

Differences Between Students With and Without ADHD on Task Vigilance Under Conditions of Distraction

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Distraction is a typical component of any classroom environment. For effective instruction and learning to take place, it is critical for students to eventually return to task and maintain task vigilance (i.e., returning to the task at hand) when a distraction occurs. Students with attention-deficit/hyperactivity disorder (ADHD), by definition, are more distractible than students without ADHD. However, studies showing specific variability of task vigilance between students with and without ADHD are limited. This correlational study examined the differences in distractibility on task vigilance between students with and without ADHD under conditions of distraction. Two groups of participants, ranging in age from 7 to 11 years, were identified. The participants with existing diagnoses of ADHD were matched to participants without ADHD by gender, age, grade, race, school performance, and ability to help maintain group equivalence. The procedure called for all students to complete simple math computations and copying tasks while exposed to a distracting stimulus. Results showed a marked, statistically significant difference in task completion rates for both tasks between groups. Secondly, students with ADHD had considerable difficulties disengaging from the distracting stimulus and returning to task (i.e., maintaining task vigilance). These findings, rather than generic deficits, may account for a large portion of underachievement suffered by students with ADHD. Treatment recommendations and implications for teaching students with ADHD are discussed.

Keywords: *ADHD, attention, concentration, distractibility, task vigilance*

Introduction

The fundamental characteristics of attention-deficit/hyperactivity disorder (ADHD) have been well documented (Barkley, DuPaul, & McMurray, 1990; Schaughency & Rothlind, 1991). For example, individuals with ADHD typically demonstrate (a) problems with attention, concentration, and distractibility; (b) excessive movements and fidgety behavior; and (c) poor impulse control. Individuals with ADHD can also demonstrate poor organization skills and appear careless more often than their same-age peers. Further, there are two main variants of this essentially life-long condition: ADHD with hyperactivity and poor attention, concentration, and impulse control and ADHD that predominantly manifests only with poor attention and concentration (i.e., ADHD-inattentive type; American Psychiatric Association, 2013). The overall prevalence of ADHD is considered to be about 7% of the population (American Psychiatric Association, 2013). And, according to the U.S. Centers for Disease Control and Prevention (2013), the economic burden of

ADHD in the United States is approximately \$31.6 billion, making it one of the most costly childhood disorders.

Students with ADHD often experience difficulties at school and present a number of classic symptoms in the instructional setting. These symptoms include having difficulties with sustained attention and concentration, being easily distracted, moving about in their seat or classroom more than their same-age peers, and having difficulties delaying impulses and other rule-governed behavior (e.g., blurting out answers before having their turn for speaking). Students with ADHD often lose or misplace items required for schoolwork or may forget to turn in assignments. Finally, students with ADHD perform poorly in academic settings because these settings require exactly those behaviors that are deficient in this student population. In other words, students with ADHD become easily bored with mundane tasks as compared to their same-age peers. All of these symptoms presumably affect task vigilance and subsequent academic performances of students with ADHD, but these interrelated variables are rarely directly evaluated. We define task vigilance as the student's ability to separate from a distracting stimulus and return to the task at hand. In this way, task vigilance is similar to Barkley's (2006) concept of "resisting interference."

Some students with ADHD demonstrate additional comorbid symptoms. This smaller subgroup is at greater risk for serious long-term academic and social problems (Barkley, 1997). These additional high-risk ADHD symptoms include conduct problems (problems with following rules and interpersonal relationships) and antisocial behaviors. The types of antisocial behaviors exhibited by this group of students with ADHD include defiance of authority, poor peer relations, bullying and fighting, stealing, and serious rule violations.

