Distinguished Fellowship Project Brief

An Interdisciplinary Approach to Improving Reading Comprehension in High-Functioning Individuals with Autism (2015-2017)

| **Fellow:** | Emily L. Coderre, Ph.D. Postdoctoral Fellow | **Mentors:** | Barry Gordon, M.D., Ph.D. Professor Division of Cognitive Neurology/Neuropsychology Department of Neurology School of Medicine | Nancy Madden, Ph.D. Professor Center for Research and Reform in Education School of Education |

Research Question: Can brain stimulation improve the outcomes of a reading comprehension training intervention in high-functioning individuals with autism?

Interdisciplinary Approach: This fellowship project bridges education and cognitive neuroscience interventions to improve reading comprehension in individuals with autism.

Potential Implications of Research: This project will inform the development of future literacy interventions and how they can better target the underlying neurobiology in autism.

You are sitting in a quiet room with hundreds of other students. The next section in the SAT is reading comprehension: your worst subject. You read the first text passage carefully, trying to remember the important details. But the first comprehension question asks about something you don't remember reading, so you go back and reread more slowly. By now 10 minutes have passed and you're still on the first question. You're running out of time, and if you don't do well on this test, your chances of getting into a good college are shot.

Reading comprehension is a complicated task, requiring not just understanding individual words and sentences but also rapidly assimilating concepts and details. For individuals with autism, this process is even more difficult. In this project, we attempt to improve reading comprehension for these individuals via a unique reading intervention combining empirical research from the fields of education and cognitive neuroscience.

Autism spectrum disorder (ASD) affects one in every 68 children. Comprehension deficits are thought to arise from difficulties with integrating the meanings of various pieces of information, a process called *semantic integration*. This project aims to improve semantic integration in readers with ASD by developing an intervention based on *The Reading Edge*, a literacy program in the Success for All educational curriculum. The Reading Edge emphasizes semantic integration skills such as using background knowledge to provide context. Because it targets the very skills that readers with ASD struggle with, it may help improve their comprehension.

We developed a 5-day intervention based on The Reading Edge for readers with ASD. While readers practiced semantic integration skills during the intervention, half of them received *transcranial direct current stimulation (tDCS)* – a brain stimulation technique in which a weak electrical current is applied to the scalp – to target the brain areas involved in semantic integration and further boost reading outcomes. The other half received "sham", or placebo, stimulation during the intervention.

Eleven participants completed the study (5 received active tDCS, 6 received sham tDCS). Although no significant differences occurred at the group level, 5 of 11 participants showed clinically significant improvements in reading comprehension grade levels from pre- to post-intervention, improving between 1 and 4 grade levels. These "improvers" were split between active and sham tDCS groups, but tended to be those with higher baseline reading levels.

These results suggest that this intervention may be effective for certain participants, particularly those with less impaired comprehension. tDCS did not improve outcomes, possibly because reading comprehension is too broad a skill to be enhanced by targeting a single brain region. Although much work remains to be done to design an intervention that can improve reading abilities for students of all levels, these results offer a promising glimpse into potential ways of making the SATs less anxiety-provoking for students with ASD.
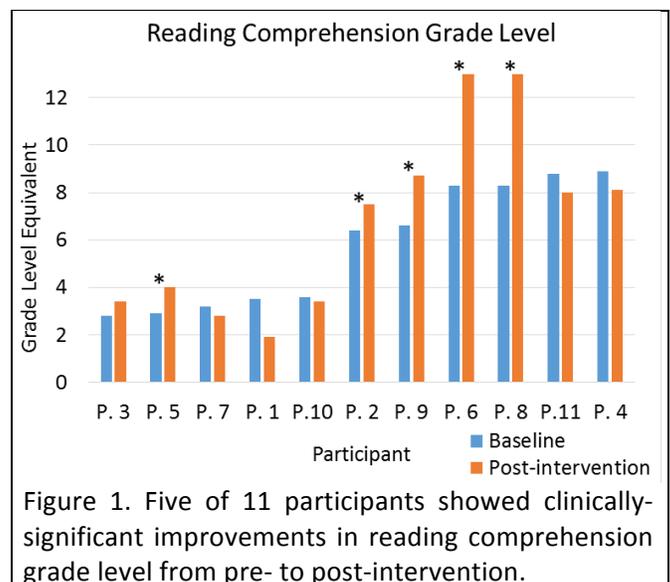

Figure 1. Five of 11 participants showed clinically-significant improvements in reading comprehension grade level from pre- to post-intervention.