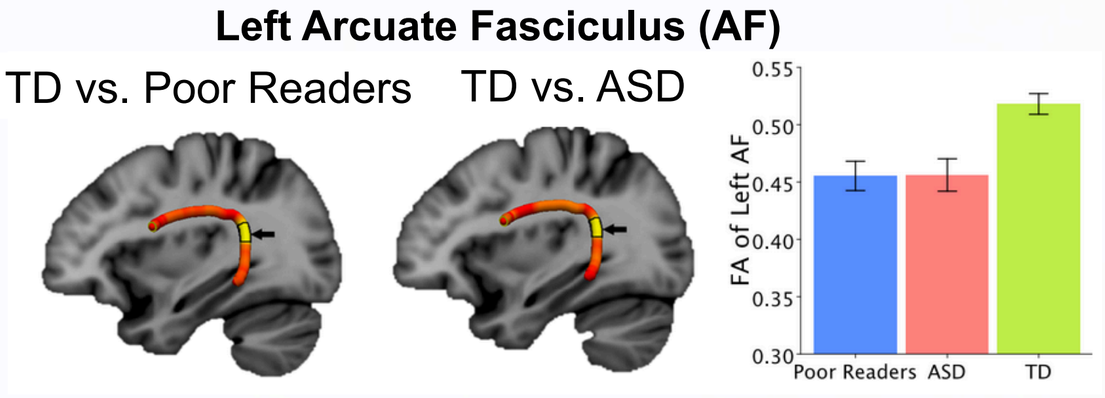


Notes:
1. Standard KBIT Non-verbal IQ
2. Calibrated Severity Score (1-10) (Gotham et al., 2009; Hus & Lord, 2014)
3. Average of the standard scores of 4 reading tests from TOWRE and WRMT
4. Standard score of sentence reading fluency from WJIII
5. Core language score of CELF-4
6. Averaged Z-normed scores of standard scores of four CTOPP subtests (Blending words; Elision; Memory for Digits and Non-word repetition) and the raw score of CNRep.

COMMON ANATOMICAL ALTERATION

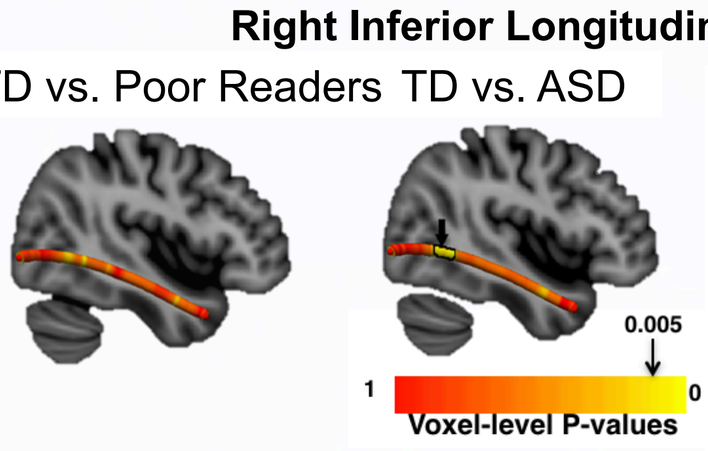
Left Arcuate Fasciculus (AF)

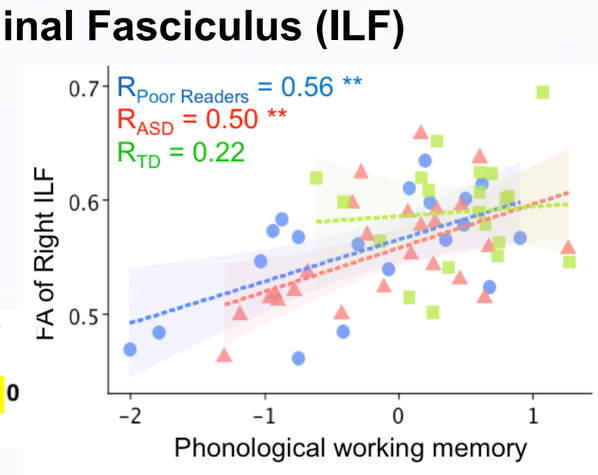
TD vs. Poor Readers TD vs. ASD



Right Inferior Longitudinal Fasciculus (ILF)

