Stop-signal Inhibition in Pre- and Post-Intervention Struggling Readers

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INTRODUCTION

Background:
The stop-signal task (SST) is currently used to measure response inhibition, an executive function component that may play an important role in reading.

- Studies suggest that inhibitory control predicts reading comprehension performance in 4th-grade students (Snell et al., 2012).

Objective:
To assess the interaction of reading comprehension with attention and executive function in the context of a reading intervention study.

Approach:
Multi-site (areas around Austin, and Houston, Texas) 4th grade in-school reading intervention.

- Multimodal imaging approach (task and resting state fMRI, structural MRI, DTI).

- Struggling readers assigned to Baseline-Aus-Gal (BAU) or Intervention conditions. The intervention was implemented by the UT Austin Meadows Center for Preventing Educational Risk.

- The stop-signal (Korn et al., 2004) and sentence comprehension (Meyer et al., 2008) tasks were used to study pre- and post- grade effects.

METHODS

Stop Signal (Inhibition) Task

Participants:
- 35 Pre-Intervention Struggling Readers, 16 females (M=9.66 yrs); 22 BAU.
- 16 Post-Intervention Struggling Readers, 10 females (M=10.58 yrs), 4 BAU.
- 20 Typical Readers, 11 females (M=9.66 yrs), 9 BAU.

- Task:
  - Reaction time (RT) slowing during correct “Go” trials after correct “Stop” trials in Typical Readers may reflect greater flexibility in performance.
  - GO trials: 500ms, 60 “Go” trials and 32 “Stop” trials per run, 6ms frames (180 frames).
  - Visual stop signal (red X)
  - Stimuli duration of 1000ms with a 1000ms inter-stimulus interval
  - Starting stop signal delay (SSD) at 250ms with staircase +/− 50ms

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STOP SIGNAL BEHAVIORAL RESULTS

Similar stop signal task performance across Struggling and Typical Readers

Mean “Go” Accuracy

Mean “Go” RT

Mean SSRT

Task:
- Sentence Comprehension Task
  - Participants:
  - 34 Pre-Intervention Struggling Readers, 17 females (M=9.69 yrs), 12 BAU.
  - 18 Post-Intervention Struggling Readers, 10 females (M=10.55 yrs), 4 BAU.
  - 20 Typical Readers, 11 females (M=9.66 yrs), 9 BAU.
  - 50% task accuracy.
  - BOLD runs with 60% frames after a movement FD threshold <0.9mm

- Tasks:
  - 2 runs, 32 sentences per run, ~7 minutes per run (213)
  - Four sentence categories (Action/Predictable/Unpredictable/Non-senseable)
  - 6-second presentation with 2-second ITI and jitter

Sentence Comprehension Task

Mean SSRT (s)

0.2

0.3

0.4

0.5

0.6

0.7

0.8

0.9

Struggling readers were slower and less accurate than Typical Readers when reading sentences.

Mean % Signal Change

- GO trials: 500ms, 60 “Go” trials and 32 “Stop” trials per run, 6ms frames (180 frames).
- Visual stop signal (red X)
- Stimuli duration of 1000ms with a 1000ms inter-stimulus interval
- Starting stop signal delay (SSD) at 250ms with staircase +/− 50ms

STOP SIGNAL IMAGING

Struggling readers were slower and less accurate than Typical Readers when reading sentences.

All Struggling and Typical Readers (n=67), Correct “Stop”s vs. Correct “Go”s, corrected for multiple comparisons

CONCLUSIONS & NEXT STEPS

- Behaviorally, the Pre-Intervention Struggling Readers trended towards slower and less accurate SST performance.
- Typical Readers slowed, and then speed up after both correct and failed “Stop”s, perhaps indicating greater behavioral adjustments/adjustments relative to Struggling Readers.
- While there were few brain differences between groups for “Stop” vs. “Go”, greater fronto-parietal and anterior cingulate activity (task control) was observed Post-Intervention compared to Pre-Intervention Struggling Readers.
- During sentence reading, struggling readers show differences from non-struggling readers in occipital-temporal cortex, and sensorimotor cortex, suggestive of less fluent processing.
- SUMMER 2015: Cohort 2 post-intervention scanning
- FALL 2015-SUMMER 2016: Cohort 3 identification and scanning

References