

Visual Processing Patterns of Adults with ADHD

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Introduction

The neurodevelopmental disorder of attention-deficit/hyperactivity disorder (ADHD) has been characterized as difficult to describe. This may be due to the fact that both neuronal and behavioral patterns differ depending on the context and person being considered. Given that this disorder is incredibly complex and difficult to follow, how can one offer an alternative approach to elucidating the disorder? Well according to the journal “Eye Vergence Responses During an Attention Task in Adults With ADHD and Clinical Controls. Journal of Attention Disorders,” by Elizabeth Carolina Jiménez et al. (2020), some of the major issues of ADHD are “a low degree of attention, distractibility, excessive motor activity, and the incapacity to inhibit inappropriate actions”. Thus, an intuitive starting point for researching this phenomenon might be to study how the brain appropriates attention during information processing tasks. In order to gain insight on behavioral patterns of information processing and attention, this research will explore visual gaze patterns among patients with ADHD when performing a reading comprehension task containing unexpected words. Eye tracking methods will be employed to focus on several aspects of attention mediated eye gaze, such as convergence, fixation, saccades, and saccadic drift; all of which may provide behavioral displays of intentional eye movements when conducting visual information processing. Participants will be broken down into two groups of people with ADHD. One group will receive a treatment priming them to unexpected words before the reading comprehension task. We hypothesize that the visual search patterns of those who did receive the treatment will be spread out and contain far more regressive saccadic movements than those of the treatment group.

Methods

Participant Group

Participants of this study were selected from a random population of individuals who were diagnosed with ADHD. Researchers gathered only participants with ADHD to ensure all participant groups were similar so that the treatment would in theory provide meaningful comparisons. The participant pool consisted of 20 subjects total with ages ranging from 18-36 years old. This particular age group was chosen because researchers wanted to explore the neurodevelopment of adults rather than children based on the notion that life and experience may alter how well or poorly one deals with the disorder.

Experiment

The participants of this study were tasked with a reading comprehension test in order to effectively ensure they were engaged with the visual processing task. The true purpose was to track their eye movements to understand the overall eye movement pattern and shifts in attention. Additionally, researchers placed what we termed as unexpected words throughout the body of text that contained familiar nursery rhymes, like “The Wheels on the Bus”. An example text is as follows: “the wheels on the ‘large motor vehicle transport’ go round and round all through ‘New York’”. The reasoning behind this method was to observe how unexpected words caused challenges in the overall flow of processing the sentence and directing attention. We particularly focused on the saccadic eye movements, convergence, fixation, and saccadic regression. According to Maria Pia Bucci et al. (2010), saccadic eye movements are “used to change the direction of fixation rapidly,” which have been noted to be regulated by the capacity for visual attentional control (Bucci et al., 2010). Saccadic regression is the ability for one to move their gaze back to previously seen information. Accordingly, this relates to the concept of fixation which is the general ability to focus one’s gaze at a particular spot in the visual field. Vergence is a key component of fixation since it determines the ability to focus on both close

and far objects. Normally these “these movements are disconjugate,” but convergence is used to use the movement in both eyes to focus in on something close (Bucci et al., 2010). As one can see, each of the aforementioned concepts may be pertinent to understanding visual attention patterns.

Participants were randomly and evenly placed into two groups, the experimental group who were set to receive the treatment, and the control group who did not receive the treatment. The experimental group received a treatment of several pictures that were related to the sentences containing the unexpected words. For example, a picture of a yellow school bus driving through a town was displayed to prime the viewer for an association when coming across the related text. We expected that the picture would prime the subject for an association of the correlated nursery rhyme once they read the passage. Furthermore, we expected this association would cause confusion being that the observer might expect specific words for the well known nursery rhyme. This confusion would be characterized through the saccadic regressions.

Results

Planned Statistical Analysis

The overall pattern of eye movements was observed through two key factors, the number of fixations and the number of saccadic regressions. A simple bar plot was run to compare the number of occurrences for each of these concepts per participant. Researchers anticipated results were not confirmed. The aggregated distributions for saccadic regressions and participants ended up quite similar for each group.

Conclusion

Limitations

The limitations of this study are many. First, the sample size used may not have been large enough to get a meaningful difference in performance for each group. Second, priming the subjects with pictures correlated to the nursery rhyme that was altered assumes that each participant has in fact heard the nursery rhyme before. Unfortunately, there was no way to determine whether or not this was true. Lastly, the participant age group may have also confounded the study being that the nursery rhymes used are quite older than the groups themselves, which may decrease the likelihood they heard the nursery rhyme at all. There are far more limitations, but these seem to be the main contributors for the lack of meaningful results.

Future Implications

Eye tracking methods can benefit from real world and dynamic processing that reflects the true nature of how we navigate the real world. This information may be more informative of the underlying processes of this phenomenon. Additional future directions of this research would be to implement machine learning models that can effectively learn the typical visual search patterns of an individual with ADHD. This may benefit the research endeavors twofold: first, a machine learning model could be employed to study visual search patterns of patients and successfully recommend when an individual shows signs of typical search patterns of an individual with ADHD. This can offer an additional method to diagnose patients with the disorder. Second, a machine learning model can also learn how to mitigate some of the issues in visual search patterns by effectively disentangling aggregated image processing information. The steps used to improve the model may inform future treatment.

Bibliography

Bucci, M. P., Vernet, M., Gerard, C.-L., & Kapoula, Z. (2009). Normal speed and accuracy of saccade and vergence eye movements in Dyslexic Reader Children. *Journal of Ophthalmology*, 2009, 1–8. <https://doi.org/10.1155/2009/325214>

Jiménez, E. C., Avella-Garcia, C., Kustow, J., Cubbin, S., Corrales, M., Richarte, V., Esposito, F. L., Morata, I., Perera, A., Varela, P., Cañete, J., Faraone, S. V., Supèr, H., & Ramos-Quiroga, J. A. (2021). Eye Vergence Responses During an Attention Task in Adults With ADHD and Clinical Controls. *Journal of Attention Disorders*, 25(9), 1302–1310. <https://doi.org/10.1177/1087054719897806>