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EFFECTS OF SHORT DURATION OF ACTIVITY FOR STUDENTS WITH ADHD

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ABSTRACT

Students with attention deficit hyperactivity disorder (ADHD) struggle with symptoms of inattention and hyperactivity that negatively affects their everyday lives and functioning in the classroom. When students are not paying attention, they are not learning or progressing in their education at their full potential. Exercise and yoga are both interventions that have shown promising results for improving the attention of students with ADHD. This study attempted to determine if three-minute exercise breaks improved student completion of one-digit addition problems. The study targeted elementary-aged students in second grade who had ADHD or symptoms of ADHD, as determined by their parents. The results of this study differed for each of the three participants included in the study, showing that more research is needed to determine the parameters that make this intervention successful, including duration, intensity, medication, and subtype of ADHD.

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1.Introduction

Educators hold a responsibility to create the best learning environment for their students, but students with ADHD require additional services to enhance their learning and increase their educational growth (Zental, 2006). As an educator, it is essential to determine the approaches that are most efficient for enhancing the learning environment for students with ADHD to fulfill the duties of educators to help students reach their highest potential. ADHD is becoming more common in school-age students throughout the United States and throughout the world. According to the Centers for Disease Control and Prevention, 11% of school-age students in the United States were diagnosed with ADHD in 2011. Between 5.3%-20% of children worldwide were also diagnosed with ADHD (Mehta et al.). In fact, ADHD is the most common childhood disorder in the world (Grassman et al., 2014).

Students with ADHD often have trouble engaging in classroom activities, especially when there is limited movement and stimulation in the classroom, and experience academic and social adversities. Since ADHD is common among students, research on effective classroom management techniques that support and enhance learning for students with ADHD is crucial. Studies have discussed the effectiveness of many different interventions, and continued research is still relevant because of the growing number of students with ADHD. Teachers continue to search for effective techniques to aid students in attentiveness in the classroom and therefore increase their learning. Continued research of non-pharmaceutical classroom procedures additionally may reduce reliance on medication in the management of students and addresses concerns of families who are uncomfortable with medicating their children. Research on

effective classroom management techniques should benefit all students in the classroom, including students without ADHD. Students cannot learn if they are not paying attention. Research in the field is pertinent because students with ADHD will not have the opportunity to show their full potential in the classroom if they are not engaged and attentive during tasks. One emerging area of research in ADHD is in the area of yoga and exercise.

Yoga and exercise are two approaches that are relatively easy to implement, have limited or no side effects, are available to all families, and are affordable. Yoga and stretching are popular forms of exercise and reduce stress, anxiety, fear, and aggression (Jensen & Kenny, 2004). Yoga has yielded positive effects on oxygen consumption, brain wave activity, cognition, and cerebral lateralization. Although yoga and exercise are backed by only a limited amount of evidence, there are trends in research and they can potentially be used as an intervention that will benefit all students in the classroom.

Students with ADHD have been reported to have slower brain wave amplitudes, cerebral lateralization deficits, and executive function impairments, all symptoms that have been shown to be positively affected by yoga (Jensen & Kenny, 2014). Reduced dopamine levels are also observed in people with ADHD. These levels may be affected by yoga and/or exercise activities as dopamine is released during participation in yoga (Mehta et al., 2011). In addition to the scientific data, studies of the effects of yoga on ADHD symptoms have reported improved sleep patterns and reduced anxiety, as well as greater concentration and less conflict at school (Harrison et al, 2004). Additional research is needed to support these findings, but emerging studies have seen positive effects from implementing yoga into the lives of students with ADHD.

Zental (2006) suggests channeling the energy of students with ADHD into sports and positive play to use hyperactivity positively. While medication is currently recognized as the

most effective treatment method for ADHD, its effectiveness is related to the fact that it contains dopaminergic and noradrenergic agonists (Byshiausek et al., 2016). Since physical exercise produces an increase in dopamine and norepinephrine naturally and affects their regulation, research is promising in supporting exercise as an alternative or supplement to medication for ADHD (Vyshiauske et al., 2016). There is evidence that exercising regularly can help improve academic performance and reduce disruptive class behavior in all students (Mulrine, Prater, & Jenkins, 2016). It has also been shown to reduce stress, improve self-image, improve memory, and allow clearer thought (Mulrine, Prater, & Jenkins, 2016). Well established research indicates that physical activity improves cognitive functioning in all ages and has mental health benefits (Gawrilow, et al., 2016).

Physical activity, including yoga, should continue to be studied as an approach for ADHD because it does not negatively affect other therapies and can act positively to improve emotional and social functioning (Gawrilow, Stradler, Langguth, Namann, & Boek, 2016). While it is becoming clear that exercise and yoga can have positive effects for students with ADHD, it is important to continue studying its effects to determine the exact conditions that moderate the effects of exercise for students with ADHD (Vyshiauske et al., 2016). Trends in exercise and yoga are becoming apparent, but further research and controlled studies are needed to make exercise and yoga evidence-based practices for targeting symptoms of ADHD.

The purpose of this study is to further examine the effects of exercise on students with ADHD. The following research questions were used to guide this study.

1. Is there a functional relation between short bouts of exercise and increases in math problem completion for students with ADHD?

2. Is there a functional relation between short bouts of exercise and increase in the percentage of math problems answered correctly for students with ADHD?

2.Literature Review

In this review, I will discuss the definition of Attention Deficit Hyperactive Disorder, the diagnosis, and the prevalence. I will highlight effective interventions and existing studies that have shown success for students with ADHD through yoga and exercise interventions.

ADHD DEFINITION, DIAGNOSIS, AND PREVALENCE

According to the DSM-V, Attention Deficit Hyperactivity Disorder (ADHD) is defined as a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning and development. In children below age 17, diagnosis includes six or more symptoms of inattention, hyperactivity, and impulsivity that have persisted for six months and are developmentally inappropriate or disruptive (“DSM-5,” 2016). Examples of inattentive behaviors include not listening when spoken to directly, reluctance to do tasks that require mental effort, not following through on instructions, having trouble organizing tasks and activities, and being easily distracted. Examples of hyperactivity and impulsivity include fidgeting or tapping in seats, leaving seat when staying is expected, running or climbing in inappropriate situations, talking excessively, and blurting out answers (“DSM-5,” 2016). In addition to the aforementioned behaviors, other conditions must be present. Symptoms must be present before age twelve, must be present in multiple settings, must interfere with social, school, or work functioning, and cannot be categorized as another mental disorder (“DSM-5,” 2016). Attention Deficit Hyperactivity Disorder can be classified into three subtypes including the hyperactive type, the inattentive type, and the combined type, while co-occurring conditions in

the combined type are most common (Zental, 2006). Children with ADHD tend to perform worse than typical peers in school performance and organization because of their disability (Archer & Kostrzewa, 2012). While ADHD is more common in males than females, females tend to show more symptoms of inattentiveness that negatively affects their school performance (Archer & Kostrzewa, 2012). Additionally, studies have shown that approximately half of children who have ADHD still show symptoms into adulthood, based on the criteria defined in the DSM-V (Archer & Kostrzewa, 2012).

The Individuals with Disabilities Education Act (IDEA) defines students with ADHD as qualifying for services if the disability is categorized as a co-occurring disability or if there are other health impairments (Zental, 2006). Under these specifications, only about 25%-50% of students with ADHD qualify for services while a majority of students are mainstreamed in the general education classroom. A disability is classified as a condition that seriously affects the ability of students to learn and negatively affects social or academic functioning (Zental, 2006). ADHD is a disability that affects the engagement of students and therefore minimizes their ability to learn. Since so many students are diagnosed but do not receive services, it is relevant to examine classroom techniques to manage behavior and improve attention skills in students with ADHD.

