

SUPPLEMENTARY APPENDIX

SUPPLEMENTARY METHODS

Image Acquisition

The fMRI imaging for the CMU group was performed at the Brain Imaging Research Center (Carnegie Mellon University and University of Pittsburgh) with a 3.0 Tesla (T) Allegra scanner (Siemens Medical, Malvern, PA). A T2*-weighted gradient echo, resonant echo planar pulse sequence sensitive to blood oxygen level-dependent contrast was used with the following acquisition parameters: TR (repetition time) 1,000ms, TE (time to echo) 30ms, flip-angle 60°, field of view (FOV) 20×20cm, matrix size 64×64, axial-oblique plane with 16 slices, and slice-thickness of 6mm with a 1-mm gap. The fMRI imaging for the Stanford group was performed at the Lucas Center (Stanford University) using a 3.0 T Signa LX (GE Medical Systems, Milwaukee, WI). fMRI data were acquired using whole-brain imaging with a T2*-sensitive gradient echo spiral in/out pulse sequence (Glover & Law, 2001) with the following acquisition parameters: TR 1,000ms, TE 30ms, flip-angle 90°, FOV 24x24cm, matrix size 64×64, axial-oblique plane with 15 slices, and slice-thickness of 7mm with no gap.

fMRI Data Preprocessing

Statistical analysis was performed with statistical parametric mapping software (SPM2; Wellcome Department of Cognitive Neurology, London, UK). After image reconstruction, each participant's data were realigned to a reference volume (motion correction). Data were spatially normalized using the mean functional volume resampled to 2x2x2mm voxels in Montreal Neurological Institute (MNI) stereotaxic space (12 nonlinear iterations, 7x8x7 non-linear basis functions, medium regularization, sinc interpolation). Spatial smoothing was done with a 8mm Gaussian filter. Each participant's data were high pass filtered at 97s, and analyzed using a fixed effects model examining task (rhyme) vs. rest.

SUPPLEMENTARY REFERENCES

Glover, G. H., & Law, C. S. (2001). Spiral-in/out BOLD fMRI for increased SNR and reduced susceptibility artifacts. *Magnetic Resonance in Medicine*, 46(3), 515-522.

SUPPLEMENTARY TABLE

sTable 1: Demographic Information

		Typical Readers	Discrepant Poor Readers	Non-Discrepant Poor Readers	ANOVA (Chi-square)		Post hoc
					F / chi	P	
CMU Group	N	26	16	15			
	Age	10.0 (1.0)	10.3 (1.0)	10.9 (1.1)	3.62	0.034	1vs3
	Gender (girl:boy)	18:8	7:9	9:6	2.70	0.26	
	Handedness (left:right)	0:26	0:16	0:15	0.00	1.00	
	PPVT[SS]	114.2 (10.6)	103.8 (10.5)	82.6 (5.2)	52.75	<0.001	1vs2 ^{***} , 1vs3 ^{***} , 2vs3
	WID[SS]	109.6 (12.3)	81.7 (9.5)	84.3 (5.5)	49.35	<0.001	1vs2 ^{***} , 1vs3
	Discrepancy (PPVT-WID[SS])	4.6 (10.3)	22.1 (17.6)	-1.7 (7.1)	16.48	<0.001	1vs2 ^{***} , 2vs3 ^{***}
	WA[SS]	114.6 (13.7)	88.6 (9.4)	89.1 (8.6)	35.81	<0.001	1vs2 ^{***} , 1vs3
	PC[SS]	112.8 (10.3)	87.8 (14.3)	87.2 (11.3)	32.36	<0.001	1vs2 ^{***} , 1vs3
	Task performance (correct %)	95.2 (6.7)	71.9 (18.2)	73.7 (19.9)	16.66	<0.001	1vs2 ^{***} , 1vs3
Stanford Group	N	36	18	20			
	Age	12.7 (3.0)	14.1 (1.8)	14.0 (1.6)	2.85	0.064	
	Gender (girl:boy)	18:18	6:12	8:12	1.48	0.48	
	Handedness (left:right)	2:34	1:17	1:19	0.007	>0.99	
	PPVT[SS]	116.4 (13.8)	99.2 (7.9)	80.2 (8.4)	66.75	<0.001	1vs2 ^{***} , 1vs3 ^{***} , 2vs3
	WID[SS]	112.1 (11.3)	82.5 (6.5)	79.8 (7.7)	100.29	<0.001	1vs2 ^{***} , 1vs3
	Discrepancy (PPVT-WID[SS])	4.3 (14.2)	16.7 (8.2)	0.5 (9.2)	10.07	<0.001	1vs2 ^{***} , 2vs3 ^{***}
	WA[SS]	109.9 (10.8)	87.3 (6.3)	89.0 (9.2)	48.76	<0.001	1vs2 ^{***} , 1vs3
	PC[SS]	113.9 (8.5)	90.1 (9.8)	79.5 (8.5)	109.52	<0.001	1vs2 ^{***} , 1vs3 ^{***} , 2vs3
	Task performance (correct %)	94.9 (6.8)	81.7 (13.1)	77.5 (11.6)	22.71	<0.001	1vs2 ^{***} , 1vs3

Posthoc tests: Group 1: Typical Readers, 2: Discrepant Poor Readers, 3: Non-Discrepant Poor Readers; Tukey correction, ~*: P<0.1, *: P<0.05, **: P<0.01, ***: P<0.001

Chi square tests: Pearson Chi-square performed for gender and handedness (assessed using Oldfield Handedness Questionnaire)

PPVT: Peabody Picture Vocabulary Test, WID: WRMT Word Identification subtest, WA: WRMT Word Attack subtest, PC: WRMT Passage Comprehension subtest, SS: standard score

Numbers in brackets indicate SD of the mean.

SUPPLEMENTARY FIGURE

Figure S1. Brain activation differences (rhyme > rest) between typical reading children (TR) and both IQ-discrepant (Disc PR) and non-discrepant poor readers (Non-Disc PR) in the CMU group dataset regressing out age. Typical readers exhibited greater activation than both groups of poor readers in left inferior parietal lobule (LtIPL) and fusiform gyrus (LtFG) (left panel). Mean parameter estimates from those brain regions (right panel). Error bars represent standard error of the mean.

