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IMPULSIVITY AND ACCURACY OF CHILDREN WITH ATTENTION DEFICIT  
HYPERACTIVITY DISORDER

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Doctoral Candidate(s)

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Date

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HYPERACTIVITY DISORDER

by

Emily Renae Gillette

Has been approved

\_\_\_\_ May, 2015

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IMPULSIVITY AND ACCURACY OF CHILDREN WITH ATTENTION DEFICIT  
HYPERACTIVITY DISORDER

by

Emily Renae Gillette

This paper is submitted in partial fulfillment of the  
requirements for the degree of

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## ABSTRACT

*Background:* Inhibition of responses in children with Attention Deficit Hyperactivity Disorder has shown to be reduced. It is theorized and debated that ADHD comes from a dysfunctional inhibitory process. Studies have revealed that selective attention is not as affected by ADHD as sustained attention. This research project aims to further investigate these theories and answer the question: Does ADHD cause children to become more impulsive, is the impulsivity accurate when set to a visual task, and do visual diagnoses play a role? *Methods:* Fifteen subjects ages twelve or under that have or have not been diagnosed with attention deficit hyperactivity disorder were tested for impulsivity and accuracy of visual attention by using the Matching Familiar Figures Test (MFFT). Their scores were compared to the age-related norms determined by the MFFT for standardized scoring. These results were evaluated for consistent patterns of irregularities between the impulsivity scores, the accuracy scores, and visual diagnoses found throughout the examination. *Results:* Of the fifteen patients involved in this study, three were diagnosed with ADHD, one subject was suspected to have ADHD, and the remaining eleven subjects had no formal diagnosis or suspicion of ADHD. In analyzing the data, two subjects scored in the more reflective than impulsive category, the other thirteen subjects scored in the impulsive category. When comparing error scores, four subjects scored in the inefficient category while the remaining eleven scored in the efficient category. The data shows that children with ADHD scored slightly more

impulsive and more inefficient than the children without ADHD. With visual diagnoses taking into consideration, there was no correlation between subjects with and without ADHD related to their visual diagnoses. *Conclusion:* The small sample size used in this study limits the data available for analysis. With more participating subjects, a similar study may demonstrate more accurately whether children with ADHD have a difficult time with visual attention tasks, resulting in poor academic performance and poor cooperation in the exam room. This could help us better understand the challenges our patients face, and better cater to their needs.

## TABLE OF CONTENTS

|                             | Page |
|-----------------------------|------|
| LIST OF TABLES.....         | vi   |
| CHAPTER                     |      |
| 1 INTRODUCTION.....         | 1    |
| 2 METHODS.....              | 3    |
| 3 RESULTS.....              | 5    |
| 4 DISCUSSION.....           | 8    |
| APPENDIX                    |      |
| A. IRB APPROVAL LETTER..... | 12   |



## LIST OF TABLES

| Table |  | Page |
|-------|--|------|
| 1     | MFFT and Examination Data.....         | 7    |
| 2     | MFFT recording form and MFFT Data..... | 8    |

## CHAPTER 1

### INTRODUCTION OF ATTENTION DEFICIT HYPERACTIVITY DISORDER

Many children and adults around the world face challenges daily due to attention deficit hyperactivity disorder. It is estimated that between 5.29% and 7.1% of children under 18 years old worldwide have ADHD. Many factors are thought to contribute to the development of ADHD in children, including cultural influences, age, gender, concurrent anxiety disorders, genetics, nutrition, and other environmental causes<sup>4,5</sup>. ADHD is considered a psychiatric illness; this means that it may cause significant impairment to cognitive function<sup>6</sup>.

Although many factors are thought to contribute to the development of ADHD in children, special consideration must be given to the visual system, as recent studies show there may be a link between visual disorders and manifestations of ADHD symptoms in children. One study compared two groups of children, the experimental group was made up of children with a diagnosis of ADHD currently receiving pharmacological treatment. The control group contained children without ADHD. Both groups were asked to complete a quality of life survey. The results of this study showed that children with ADHD experienced significantly more visual and quality of life symptoms than those in the control group.