In addition to the symptoms presented by attention deficit and hyperactivity disorder, students can also experience a variety of co-occurring conditions. Students with ADHD performed lower than peers in reading, spelling, and math (Zental, 2006). While IQs are not affected by ADHD, it can be difficult to determine whether the students have learning disabilities in these areas, or if the scores reflect the prominent features of ADHD that prohibit learning to

the full potential (Zental, 2006). However, learning disabilities are not considered a symptom of ADHD, although there is a high level of comorbidity (Zental, 2006).

Typical Interventions

Psychostimulant medication is an evidence-based method of ameliorating the symptoms of ADHD and is the most common approach in North America (Harrison, Manocha, & Rubia, 2004). However, medication can be expensive and is not available worldwide. Additionally, up to 30% of children do not respond to medication and may experience negative side effects (Vyshiauske, Verbughm Oosterlaan, & Moledijk, 2016), which can include insomnia, appetite loss, stomach aches, dizziness, drowsiness, and emotional instability (Harrison et al., 2004). Another potential problem with medication is that it does not guarantee long-term benefits for students and any benefits gained may be lost if the medication is discontinued (Zental, 2006). Additionally, some parents may be hesitant to medicate their children. Because of the hesitancy to use medication, side effects, and inability to acquire medication worldwide, it is important to search for alternate approaches for students with ADHD to decrease the dependence on medication.

Another evidence-based approach to treating ADHD is using behavioral techniques, which include positive and negative consequences (Zental, 2006). In moderating student behavior, children can learn behaviors based on the consequences that they receive because of those behaviors. While positive and negative consequences are both effective in changing the behavior of students with ADHD, higher amounts of positive behavior, specifically praise, pose a more effective long-term solution to helping students learn expected behaviors (Zental, 2006). Examples of positive reinforcement that are effective for symptoms of ADHD are positive feedback, social attention, and environmentally-based stimulation, which is particularly effective

for students with ADHD (Zental, 2006). Reinforcement should be immediate so that students can make the association between the behavior and the consequence.

Yoga and Relaxation Training

Meditation is defined as “a family of self-regulation practices that focus on training attention and awareness to bring mental processes under greater voluntary control and thereby foster general mental well-being and/or specific capacities, such as calm, caring, concentration,” (Cassone, 2013, pg. 149). Due to the relationship between meditation and allocation of attention, yoga and meditation have received attention as an intervention for students with ADHD. The correlation between yoga and meditation on attention and concentration of students with ADHD should be researched thoroughly to determine which conditions can be beneficial to students and the duration and frequency necessary to cause the desired variations in symptoms.

While psychostimulant medication combined with behavior management has been proven as the most effective way to treat ADHD, exercise targets the same dopaminergic and noradrenergic systems as medication (Wigal et al., 2012). The prefrontal cortex is the area of the brain that affects attention, inhibition, and memory. Many studies have found abnormalities in the prefrontal cortex of people with ADHD. Studies have shown that abnormalities of dopamine levels in the prefrontal cortex may be a cause for some of the effects of ADHD (Wigal et al., 2012). Since dopamine is released in exercise, it is important to address the possibility that exercise may have a positive effect on students with ADHD, especially considering the research trends that suggest a correlation between exercise and a decrease in symptoms of ADHD. Several studies have examined the effects of yoga on students with ADHD.

In a study by Harrison, Manocha, & Rubia (2004), students and parents were both taught *Sajha* yoga techniques in meditation. The study was designed to target stability of attention and

concentration in motor activities, problems of inhibition, and frustration, as well as self-esteem and cognitive difficulties in school. The results were measured on the Cognitive Ability Peabody Picture Vocabulary Test and On the Child-Parent Relationship Scale (CPRS). According to the Conners Parent-Teacher Questionnaire, parents rated behaviors on a 4-point scale, including categories of excitability, impulsiveness, attention span, and failure to finish tasks. After teaching the students intervention components to use biweekly for six weeks, 92% of parents reported that they saw benefits in their child's behavior and that hyperactivity and impulsivity were decreased using Sajha meditation techniques. Parents reported an average of a 35% improvement rate and many parents reported that they could reduce medication during the study (Harrison, Manocha, & Rubia, 2004). However, student self-evaluation of self-esteem did not change much through the intervention (Harrison, Manocha, & Rubia, 2004). Additionally, parents found it important to note that they had also been meditating alongside their children and speculated that their child's behavior may have fed off of calmer parent behavior. Meditation was not implemented in the classroom and the focus was on teaching techniques for students that would provide long-term effects in the stability of attention and concentration in the classroom because of regular meditation strategies implemented at home (Harrison, Manocha, & Rubia, 2004).

In a similar study, yoga was implemented in one-hour weekly sessions after school over a twenty-week period (Jensen & Kenny, 2004). Techniques that were taught in intervention included respiratory training, postural training, relaxation training, and concentration training. The Conner's Parent and Teacher Rating Scale was used to determine benefits to the students' post-intervention. The goal of the study was to target hyperactivity by decreasing muscular tension and the inability to relax to decrease the symptoms of hyperactivity (Jensen & Kenny, 2004). Other targeted behaviors included self-control, scholastic performance, inattentiveness,

and impulsivity. Based on the Conner's Global Index, the study showed a reduction in restlessness, impulsivity, and inattentiveness (Jensen & Kenny, 2014). It was noted that home practice and fewer days absent impacted hyperactivity and impulsivity (Jensen & Kenny, 2014). Significant improvements from pretest to posttest were recorded. A similar trend in this study was identified because interventions were implemented over a long period of time and student benefits from the study were not immediate (Jensen & Kenny, 2014).

Cassone (2013) reviewed studies that taught students mindfulness training through meditation, focusing on three core elements of mindfulness practice: intention, attention, and attitude. The studies advocate for mindfulness training to help students learn how to orient and alert their attention and therefore establish control (Cassone, 2013). The targeted behaviors in the studies involved improving the regulation of the attentional process using practices that train attention and awareness in the mental process (Cassone, 2013). The implementation of meditation resulted in improvements in 78% of participants based on the Attentional Network Test (ANT). Improvements were noted in attentional process and mindfulness with approaches that had been successfully adapted for ADHD. It was important to note that while there were positive results from baseline, greater results were observed in students who had previous experience with meditation. The study promoted using meditation in addition to other evidence-based methods to continue to improve attention and reduce hyperactivity for students with ADHD.

Mehta et al. (2011) used yoga exercises that were specifically developed by a yoga instructor and were implemented among 910 students in a regular exercise program. The Vanderbilt Assessment was used to determine the effectiveness of the intervention, which includes categories of reading, math, written expression, relationships with peers, following

directions, disruptive class behavior, assignment completion, and organizational skills (Mehta et al., 2011). Targeted behaviors included classroom attention to tasks. In addition to the yoga sessions twice a week, students were also receiving behavioral therapy for part of the day. Play therapy was also integrated with one hour sessions during the school day. After six weeks of the regular yoga program, 90.5% of students showed improvements as measured by the performance impairment score measurement of academic performance and the parent and teacher evaluations of behaviors (Mehta et al., 2011). The biggest improvements were seen in academic and social aspects of behavior. The intervention was implemented for long periods of time and improvements were seen as students increased their skill set in yoga and meditation. The study showed positive results when meditation was implemented alongside behavioral therapy.