Treatment of ADHD falls under several headings. Medication management is a key dimension in the treatment of ADHD (Dupaul, Barkley, & McMurray, 1991; Frick & Lahey, 1991; Olfson, Marcus, & Wan, 2009). The general class of drugs that demonstrates fair to excellent treatment efficacy is referred to as psychostimulants. For example, methylphenidate (e.g., brand name: Ritalin) has been used to treat ADHD symptoms for many years. Psychostimulants are believed to affect the dopamine receptors in the frontal cerebral cortex associated with response inhibition and motor control, thus ameliorating the chief symptoms of ADHD (Hynd, Hern, Voeller, & Marshall, 1991; Olfson et al., 2009).

Treatment for ADHD also includes instructional and cognitive strategies (Barkley, 2006). Teachers can effectively utilize these types of interventions in the classroom. For example, strategies that can help students with ADHD in classroom settings include breaking down instructional periods and assigned work into smaller sections of time, teacher providing instructional cues and reminders to the student to return to task, instructing students to talk aloud as they solve problems, asking students to self-check completed work, allowing students flexibility with movement such as being able to stand at their desks rather than being seated at all times, providing outlets for movement in the classroom (including ample opportunities for recess and physical activities), modeling desired behaviors, and providing positive reinforcement when students demonstrate target and appropriate behaviors (Barkley, 2006; Reid, Trout, & Schartz, 2005).

In this Institutional-Review-Board–approved study, we set out to directly measure task vigilance under conditions of distraction between students without ADHD (hereafter *non-ADHD students*) and students with ADHD. This type of analysis helps quantify and validate anecdotal reflections from teachers about the distractible nature of students with ADHD and establish actual differences in distraction effects. Further, quantitative data help clinicians and educators more clearly define

and make informed statements about the characteristics and functioning of students with ADHD in classroom settings. The research question that guided this study is as follows: *Under conditions of distraction, is there a statistically significant difference in the task vigilance of students with ADHD and non-ADHD students in terms of sentence-copying and basic mathematics ability?*

Methods

Sample

Six participants were selected for the group of students with ADHD. The participants were recruited by way of advertisement in a large metropolitan-area college of education. All participants were required to have a valid ADHD diagnosis that was confirmed either by a treating physician or psychologist or by way of a detailed psychological evaluation. In addition, all participants were to have had the diagnosis of ADHD for at least 3 months. This additional procedural requirement was included in order to help substantiate the ADHD diagnosis. Five of the six participants with ADHD were taking prescribed medication for the treatment of ADHD. However, all of the ADHD participants were asked to not take their medication on the day of the experiment.

Participants for the group of students without ADHD were obtained by way of advertisement in a large metropolitan-area college of education. The group of students without ADHD was matched to the experimental group by gender (female or male), race (Black or White), and grade level (2nd through 5th grades) to help ensure equivalence of groups on those variables. Table 1 illustrates demographic data of the participants.

Table 1: Demographic Characteristics of Matched Participants

Participants	Race/Gender	Age	Grade
1 and 7	Black male	7	2nd
2 and 8	White male	8	2nd
3 and 9	White female	8	3rd
4 and 10	Black female	9	3rd
5 and 11	White male	9	3rd
6 and 12	Black male	11	5th

Procedures

This investigation was conducted in a typical classroom setting at a college of education located in a large urban area. The classroom was equipped with a television and VCR that were placed at the foreground corner of the classroom. Each participant worked individually with no other students present. Each participant was asked to perform two separate tasks. First, each participant was asked to complete as many basic addition and subtraction facts as possible during a 2-min period (see Appendix A). Second, each participant was asked to copy 10 simple sentences over the course of 5 min (see Appendix B).

The instructions for each task were read aloud by the investigator to each participant. At the beginning of each task, each participant was told that the television would be displaying a program but that they were to work on their task. A recorded episode of a nationally broadcasted television program for children was played during the entire work period of 7 min.

During task-solving, the investigator monitored participants' performances but remained out of the immediate view of the participants. The investigator kept time for each task with every participant. The numbers of correctly executed math problems and correctly copied words within each sentence were tabulated when each participant completed the investigation.