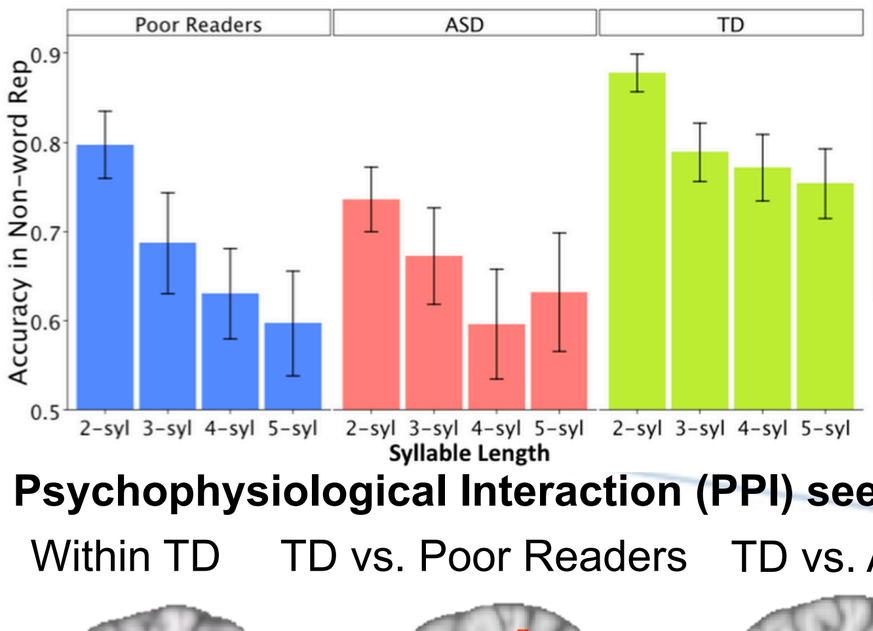
TD vs. Poor Readers TD vs. ASD





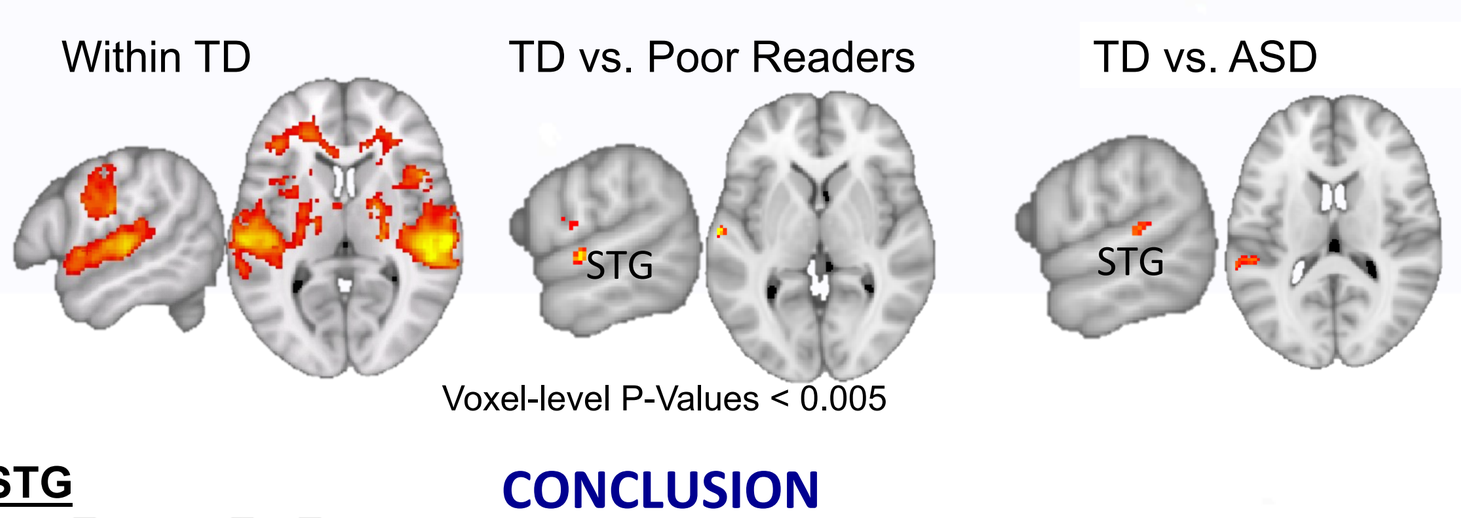
COMMON FUNCTIONAL ALTERATION

Non-word Repetition Task



Task vs. Rest BOLD Activity

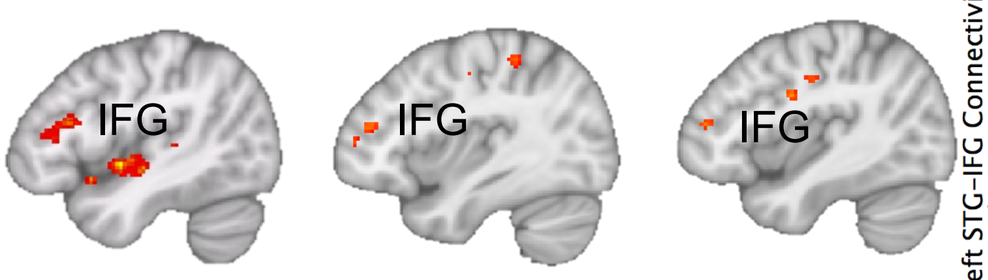
Within TD TD vs. Poor Readers TD vs. ASD



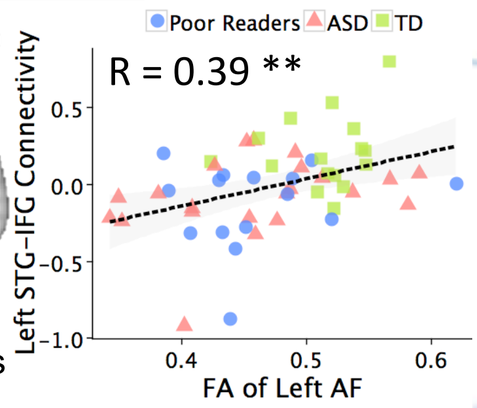
Voxel-level P-Values < 0.005

Psychophysiological Interaction (PPI) seed: left STG

Within TD TD vs. Poor Readers TD vs. ASD



Voxel-level P-Values < 0.01, Corrected cluster-level P-Values < 0.05, Extent > 1336 mm^3



CONCLUSION

- Phonological deficits are transdiagnostically associated with shared structural and functional neural abnormalities in ASD and Poor Readers.
- Left dorsal route and right ventral route play important roles in the development of phonological working memory.