Neural Correlates of Reading Comprehension in Struggling and Typical Readers
Mary Abbe Roe¹, Lauren Deschner1, Joel E. Martinez2, Jeanette A. Mumford3, Dana M. DeMaster4, Jenifer J. Juraneck, Jessica A. Church1
1Dept. of Psychology, The University of Texas at Austin; 2Dept. of Psychology, Princeton University; 3Dept. of Biostatistics & Medical Informatics, The University of Wisconsin Madison; 4Dept. of Pediatrics, The University of Texas Health Science Center

INTRODUCTION

Background:
- Struggling readers have fixed altered brain activity in struggling readers relative to typical readers (Yeung et al., 2010). Struggling readers who adequately respond to reading intervention differ in measures of oral language compared to inadequate responders (Cho et al., 2013).

Objectives:
- To assess brain and behavior differences between struggling and typical readers in the context of a reading comprehension intervention study.

Approach:
- 31 4th graders (ages around Austin, TX) and Houston, Texas, 4th grade in-school reading intervention.
- Struggling readers assigned to Business As Usual (BAU) or Intervention conditions. The intervention was implemented by the UT Austin Meadows Center for Preventing Educational Risk.
- The intervention condition received small group reading instruction focusing on reading comprehension for 35 minutes each day for 16 weeks.
- Multimodal imaging approach (task and resting fMRI, structural MNI, DTI).
- fMRI sentence comprehension (Meyler et al., 2008) and stop-signal (Arnon et al., 2004) tasks were used to study pre-post 4th grade effects.

METHODS

Participants
- 1 3rd graders, 16 females (M=9.71).
- 34 Pre-Intervention Struggling Readers, 24 F (M=10.1 years), 20 BAU.
- 29 Post-Intervention Struggling Readers, 17 F (M=10.5 years), 12 BAU.
- 10 Struggling Readers with pre and post scans, 12 F, 8 BAU.
- 20% task accuracy.
- SOLO runs with 9500 frames after a movement TD threshold <0.5mm.
- Imprpior groups were defined using post-intervention ftest scores on the WJ Passage Comprehension test. The “Non-Improviers” were defined as having a standard score of 90 or better (25th Percentile).
- Pre-Intervention (sorted by post-test scores):
  - 18 future Improvers, 9 F (M=10.1 years)
  - 11 future Non-Improvers, 5 F (M=10.6 years)
- Post-Intervention (sorted by post-test scores):
  - 14 Improvers, 9 F (M=10.6 years)
  - 7 Non-Improvers, 4 F (M=10.7 years)
  - 11 Improvers with pre and post scans, 6 F, 5 BAU
  - 4 Non-Improvers with pre and post scans, 7 F, 8 BAU

Sentence Comprehension Task
- 1-3 runs, 32 sentences per run, ~7 minutes per run (215 frames).
- Four sentence categories:
  - (Articles/Facets vs Sentence, Non-sentinel)
- 8-second presentation with 2- second ITI and jitter.

23 10mm Reading, Control, and Motor Literature-based ROIs

Whole Brain Activation During Reading

Improvement in Reading relates to scanner task performance

Struggling Readers are slower and less accurate than typical Readers when reading sentences

Whole Brain Activation During Reading

Greater left mouth motor activation in non-improvers at pre-intervention scan

Greater right fusiform activation in improvers at post-intervention scan

Conclusions & Next Steps

- Struggling Readers defined as “Improvers” are no longer different from Typical Readers on sentence task accuracy.
- WJ Passage Comprehension scores significantly predict performance on the in-scanner sentence comprehension task.
- Pre-4th grade Non-Improvers show greater activation than Improvers in left mouth motor during correct and incorrect sentence trials.
- Post-4th grade Non-Improvers show greater activation than Non-Improvers in the right fusiform during correct trials.

These results suggest that “Improvers” are able to bring additional regions (left mouth, right fusiform) to task performance after the intervention, while “Non-Improvers” may already be at max engagement or less flexible.

References
Campbell et al., 2011. Mapping the brain activation of poor readers during sentence comprehension with extended remediational instruction. - Neuropsychologia, 49(2). 2560-2580.

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