Measures

The first measure—a measure of mathematics ability—was a mixed probe of 64 addition and subtraction problems (see Appendix A). Students were asked to add to or subtract from a randomly selected number between 1 and 10 another randomly selected number between 1 and 10. The order of the operations was randomized; the randomization resulted in 37 addition problems and 27 subtraction problems. The corresponding grade level for this task fell at a minimum 2nd grade level. The second measure, sentence-copying, was a group of 10 simple sentences (see Appendix B). The corresponding grade level for this task was estimated to fall between 2nd and 5th grades.

Research Design and Data Analysis

In this correlational study, we compared the mean of students with ADHD to the mean of non-ADHD students on task vigilance, when the students were under a condition of distraction. Had this been an experimental study, the design would have been the posttest-only with control group design, where the between factor would have been ADHD classification (Shadish, Cook, & Campbell, 2002).

Because of the small N size of this study, we analyzed the data using randomization tests using the method and SPSS macros in Dugard, File, and Todman (2012); the parametric counterpart would have been an independent samples t test. The data analyses were conducted with SPSS 20.0. Because there were two inferential tests conducted, we used the Bonferroni correction to set the nominal α at the .025 level of significance to keep Type 1 error rates in check.

Results

On average, students with ADHD had significantly lower sentence-copying scores ($Mdn = 38.50$, $M = 36.33$, $SD = 27.09$) than non-ADHD students ($Mdn = 62.50$, $M = 61.83$, $SD = 1.60$); the results of the randomization test showed that the difference was statistically significant, $p < .001$, and the standardized mean difference effect size was large, $d = 1.33$. Note the strong lack of homogeneity of variances between the two groups: Levene's test $F(1, 10) = 162.60$, $p < .000$. Observation of a histogram of the students with ADHD showed a clear bimodal distribution as shown in Figure 1. One group of students with ADHD (Participants 3, 4, and 6) scored nearly as well on sentence-copying as the non-ADHD students.