A similar study compared the Korea-ADHD rating scale (K-ARS) scores in children with ADHD before and after receiving vision therapy for visual issues, including convergence insufficiency. The results of this study showed that the post-vision therapy scores had improved significantly when compared to the pre-vision therapy questionnaire scores<sup>8</sup>. This study alone supports the idea that some cases of ADHD may be exacerbated by visual deficiencies. It also opens the door for vision therapy as a potential treatment option for ADHD patients with visual abnormalities to decrease patient symptoms.

In our study we aimed to evaluate the impulsivity of responses and the accuracy of those responses in children with ADHD, and compare those results to the results of children without ADHD. We also analyzed visual diagnoses for any patterns of diagnoses that corresponded with abnormal impulsivity and accuracy. We measured these characteristics of behavior with the Matching Familiar Figures Test (MFFT).

## CHAPTER 2

### METHODS OF RESEARCH

In this study, children between the ages of 5 and 12 were asked to participate in a special test during their comprehensive eye exam. The Matching Familiar Figures Test (MFFT) was used to assess the impulsivity and accuracy of decision making in children with and without attention deficit hyperactivity disorder. The MFFT is a test that displays one reference picture to the subject, and six slightly different answer choices. Only one answer choice is identical to the reference picture. There are twelve testing items contained in this test, each containing one reference picture and six answer choices. The reference picture and answer choices are presented to the subject simultaneously. The subject is asked to select the one answer choice that is the same as the reference picture. The time it takes for the subject to elicit their first answer selection per test item is recorded. If the first selection is incorrect, the subject is asked to continue searching for the correct answer for that test item. The number of errors before arriving at the correct response is recorded.

The average time per testing item is calculated by adding the total amount of time (in seconds) taken to arrive at the first response by the subject, and dividing that sum by 12. That number is then used in conjunction with age and gender related norms to calculate a score that is used to determine overall impulsivity and accuracy scores. The

total number of errors is also compared to age and gender related norms. Z scores are then calculated and used to determine the overall impulsivity and accuracy scores of that individual.

The subjects that were tested for this study also had their visual diagnoses from their comprehensive eye exam compared with their impulsivity and accuracy scores. This comparison had the potential to highlight certain visual diagnoses that may contribute to ADHD, or abnormal impulsivity and/or accuracy scores on the MFFT.

## CHAPTER 3

### RESULTS

This study involved fifteen subjects between the ages of 6 and 12. Three subjects had been diagnosed with ADHD and were taking medications, and one of the subjects was suspected to have ADHD, but had not received any formal diagnosis or treatment for symptoms. The remaining six subjects were not diagnosed with ADHD, and were not suspected to have ADHD as reported by their parent or guardian.

The visual diagnoses of these subjects, determined by their comprehensive eye exam varied greatly, and the majority of subjects had multiple visual diagnoses. The most common diagnosis was hyperopia, found in nine subjects. The other diagnoses were found in a fewer number of subjects, these diagnoses included regular astigmatism found in four subjects, saccadic deficiencies in three subjects, myopia in two subjects, and intermittent monocular exotropia, divergence excess, esophoria, convergence excess, strabismic amblyopia, accommodative esotropia, accommodative spasm, convergence insufficiency, and paresis of accommodation all of which were noted in only one subject each.

Of the fifteen total subjects, two scored in the category of more reflective, and the remaining thirteen scored in the more impulsive category. Additionally, four subjects scored in the inefficient category, while the remaining eleven scored in the efficient

category. All three of the subjects diagnosed with ADHD fell into the categories of more impulsive and inefficient, the one subject that was suspected to have ADHD scored in the impulsive and efficient categories.