Jensen and Kenny (2004) conducted 20 one-hour yoga intervention sessions and compared the results to a control group to target behaviors of self-control, scholastic performance, inattentiveness, hyperactivity, and impulsivity. None of the students in the study were on medication and parents observed their behaviors based on the Conner's Parent and Teacher Rating Scale. At the end of the sessions, the Conner's Global Index indicated that students exhibited a reduction in restlessness, impulsivity, and inattentiveness (Jensen & Kenny, 2004). The methods used included respiratory training, postural training, such as stretching, relaxation training, and concentration training (Jensen & Kenny, 2004). The results reflected that students improved significantly in their yoga skills from a pre-test to a post-test. No significant effects were reported for either group on the Test of Variables of Attention (TOVA). However, it was determined that students who practiced at home and missed fewer days were more affected in hyperactivity and impulsivity (Jensen & Kenny, 2004). The study suggested that increased

time spent on yoga maximizes positive results. The need for further research on the duration of the effects of yoga on symptoms of ADHD is indicated.

Executive functions are important components of self-control and discipline for students, particularly for students with ADHD who generally exhibit disruptive behaviors and a lack of self-control and self-regulating behaviors in the classroom. One study involves a combination of programs to target the executive function of children including computerized games, aerobics, martial arts, yoga, and mindfulness training targeted at improving executive functions and social and emotional development (Diamond & Lee, 2011). Martial arts were investigated as a specific form of exercise and were shown to improve inhibitory control and found that students participating in martial arts showed greater gains in their education, including their working memory for mental math problems. However, the study cautions that results were more effective for boys than girls and for students in grades 4-5 as opposed to students in grades K-3 (Diamond & Lee, 2011). In the intervention, students participated in martial arts and were asked specific questions about goals for improvements and plans to reach those goals. The study posed more questions for further research, including the specifics of the type of exercise and the ages that are most highly affected by exercise interventions. A similar study focused on the effects of yoga training that included relaxations, sensory awareness, and physical participation. The researchers found that executive functioning improved when physical and mindfulness training were combined but was unaffected when physical training alone was utilized in the intervention (Diamond & Lee, 2011). The research suggests that yoga must be implemented with other mindfulness training to reap full benefits on executive functioning. In conclusion, the research found that the greatest gains in executive functioning were correlated with the intensity of the intervention. Additionally, the study suggests that exercise alone may not be a sufficient

intervention for students with ADHD but that it should be incorporated with mindfulness training and yoga. However, trends showed an improvement in executive functioning in students when participating in martial arts, yoga, and mindfulness training (Diamond & Lee, 2011).

Abadi & Venkatesan (2008) examined the effects of students participating in yoga sessions for two months in comparison to a control group who were not receiving the intervention. The students were evaluated by the Child Symptoms Intervention (CSI-4) which required parents and teachers to fill out rating scales to represent the ADHD symptoms in the participants. A comparison of the CSI-4 before and after the intervention showed a change in the way that students could cope with the behaviors of ADHD and showed an overall positive difference in the students. Differences were shown in hyperactivity and impulsivity scores, as well as in inattention (Abadi & Venkatesan, 2008). These same authors proposed that students with ADHD have more to worry about and are exposed to more stress, so yoga may help them reduce stress and affect emotional and behavioral problems. Additionally, rating scales showed a positive change in hyperactivity, impulsivity, and attention. The study measured overall effects over long periods of intervention.

Exercise

A literature review of fourteen studies analyzed different exercise techniques, including acute running/cycling exercises, mixed long-term exercise programs, and sensory-or-perceptual-motor training (Neudecker, Mewes, Reimers, & Woll, 2015). The results showed that mixed exercise programs had the most positive effects on aspects of behavior and cognitive functions, attention, and motor skills. The study also suggested that regular daily activity would have valuable effects in the long term in cognitive performance. Yoga was also mentioned as a specific exercise program and showed improved attention and reduced ADHD symptoms

(Neudecker, Mewes, Reimers, & Woll, 2015). Long term benefits were noted as decreases in emotional and behavioral problems while moderate effects were noted on cognitive functioning. This study was focused on the acute, long term effects of specific exercise programs and yoga on ADHD rather than immediate short-term effects (Neudecker, Mewes, Reimers, & Woll, 2015).

Gawrilow et al. (2016) implemented exercise into student's daily routines in two different ways. Some students were given exercise activities to complete regularly throughout their daily lives, while other students were asked to do small bouts of physical activity directly before completing a task. In the long term, it was concluded that regular physical activity might improve executive function, but further research is needed to support the intervention. However, many students reported being less depressed after implementing regular physical activity into their lives. Other students were given short bouts of activity before completing attention tasks and coloring. The students who were given short bouts of exercise immediately before their work displayed fewer errors in activities and less disruptive behavior. The importance of this study is the short-term aspect that was examined and the consequential immediate decrease in disruptive behavior and the number of problems solved incorrectly.

In a study examining the effects of moderate to vigorous physical activity on ADHD, students showed improved behaviors in the classroom after participating in fifteen minutes of exercise first thing in the morning (Hart, 2015). However, the effects of exercise were not persistent throughout the day and booster sessions were needed to maintain the positive effects. This research suggests that small bouts of exercise should be implemented frequently in the classroom to maintain attention and increase positive behaviors and academic skills in the classroom (Hart, 2015). The results of the study suggested that it was best to conduct booster sessions every ninety minutes because results are not maintained over time. The research poses

questions of how frequently the intervention should be implemented to maximize and maintain attention for students with ADHD and suggests that short bouts implemented more frequently could maximize attention and reduce disruptive classroom behaviors.

In a review of 49 empirically based studies, it was established that exercise was linked to higher engagement and attention for all students in the classroom, including students with ADHD (Mulrine, Prater, & Jenkins, 2016). Higher rates of movement throughout the day positively affected concentration and helped control impulsivity in students. Exercises were implemented during transition times and in the form of stretch breaks throughout the day (Mulrine et al., 2016). The study suggested that refraining from exercise in the classroom may be an additional cause for disruptive behavior and other classroom problems. Based on the research, it is recommended that exercise breaks during transitions should be made a part of the routine in the classroom (Mulrine, et al., 2016). Although academic time was lost during the day and allotted to exercise, the results demonstrated that exam scores improved despite the loss of academic time. Students with ADHD are at risk for deficiencies in movement skills and physical fitness. However, exercise is essential for these students because of its impact on oxygen levels that can improve nourishment to the brain (Mulrine et al., 2016).

An analysis of ten different studies of the effects of exercise on ADHD established that that exercise had a significant effect on the functional outcomes of students with ADHD and suggested that longer durations of intervention were associated with larger effects (Vyshiauske, Verbaugh, Oosterlaan, & Moledijk, 2016). Students showed improvement in executive functioning skills including improvements in organization, planning, and control of behaviors and goal-setting (Vyshiauske et al., 2016). However, the study called for more research to target

and determine the duration of exercise that is most effective in improving attention in students with ADHD.