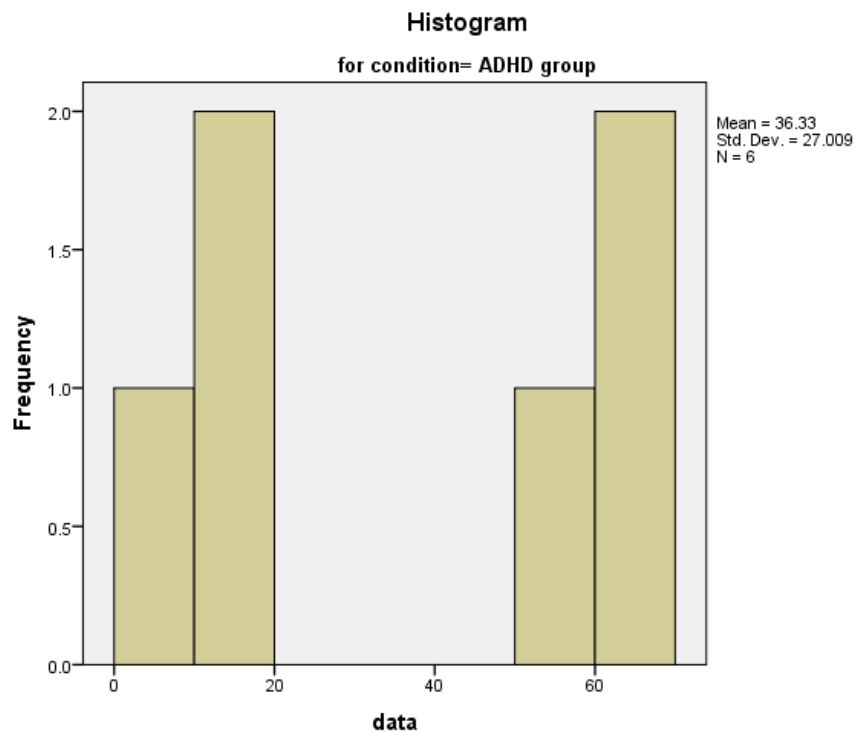


Figure 1: Histogram for Sentence-Copying of Students With ADHD

In terms of math accuracy, students with ADHD ($Mdn = 11.00$, $M = 13.33$, $SD = 9.64$) scored significantly lower than non-ADHD students ($Mdn = 55.00$, $M = 51.50$, $SD = 8.60$). The results of the randomization indicated that the results were statistically significant, $p = .002$, and the standardized mean effect size was very large, $d = 4.56$. Unlike the results for sentence-copying, there was homogeneity of variance between groups: Levene's test $F(1, 10) = .08$, $p = .789$, and the histograms showed no evidence of bimodality in either group.

Our informal observations also were of interest. We observed that non-ADHD students demonstrated more effective task vigilance than students with ADHD. In other words, non-ADHD students were distracted fewer times while working. In addition, non-ADHD students demonstrated shorter time periods of being off-task with each instance of distractibility as compared to students with ADHD. In fact, there were several occasions where students with ADHD lost task vigilance altogether upon a single instance of distractibility.

Discussion

In this study, we set out to observe how distraction is related to task vigilance with both students with ADHD and non-ADHD students. Ultimately, in this study we examined and quantified task vigilance during two academic tasks between those two groups of students under conditions of distraction. This type of direct analysis had been limited in the literature.

ADHD has been clearly defined as a disorder that manifests with poor attention and concentration, distractibility, overactivity, and poor impulse control. Poor task vigilance can likely be added to this

list of ADHD symptoms. In the past, it was assumed that this heterogeneous and sometimes vague combination of ADHD symptoms leads to underachievement. The results of this study help to better understand which specific ADHD traits can contribute to academic difficulties and how they might contribute to underachievement.

The bimodal histogram representing results for sentence-copying is an interesting feature of the results. We hypothesized two explanations for these results. First, it became apparent that this measure presented a ceiling effect with non-ADHD students. In other words, non-ADHD students completed this task well under the prescribed 5-min interval. This may have caused the clustering around the second mode at the upper end of the task parameters.

A second possible explanation exists for the bimodal distribution for sentence-copying. This task apparently presented itself as more of a rote task, requiring simple transcription of words. Perhaps rote tasks are easier to produce for students with ADHD versus other types of tasks like math computation. Thus, students with ADHD may slow down their task execution when higher levels of cognitive processing are involved. At the same time, it can be assumed that increasingly complex tasks become more vulnerable to disruptions by distraction.

It is plausible to assume that weak task vigilance can cause underachievement. In the past, underachievement has been ascribed to a potpourri of symptoms and traits among students with ADHD. For example, symptoms endemic to learning disabled children, deficits with cognitive processing, memory, inherited traits, low self-esteem, poor motivation, and motivational deficits have been blamed for underachievement among students with ADHD. This wide-ranging and diverse list of symptoms has given rise to treatments that may be ineffective or inappropriate for students with ADHD (Abramowitz & O'Leary, 1991; Barkley, 2006; Lerner & Lerner, 1991). Thus, given the findings of this study, many students with ADHD may be cleared of these erroneous secondary diagnoses.

Study Implications

The findings from this study have implications for teachers and parents who work with students with ADHD. ADHD is a type of disability, and increased understanding and acceptance of this disability is important to social change. Social change is achieved when gains in advocacy, treatment, and evidence-based practices are directed toward groups of individuals like ADHD students. Thus, this study contributes to the important philosophies and goals of social change and social justice.

In order to apply the findings of this study, several implications are identified and described. Both teachers and parents should become more aware of sources of distractibility. Distraction will cause frequent interruptions with classwork and will also likely affect the rate of completed classwork and frequency of task errors. Second, in order to increase task vigilance, teachers should frequently monitor students with ADHD. For example, teachers should avoid having their backs turned to students, and actively scan the classroom for distraction problems among students. Third, students with ADHD should be trained to self-monitor their task vigilance. To increase self-monitoring, it would be helpful to create self-cueing tools. For example, teaching students with ADHD students to redirect themselves in response to an emitted tone may be helpful to increase task vigilance, and at the same time increase personal responsibility for completed work. A computer can be used for this intervention by programming sounds or tones that are emitted at certain intervals. The teacher would instruct the student to return to the task at hand whenever the programmed tone was heard.