The average impulsivity Z score among the eleven subjects with no diagnosis or suspicion of ADHD was +0.91, the one patient with suspected ADHD scored a +0.32 for impulsivity, which is actually less impulsive than the average of the subjects without suspected ADHD. The average impulsivity score of those subjects diagnosed with ADHD was +0.93, which indicated slightly more impulsive decision making when compared to the subjects without ADHD. Additionally, the average accuracy score of the eleven subjects without suspected ADHD was -0.43. The subject with suspected ADHD had an accuracy score of -0.32. The subjects with diagnosed ADHD had an average accuracy Z score of +0.56, indicating more inefficient responses from these subjects when compared to the subjects without ADHD and with the one subject with suspected ADHD.

| Subject | Impulsivity | Accuracy | ADHD status | Diagnoses  |
|---------|-------------|----------|-------------|--|
| 1       | 1.04        | -0.82    | None        | 1. Hyperopia   |
| 2       | 0.25        | -0.25    | None        | 1. Intermittant monocular exotropia<br>2. Divergence excess                        |
| 3       | -1.3        | -0.14    | None        | 1. Hyperopia<br>2. Esophoria   |
| 4       | 0.41        | -1.01    | None        | 1. Myopia<br>2. Convergence excess   |
| 5       | 0.9         | -0.92    | None        | 1. Strabismic Amblyopia<br>2. Accommodative esotropia<br>3. Hyperopia              |
| 6       | 2.55        | -1.08    | None        | 1. Accommodative spasm<br>2. Hyperopia   |
| 7       | -0.29       | -1.63    | None        | 1. Convergence insufficiency<br>2. Saccadic deficiencies<br>3. Regular astigmatism |
| 8       | 0.61        | -0.21    | None        | 1. Myopia  |
| 9       | 1.49        | -0.01    | None        | 1. Hyperopia<br>2. Paresis of accommodation  |
| 10      | 3.69        | 1.95     | None        | 1. Saccadic deficiencies<br>2. Hyperopia   |
| 11      | 0.69        | -0.62    | None        | 1. Hyperopia<br>2. Regular astigmatism   |
| 12      | 0.32        | -0.32    | Suspected   | 1. Hyperopia   |
| 13      | 0.56        | 0.13     | Diagnosed   | 1. Hyperopia<br>2. Regular astigmatism   |
| 14      | 0.46        | 0.42     | Diagnosed   | 1. Regular astigmatism   |
| 15      | 1.77        | 1.13     | Diagnosed   | 1. Saccadic deficiencies   |