Physical exercise has been shown to help improve cognitive functioning and reduce stress, anxiety, and depressive symptoms in all participants, regardless of disability (Archer & Kostrzewa, 2012). In a research review targeted at identifying the specific effects on ADHD, Archer & Kostrzewa (2012) found that physical exercise can improve behaviors that result from uncontrolled impulses and deficits in attention, characteristics that are both common symptoms that cause problems in the classroom for students with ADHD. A review of research involved numerous studies depicting that while behaviors improved substantially, there was little to no effect on academic factors. However, exercise was linked to better memory control for all ages, a skill that can aid students in the classroom (Archer & Kostrzewa, 2012). Collectively, the studies found that exercise was also correlated to a decrease in negative behaviors, inattentiveness, and impulsivity. The results of the study suggest that regular physical exercise may be linked to an improved quality of life for people with ADHD, but does not specifically address the immediate effects of short amounts of physical activity.

Some research suggests that physical activity should be used concurrently with other therapeutic approaches, based on the premise that exercise produces similar outcomes to medication (Wiga et al., 2012). Physical exercise was found to improve the working memory, behaviors, emotional regulation, and even goal-oriented activities in children with ADHD (Wiga et al., 2012). Other research showed that regular exercise for students with ADHD led to improvements in attention, problem-solving, and social behavior when implemented three times per week for forty-five minutes. However, the research also addressed the possibility that shorter duration, or small bouts of exercise, could show immediate positive effects on engagement in the

classroom. Collectively, the research showed that students could benefit from long term exercise programs as well as single exercise bouts, but determined that an individual's cognitive performance was improved when participating in more than twenty minutes of physical activity (Wiga et al., 2012). The study suggests that managing the intensity, frequency, and duration of exercise can help to regulate positive effects on symptoms of ADHD (Wiga et al., 2012).

In a research review of three studies, it was found that acute aerobic exercise resulted in an improvement in cognition (Grassman et al., 2014). In the three studies reviewed, one study allowed students to continue medication as normal during the intervention and resulted in 50% of participants taking medication during intervention. The other two studies did not disclose whether students were taking medication during the intervention. However, the medication was an important factor in the studies, since it decreased some characteristics of ADHD before the intervention. The research suggested that a combination of exercise and medication was not any more effective than a single intervention alone and suggests that the two treatments are similar in this regard (Grassman et al., 2014). The review of the research depicted that exercise interventions targeted specific areas in students with ADHD including impulsivity, problem-solving skills, selective attention, and control on inhibitions. The research suggested that moderate to high intensities of physical activity were beneficial to cognitive functioning while levels that were too high could have negative effects and reduce cognitive functioning (Grassman et al., 2014). Based on the trends in the research reviewed in these studies, further research should target a comparison of the intensity of the exercise and the effectiveness of the results and should attempt to determine the different effects in students who are taking medication and students who are not.

Additional studies targeted the psychological outcomes of exercise as well as the cognitive and behavioral outcomes for students with ADHD (Minkyong et al., 2016). Since research suggested that students who were not taking medication were less engaged in physical activity, the review accounted for studies that targeted the impact of medication on the outcomes of the exercise intervention. For studies that did not review the effects of medication, students showed higher cognitive functioning, reduced negative behaviors, and positive relationships in psychological outcomes (Minkyong et al., 2016). In studies that accounted for the effects of ADHD medications, only one study reported outcomes in physiological domains. However, the findings showed increased cognitive functioning and benefits to attention that were equivalent to the effects in students who were not taking medication. Additionally, significant improvements were shown in behaviors (Minkyong et al., 2016). While the research suggested an overall positive impact of physical activity on cognition, behaviors, and psychological outcomes for students with ADHD, further research is needed to specifically determine the effects with/without medication.

In a research review that focused on the effectiveness of ADHD as an adjunctive treatment by studying effectiveness in both human and animal subjects, it was determined that exercise improves some symptoms of ADHD (Klil-Drori & Hetchman, 2016). These researchers recommend that exercise should be used as an adjunctive treatment to medication to further improve attention and behavior in students with ADHD. The research review suggests that multimodal treatments are promising as the best approach to treating behaviors common in children with ADHD (Klil-Drori & Hetchman, 2016). However, the research focused on children and emphasized that exercise interventions have yet to be applied to adults with ADHD as well to thoroughly determine the overall effectiveness of the intervention. The conclusion of the

research calls for more controlled and carefully planned studies of exercise to determine specific aspects of its effectiveness on specific populations of people with ADHD.

In conclusion, the research has shown that exercise and yoga interventions have demonstrated promising outcomes for attention, engagement, and behaviors in students with ADHD. However, there are still parameters of the effectiveness that need to be specifically determined. Some areas that still need to be defined are the duration, frequency, and intensity of exercise and yoga that is effective for reducing off-task behaviors and improving attention in students with ADHD. Since medication is the most common treatment in children, many students in the studies were continuing medication as normal during the intervention, so the effects of medication on the intervention should be specifically stated and evaluated in the studies. Further research should attempt to determine the correlation of medication on the effectiveness of exercise interventions and specifically determine whether medication and exercise should be used together. Some research even suggests that the age and gender of the students influences the effectiveness of exercise and yoga interventions. More specific research is needed to determine these conditions and prove that exercise and yoga interventions are effective in targeting behaviors, executive functioning, and attention in students with ADHD.

Taken together, the literature review suggests that there is a need for further research to determine the effectiveness of shorter durations of physical activity and to examine the parameters under which both physical activity and yoga exercises are successful interventions for students with ADHD. This study will attempt to determine whether short bursts of activity are successful in improving immediate attention in students.

3.Method

Participants

Participants were selected from an elementary school in a suburban area in a mid-Atlantic state. Before beginning recruitment, approval from the Institutional Review Board (IRB) was obtained to ensure that procedures followed protocol for research involving human subjects. Written permission from a parent/guardian and verbal permission from the student was obtained prior to the study. Participants were students in second grade who were diagnosed with ADHD, or exhibited ADHD-like behavior, as specified by their parents on the consent form. Consent forms were sent home to all parents in the selected classroom with information about the study, a description of what students would do, as well as the purpose and rationale of the study. Parents were asked to indicate whether their child had a formal diagnosis of ADHD or showed symptoms of ADHD. The letter further informed parents that participation was voluntary and students were free to discontinue at any time. Consent forms also verified that students should continue any use of psycho-stimulant medication normally. Documentation of verbal student consent was recorded at the time of consent and the following script was read to student participants: “I am doing a project to help me become a teacher. It would require you to do some reading, math, exercise, and stretching with me. Would you like to help?”

Three students participated in the study. Pseudonyms were used in place of participant names to protect confidentiality. Isaiah, was a seven-year-old male. He was reported by his parent to have symptoms of ADHD, although he did not have a formal diagnosis. George was an eight-year old and also had symptoms of ADHD, as reported by a parent on the parental consent form. Madison, was an eight-

year-old female who had a formal diagnosis of ADHD, as indicated by the guardian on the parental consent form. Madison displayed both symptoms of hyperactivity and inattention during the time that she was participating in the study. Students who had a formal diagnosis of ADHD continued other treatments as normal during the entirety of the study. While math and reading were required skills for the activities, no disabilities were considered other than Attention Deficit Hyperactivity Disorder, so students performed at their individual ability level for required tasks in the study.

Setting

The study took place in a hallway at the school. The hallway was chosen because there was adequate space for students to complete necessary activities safely. There was a table in the hallway where students completed the majority of the academic activities, but at some points during the study space was limited and the study was completed on the floor of the hallway. Students were removed from the classroom to avoid any potential distractions that may have resulted from intervention activities. The time that students were out of the classroom to complete intervention and baseline activities varied depending on availability of the students so that they would miss limited instructional time. Most interventions occurred at the end of the day around 2:30-2:45, but times varied depending on availability in the classroom.