A similar instructional approach can help reduce error rates among students with ADHD. Rather than passively responding to a task with “intermittent doses of effort,” students should be shown how to self-check their accuracy as they proceed with their work. For example, students with ADHD can be shown how to ask the following self-question: “I need to pay attention to what I just wrote down and check to see if it is correct.” A similar self-questioning statement can be taught to students to redirect behavior when a distraction occurs: “What do I need to do when I am distracted from my work?”

ADHD is a complex, multifaceted disorder that can present serious academic consequences in an instructional setting. It has been recognized that task vigilance is weak in students with ADHD and is likely one major cause of underachievement in this population of children. This clarification of ADHD symptoms responsible for underachievement is an important outcome from this study. Training teachers and parents to understand this important variable is also an important outcome from the study. Teachers and parents working toward increasing task vigilance in students with ADHD can ultimately improve achievement and self-reliance with schoolwork.

Study Limitations and Future Research Questions

The limitations of this study have some of the constraints encountered with human participant research involving exceptionalities and disabilities. For example, the sample size is small, as it was difficult to identify students with ADHD who met the methodology criteria. Thus, the study should be replicated. Future research should extend the analysis of task vigilance with other types of classroom assignments and distraction effects from other sources. Additionally, a follow-up experimental study in which the interaction between ADHD status and distractibility are causally examined is warranted.

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Appendix A

3	7	10	6	2	10	1	5
<u>+6</u>	<u>+10</u>	<u>-2</u>	<u>-3</u>	<u>+6</u>	<u>-8</u>	<u>+8</u>	<u>+6</u>
5	7	6	9	10	9	3	8
<u>-5</u>	<u>-2</u>	<u>+3</u>	<u>-3</u>	<u>-6</u>	<u>+3</u>	<u>+7</u>	<u>-2</u>
6	10	3	5	9	3	2	6
<u>+2</u>	<u>+7</u>	<u>-1</u>	<u>+8</u>	<u>-4</u>	<u>+9</u>	<u>+7</u>	<u>+7</u>
9	7	10	9	8	7	4	5
<u>+1</u>	<u>-5</u>	<u>-7</u>	<u>+10</u>	<u>-4</u>	<u>+8</u>	<u>-2</u>	<u>+6</u>
10	8	8	3	4	0	8	7
<u>-7</u>	<u>+3</u>	<u>+7</u>	<u>+5</u>	<u>+7</u>	<u>+8</u>	<u>-6</u>	<u>+6</u>
4	10	6	2	8	3	9	3
<u>+6</u>	<u>-3</u>	<u>-2</u>	<u>+1</u>	<u>-3</u>	<u>+8</u>	<u>+4</u>	<u>-2</u>
5	7	10	7	9	4	6	8
<u>+3</u>	<u>+3</u>	<u>-2</u>	<u>+5</u>	<u>-4</u>	<u>+8</u>	<u>+6</u>	<u>-1</u>
8	6	9	10	3	7	5	9
<u>-3</u>	<u>+8</u>	<u>-4</u>	<u>+4</u>	<u>-3</u>	<u>-5</u>	<u>+7</u>	<u>+4</u>

Appendix B

Sentence-Copying Task

Directions: Please copy these sentences onto the blank sheet of paper.

I like to play outside.

There are many flavors of ice cream.

The library has books to read.

New York City is far from my home.

Most school buses are painted yellow.

Sally made a new friend today.

Many children like to eat pizza.

Dogs and cats can be good pets.

It was sunny outside on Monday.

George Washington was our first president.

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