Figure 1: MFFT and Examination Data



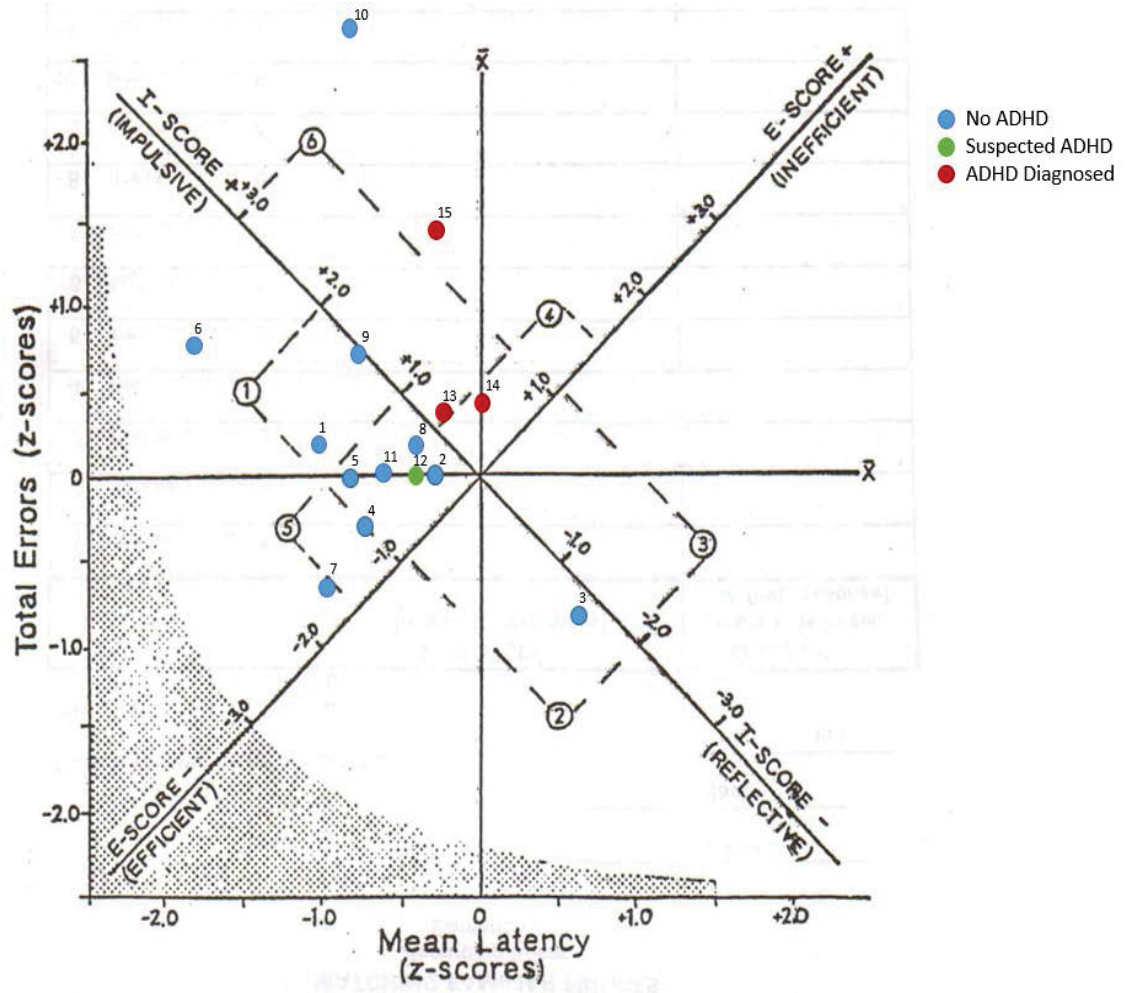


Figure 2: MFFT recording form with MFFT Data

## CHAPTER 4

### DISCUSSION

This study did not result in conclusive evidence of increased visual issues, in children with ADHD. It did, however, demonstrate that the children tested in this study tended to be more impulsive and inefficient in their responses. Additionally, no conclusions were able to be drawn when comparing MFFT scores and visual diagnoses of the subjects. Unfortunately, a lack of available subjects and a lack of subjects with ADHD led to a small sample size and inconclusive results. Age restrictions placed on the standardized test norms limited the number of available subjects for this study. Additionally, patients coming in for comprehensive eye exams who are likely to have visual problems may have contributed to a skewed control group.

There is still a great amount of research that can be done in this field, and the potential for alternative treatment options for ADHD may be considered in the future. Many previous studies point to a significant number of children with ADHD having at least one visual issue. Some studies even suggest that a vision therapy program may decrease the frequency and severity of these symptoms.

If this study were to be repeated, an increased sample size would be beneficial. With the large number of potential visual diagnoses for each subject, a large sample size is imperative to be able to draw conclusions from the data. Additionally, including a

larger percentage of patients with ADHD would give opportunity for better comparison of control and experimental groups.

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## Ferris State University

### *Institutional Review Board (FSU - IRB)*

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To: Dr. Paula McDowell and Emily Gillette  
From: Dr. Stephanie Thomson, IRB Chair  
Re: IRB Application #140807 (Title: *Impulsivity and Accuracy of Children with Attention Deficit Hyperactivity Disorder*)  
Date: September 25, 2014

The Ferris State University Institutional Review Board (IRB) has reviewed your application for using human subjects in the study, "*Impulsivity and Accuracy of Children with Attention Deficit Hyperactivity Disorder*" (#140807) and has determined that it meets Federal Regulation category, Expedited –2G. This approval has an expiration date of one year from the date of this letter. **As such, you may collect data according to procedures in your application until September 25, 2015.** It is your obligation to inform the IRB of any changes in your research protocol that would substantially alter the methods and procedures reviewed and approved by the IRB in this application. Your application has been assigned a project number (#140807), which you should refer to in future correspondence involving the same research procedure.

We also wish to inform researchers that the IRB requires follow-up reports for all research protocols as mandated by Title 45 Code of Federal Regulations, Part 46 (45 CFR 46) for using human subjects in research. We will send a reminder to complete either the Final Report Form or the Extension Request Form to apply for a study continuation. Both forms are available on the [IRB homepage](#). Thank you for your compliance with these guidelines and best wishes for a successful research endeavor. Please let us know if the IRB can be of any future assistance.

Regards,



Ferris State University Institutional Review Board  
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