



Cognitive Modeling Suggests That Attentional Failures Drive Longer Stop-Signal Reaction Time Estimates in Attention Deficit/Hyperactivity Disorder

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SUMMARY

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A sample of 234 children with Attention Deficit/Hyperactivity Disorder (ADHD) and 108 age-matched, typically developing control subjects completed a stop-signal task as a part of a larger testing battery for a study on childhood ADHD. Some children of this original sample were excluded due to data-quality concerns. Children were recruited from several sites in Pennsylvania and represented an ethnically diverse sample. Children with an IQ less than 80 were excluded from the study. If the child was taking any psychoactive medications, they stopped 24-48 hours before the procedure.

Children were asked to complete a stop-signal task on a computer. The child was instructed to select either an X or an O whenever they saw one appear on the screen. If the child successfully identified the stimulus, then the stimuli would begin appearing faster, testing the child's response times. Times were adjusted through the analysis, and then an average measure was produced for each child.

"We used a hierarchical modeling approach that treats subject-level parameters as random effects, described by group-level distributions," the researchers wrote. "On average, this method (a) provides more accurate estimates of individual-level parameters, because the group-level parameters serve as priors that constrain individual estimates (parameter 'shrinkage') and (b) allows for more robust estimation of the mean and standard deviation of the individual parameters for each group."

Only group levels were utilized in the data analysis for inference because of the low number of individual trials.

Accuracy, reaction time, and stop-signal delay were analyzed. Some of the analysis showed that a main effect of stop-signal indicated that reaction times were shorter on single-respond trials than on go trials. The group effect is consistent with previous research on ADHD, where researchers note the stop-signal effect was "expected because the race model assumes that the inhibition process on stop-signal trials censors longer reaction times." The effect of stop-signal on accuracy showed that error reaction times were faster than correct answers because incorrect responses would be censored to a lesser extent.

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The study hypothesized that the ADHD group would have larger variable reaction times than children with typical development. The study found that the group of children with ADHD had disproportionate difficulty initiating the stop-signal task cues, showing that children with ADHD reflects broad problems with “initiating goal-directed behaviors in response to relevant cues.”

Having difficulty initiating the task shows that there could be issues implementing cognitive control in children with ADHD, which leads the researchers to believe that top-down functioning for children diagnosed with ADHD is difficult. The study also showed that children with ADHD showed impairment on tasks that required working memory functioning and decision-making tasks. A core symptom of ADHD is behavioral impulsivity, which is explained by the disinhibition hypothesis within the study; that the performance deficits are due to trigger failures and impulse responses. This suggests evidence that those with ADHD have difficulty initiating control processes and enacting top-down thinking processes.

1. Weigard, A., Heathcote, A., Matzke, D., & Huang-Pollock, C. (2019). Cognitive Modeling Suggests That Attentional Failures Drive Longer Stop-Signal Reaction Time Estimates in Attention Deficit/Hyperactivity Disorder. *Clinical Psychological Science*. doi.org/10.1177/2167702619838466