Experimental Task and Dependent Variable

During both baseline and intervention sessions participants were asked to complete math worksheets with basic, single digit addition facts. The fact sheets contained one hundred problems and were randomly generated from an online source. Students were given a different worksheet during each stage of the study. Students were given 5 minutes to work on the task. The task was chosen because all students were capable of completing the task accurately; so, the focus was on attention to the task rather than skill.

The dependent variable was the number of problems attempted and the number of problems completed correctly during each 5-minute session. No students completed the entire sheet over the five-minute period and new sheets were distributed during each phase. The number of math problems that participants completed in the time allotted and the number of problems that they completed correctly were recorded and compared across baseline and intervention conditions. The number of problems that were attempted were recorded because they showed the attention that students allocated for solving specific problems, rather than the ability level of the students. Tasks included were basic, one-digit addition problems, so that students would already show a basic competency to tasks that were age appropriate. The problems were chosen so any increases in problems completed could be attributed to attention rather than growth in abilities. The percent of problems that were answered correctly were also recorded to determine if intervention activities resulted in an increase in ability to solve problems or attention to detail in the task.

Procedures

In baseline, students read short, non-chapter books that they selected from their classroom library for five minutes and then were asked to complete as many questions on the math fact sheet as they could in a five-minute period. The students were instructed to begin reading. At the end of five minutes, students were told to stop immediately. They were handed a math worksheet and instructed to wait until I said begin to start. Reading was used as a control between baseline and intervention sessions. The number of correct responses were recorded to assess student attention to the task.

The independent variable was short, two-minute bursts of moderate to vigorous physical activity followed by one minute of stretching. The intervention was chosen because trends in

research have shown that exercise and yoga activities such as stretching may increase a student's attention and on-task behavior. During intervention sessions, participants were required to complete jumping jacks for 30 seconds, followed by running in place for 30 seconds, followed by hopping in place for 30 seconds, followed by dancing in place for 30 seconds. The methods were chosen based on research of aerobic activity and running and the effects on attention. Exercises were varied because of research supporting a mixed exercise program for success for students with ADHD (Neudecker et al., 2015). Participants stretched for a short amount of time following the bout of exercise. Stretching activities included 30 seconds of touching their toes with the legs straight and heels touching, followed by raising their arms over their head while inhaling, and releasing their arms while exhaling. Stretching was chosen based on past research trends on effectiveness of yoga and exercise methods in improving attention and behavior of students with ADHD (Mulrine et al. 2016; Jensen & Kenny, 2004). Students were encouraged to continue movement during the entire three-minute duration of time, but personal student intensity was not monitored. Similar to baseline, students completed the 5-minute math fact activity immediately after intervention.

To ensure study fidelity, a second researcher verified that the times dedicated to each activity correctly matched the times that were agreed upon in the IRB form and the parent consent letters.

Experimental Design and Interobserver Agreement

An alternating treatment design was used in the study. Baseline (i.e., reading) and intervention were alternated because the alternating design allows results to be determined

quickly, and the research in this study was completed over the course of only four weeks (Herrera & Kratochwill, 2014).

Interobserver agreement was documented by a second observer who independently counted the number of problems attempted and number correct for all participants in 33% of baseline and 33% of intervention sessions. Agreement was calculated by dividing the small of the two totals by the larger and multiplying by 100%. Agreement for Isaiah was 100% baseline and 100% intervention. Agreement for George was 100% baseline and 100% intervention. Agreement for Madison was 100% baseline and 100% intervention.

4.Results

Figure 1 is a graph that depicts the number of problems that Isaiah attempted in both baseline and intervention. Visual analysis of Isaiah's data showed a higher number of problems answered in intervention than baseline. However, there were no differences in accuracy between phases (see Fig. 2). The mean number of problems attempted and correct during baseline was 16 and 15 respectively. The mean number of problems attempted and correct during intervention was 15 and 14 respectively. The number of problems attempted for baseline and intervention was 4-39 and 7-33 respectively. Anecdotally, Isaiah showed both symptoms of inattention and hyperactivity throughout the study, including talking when he should be completing work quietly, bouncing in his seat, laughing uncontrollably, and staring out the window or at other students.

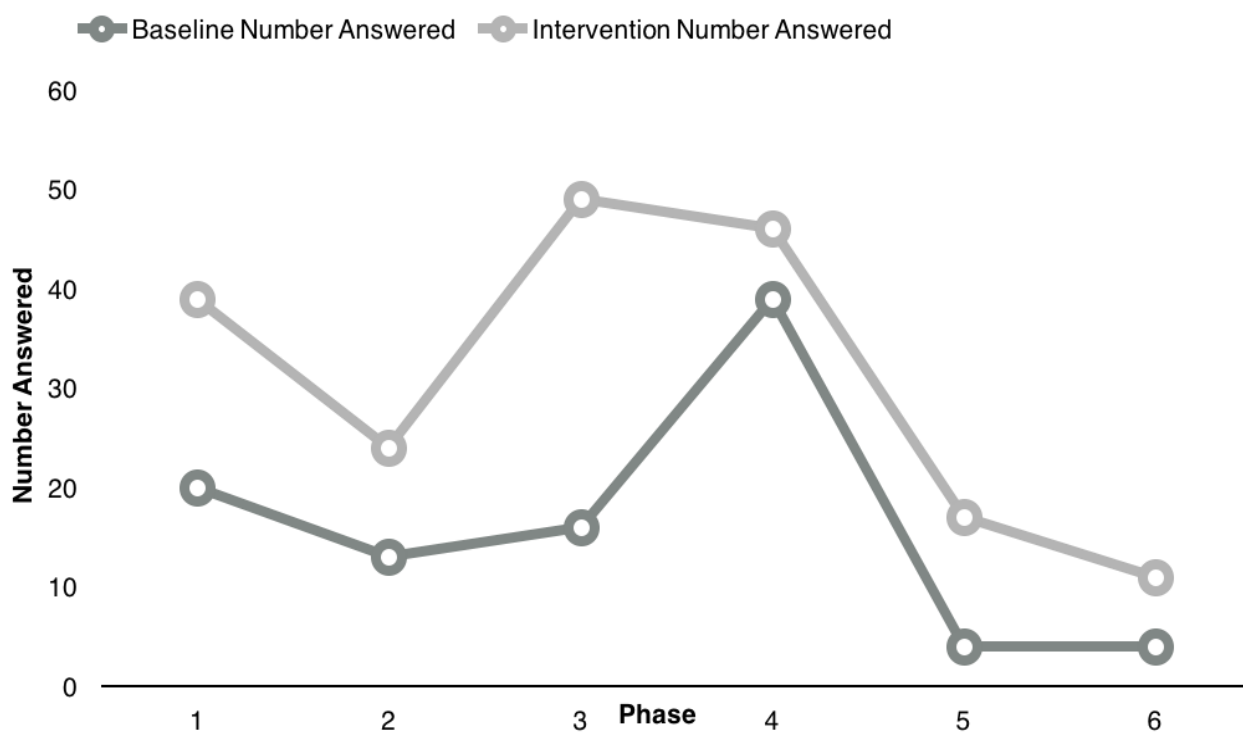


Figure 1 Isaiah Questions Attempted

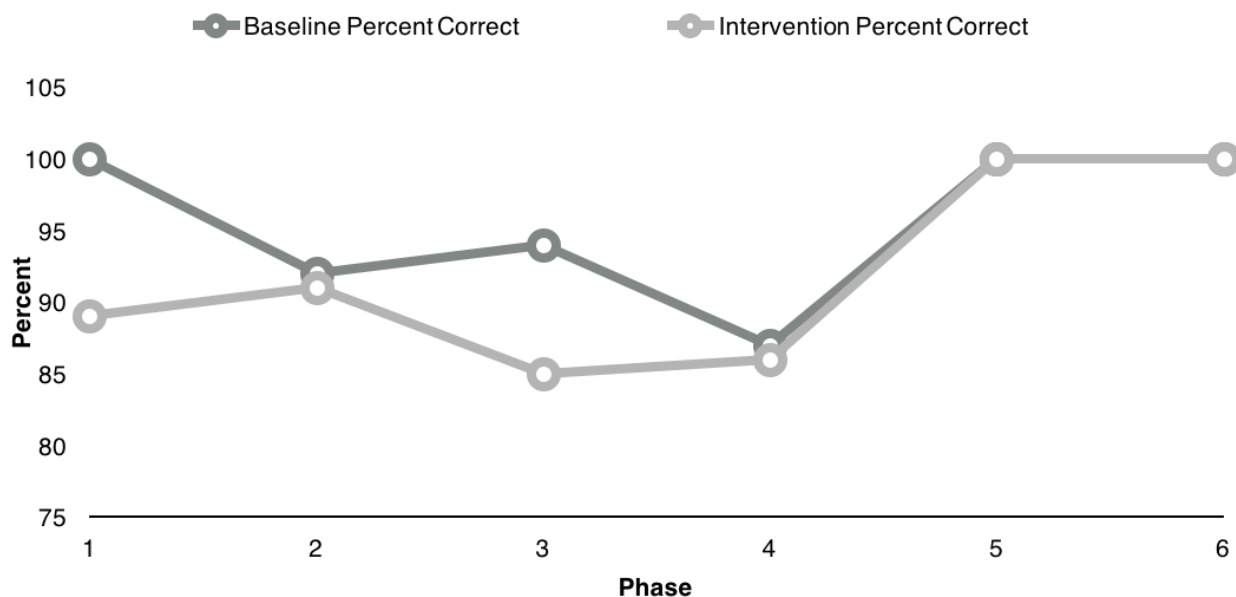


Figure 2-Isiah Accuracy (Percent Correct)

Figure 3 is a graph that depicts the number of problems that George attempted in both baseline and intervention. Visual analysis of George's data suggests that intervention was effectively allowing the student to answer more questions during the first three phases, but was inconsistent for the remainder of the study. In phase four of baseline, the student peaked in the number of questions answered at 43 questions. The lowest number of questions answered was in phase four of intervention, when the student answered 15 questions. The discrepancy in questions answered in phase four suggests that there may have been outside factors affecting the student's participation during those phases. The mean number of problems attempted and correct during baseline was 26 and 24 respectively. The mean number of problems attempted and correct during intervention was 25 and 24 respectively (see Figure 2). Visual analysis of the data indicates no differences between the intervention and baseline conditions. The number of problems attempted for baseline and intervention was 18-43 and 15-39 respectively.

Anecdotally, George showed symptoms of inattention throughout the study, including staring out the window or putting his head down at different times throughout the study.

Figure 4 is a graph that shows George’s accuracy across baseline and intervention phases. Visual Analysis depicts that George obtained higher percentages over the phases of intervention compared to baseline.

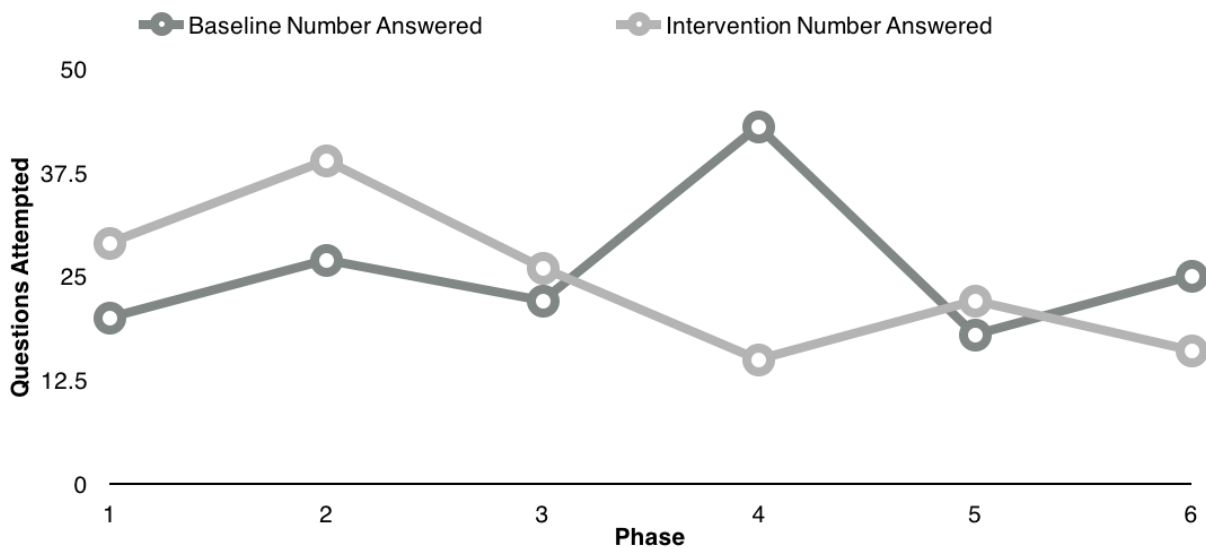


Figure 3-George Questions Attempted

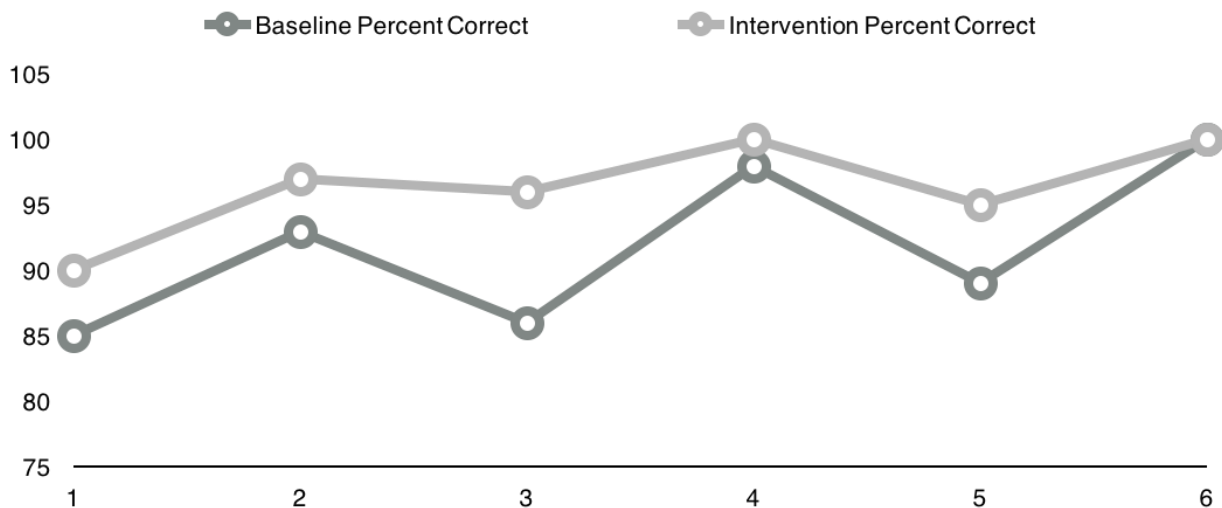


Figure 4-George Accuracy (Percent Correct)

Figure 5 is a graph that depicts the number of problems that Madison attempted in both baseline and intervention. Visual analysis of Madison's data shows that points for both intervention and baseline graphed across the phases remained consistently close throughout the study. The number of questions answered decreased as time progressed throughout the phases, but at any given phase Madison was completing a similar number of problems in both baseline and intervention, with the number of problems decreasing throughout the course of the study. The number of problems attempted for baseline and intervention was 5-18 and 5-14 respectively. The mean number of problems attempted and correct during baseline was intervention for Madison was 12 and 1 respectively. The mean number of problems attempted and correct during intervention was 9 and 0 respectively (see Figure 5). Visual analysis of the data indicates no differences between the intervention and baseline conditions. Anecdotally, Madison exhibited both symptoms of inattention and hyperactivity throughout the study, including laughing uncontrollably, talking continuously, and moving around in her seat and around the floor.

Figure 6 shows Madison's accuracy graphs, including the percent of questions that Madison answered correctly. The percent was considerably low for the student and in many cases, she answered 0% of the questions correctly, for unknown reasons.

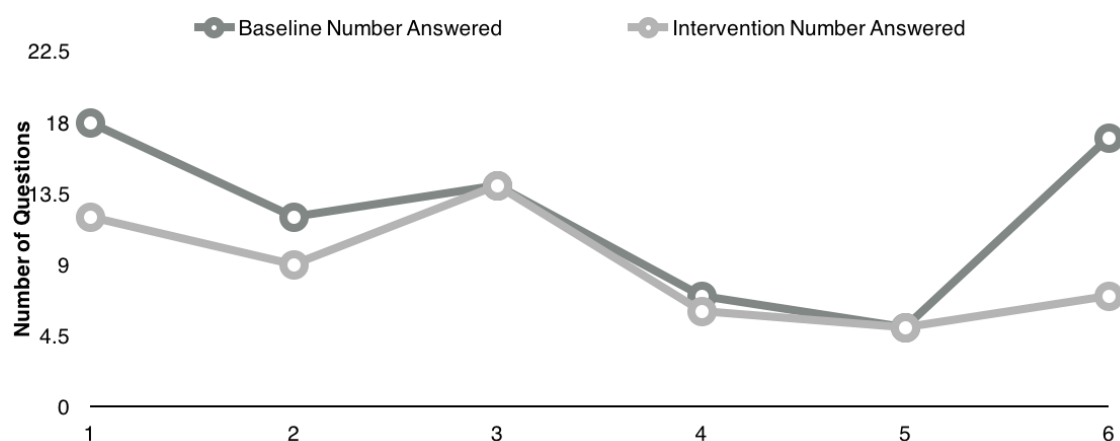


Figure 5-Madison Questions Attempted

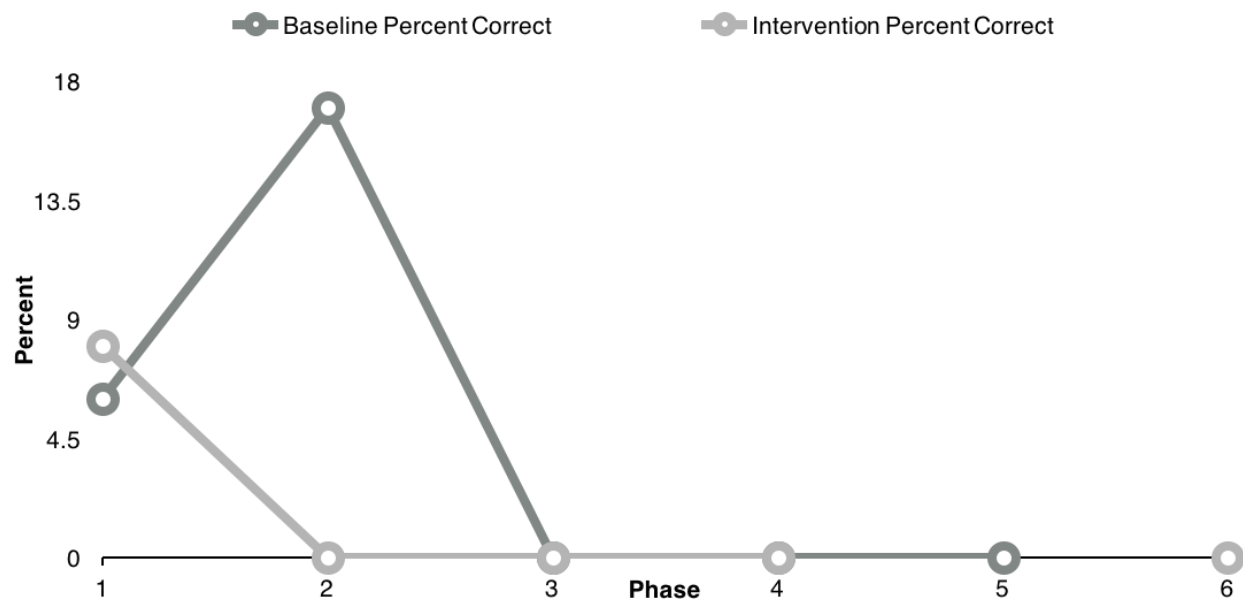


Figure 6-Madison Accuracy (Percent Correct)

5. Discussion

The purpose of this study was to determine if exercise breaks between activities would increase students' attention to task and engagement on math task worksheets. Three students with ADHD or ADHD-like behavior were asked to complete math problems in both a baseline and exercise condition. Overall findings indicated that the exercise intervention increased the number of problems for one of the three students, indicating that the effectiveness of exercise could be different for individual students and that the parameters under which it is effective still need to be specifically determined.

More specifically, Isaiah initially showed a consistent difference in number of problems attempted across baseline and intervention phases. George's data indicated that at least initially, the intervention produced higher levels of problem completion than baseline. However, these differences diminished as the study progressed. Lee and Zentall (2002) indicated that student with ADHD habituate to environmental stimulation more quickly than peers. It is possible that these data suggest a habituation effect and that changing the types and times of exercises may increase performance on sustained attention tasks. Madison was different from both George and Isaiah entirely, and stayed stable in both the percentage correct and questions attempted across baseline and intervention phases, showing that exercise had neither a positive or negative effect for her. Madison's number of questions answered was considerably low in each phase, however, suggesting that there were unknown outside factors hindering her ability to complete addition problems in general.

All participants showed a slight drop in the number of questions answered correctly across the phases of the study, suggesting that students lost motivation or attention to task over time. This result could suggest that the students tired of the task or found a lack of motivation as the study progressed. This issue should attempt to be remedied in future research, so that participant results will show consistent trends across time.

Given that the subtype of ADHD was unknown during this study, it is possible that distinguishing between inattention and hyperactivity could lead to more precise findings about the effect of exercise on immediate attention of students with ADHD. One possible explanation for the varied results in the study could be that exercise could help students who have attention problems alone increase performance in immediate tasks but hinder the productivity of students with hyperactivity or a combined subtype, because of increased stimulation. Determining these parameters could be beneficial to teachers in effectively applying the intervention to the classroom without impeding on the success of students who do not benefit from the intervention.

Existing research on the effects of yoga on symptoms of ADHD shows trends for positive results over time. Students who completed training in Sahaja yoga techniques and meditation over a six-week period showed improvements in attention over a long period of time, rather than the small bouts that were implemented in this study (Harrison, Manocha, & Rubia, 2004). In a similar study, yoga was implemented weekly and students were trained in techniques, which suggested an improvement in attention and impulsivity over time (Jensen & Kenny, 2014). In both instances, unfamiliar yoga techniques were specifically taught to students and improvements were shown after a long period of time after specific practice was allocated to the exercises. Another yoga intervention that was successful in eliciting positive results in students included mindfulness training that specifically targeted a student's way of thinking (Mehta et al.,

2011). A potential reason that participants did not show immediate benefits from yoga effects is because the exercises were implemented over a short time frame and interventions only included two, thirty second yoga components. Students were not trained on techniques to complete the interventions with specific meditation and breathing techniques. Other research was more successful with explicit instruction on meditation techniques that may have aided the three participants in acquiring greater attention skills. The duration of the yoga techniques was also a factor that differed in other research, where yoga was practiced for periods of thirty minutes to an hour, as opposed to the minute that the students completed in this intervention. Longer and more intense interventions may have elicited more beneficial results for students. Specific training could be aimed at giving students techniques that they can use over longer periods of times and continue to use, since the short durations did not provide drastic, immediate rewards for student attention.

In research on exercise interventions, numerous studies reported positive effects of sustained exercise interventions that were targeted at affecting student behavior and attention to task throughout the entire day, instead of focusing on immediate benefits after short durations. Research conducted in one study poses the theory that longer exercise interventions are associated with better effects (Vyshiauske, et al., 2016). Exercise interventions longer than twenty minutes were posed as most effective in improved symptoms of ADHD (Wiga et al., 2102). Conversely, in this study, exercise interventions were only completed for three minutes and effects were measured directly after. Other research poses the possibility that longer interventions before school are more effective, but that exercise breaks are useful in maintaining the positive effects of exercise throughout the day (Hart, 2015). The short exercise interventions may have been enough to suggest a potential effectiveness if more time was devoted to exercise

in the intervention phases. However, other research trends were generally positive for exercise trends in general and Isaiah's decrease in the number of questions answered correctly is inexplicable when compared to other positive trends.

Gawirlow et al. (2016) found that there were fewer disruptive behaviors in students after short exercise breaks and fewer errors, which suggests that similar small exercise breaks in this study should have replicated the results to show improved attention. However, only one student showed a potential for less error, while other students did not depict significant changes in error. The results show that there are still many parameters to be determined to specifically use exercise breaks in the classroom. Stretch breaks and exercise during transitions times could also be a promising way to increase student concentration and attention to task and could improve test scores (Mulrine, et al., 2016). Given the success of others in implementing exercise in short bursts as an attention break, it is important to continue research to determine ways to make this intervention effective for approving attention in all students with ADHD, and determine why some students showed more negative effects after the interventions, as Isaiah showed in his decreased scores on mathematical tasks.

At the end of the study, the participants were debriefed about the reason for the study to attempt to determine if exercise breaks helped them perform better or not. All three participants agreed that they thought that the exercise was beneficial to them. Although the scores did not depict benefits in all students, they personally felt that they were more capable after the interventions were put in place.

Applied Implications

The implications of this research suggest that classroom teachers must specifically address student characteristics to determine whether the intervention will be effective for those

students.. Shorter exercise breaks, if determined effective for individual students, would be a convenient and useful way for teachers to create a learning environment that is inclusive of students' needs and improve their attention. However, teachers must be aware that a one-size fits all approach with regard to activity times may not be effective for all students.

6.Limitations

Although suggestive of positive effects, the results of this study must be viewed within its limitations. First, reading was chosen as an activity to stimulate the attention that students will allocate for classroom resources. Students read silently to themselves before completing other activities in intervention and baseline. While all students were looking at the book during the five-minute time period, there was no way to ensure that participants were actually reading the books, as opposed to flipping through the pictures without allocating attention to the task. If students were not giving their full attention to reading the book, an accurate simulation of attention to classroom tasks could not be replicated, because students were not completing work. During the reading time, some students whispered out loud to themselves, which validated that they were completing the task. However, it was not possible to determine whether students were paying attention to the reading, or just pretending.

Second, students were not redirected during the math task to ensure that the results would represent an accurate depiction of the effect of the exercise activities rather than the teacher redirection. However, in a regular classroom setting, teachers would be redirecting students if they were not paying attention to an assignment. An accurate depiction of the effects of exercise in a classroom would include teacher redirection in addition to the bursts of activity to show the feasibility of the intervention in a general education classroom as opposed to the study setting. Since redirection was not given, students were creating distractions for each other during the study. Since all three students were sitting at the same table in the hallway, there was not sufficient space to split up the students. The distractions could have affected the number of problems that students could complete, especially in the intimate setting where the study took

place. Additionally, student results dropped over time, which suggests that students may have recognized that there was no redirection and were less motivated to attempt to answer problems.

Third, since a classroom was unavailable for the students to complete the study, it was done in a table in the hallway. While the setting was quiet and removed from classroom activity, outside parties walking in the hallway caused distractions to the students that would not be present in a general education classroom. At some points, teachers would walk by and say hello to the students, who would be distracted. Additionally, there were some times when the table was unavailable in the hallway and students had to sit on the floor in a different part of the school to complete activities. Regular school distractions ensued as normal throughout the study and could have been a factor in the lack of attention that was given at certain points of the study.

Additionally, stimulating activities including snow days and delays, classroom parties, and assemblies may have affected students' overall attention levels for the entire school day and caused distractions that are not considered in the data collection. The effect of the changes in student routines may have influenced their attention to tasks. Due to the small number of participants, students were sitting close by and began to distract each other additionally throughout the study. Distracting behaviors included laughing, talking, making noises with mouths, and tapping. At multiple points in the study, one participant asked another to stop a behavior because it was distracting. The potential distractions could decrease results, while occasional student absences could also have potentially limited distractions and increased motivation to complete problems.

Fourth, participants were encouraged to continue taking any medication as normal during participation in the study. As a result, some portion of student success could be attributed to the medication over the activity bursts. Since medication was not considered in this study, student

treatments and consistency of treatments could have been altered during this study and therefore altered the results and effectiveness of the intervention. Additionally, out of the three participants, two were indicated to have symptoms of ADHD by parents on the consent form while one participant had a formal diagnosis. Guardians indicated that the students had shown persistent symptoms at home, so students were considered in the study without having a formal diagnosis. The lack of diagnosis could potentially affect the data, based on the reliability of guardian diagnosis.

Finally, while students were diagnosed to have ADHD by their parents, no other disabilities were considered during the study. Since mathematics and reading were both important for baseline and intervention activities, disabilities in participants could have limited student potential to complete tasks accurately and efficiently. To take these disabilities into consideration, student progress was monitored on an individual level and no comparisons were made between participants. However, the presence of learning disabilities could have limited students' attention to reading activities that could have made their attention to task a less effective replication of their attention to classroom tasks. Additionally, mathematical disabilities could have limited student ability to complete math tasks and increased frustration that could limit the number of problems they can complete. There was no knowledge of individual student disability or capability to complete tasks required in the study. While the task chosen should have been developmentally appropriate for the students to give a portrayal of their attention instead of cognitive ability, learning disabilities would have altered this aspect of the study.

7. Conclusion

Students with ADHD-like behaviors need interventions to help increase academic engagement. Prior research has shown that exercise and yoga can have positive effects on the behavior of this group of students. The data in this study did demonstrate some benefits for students with ADHD. However, the individual parameters of exercise (e.g., duration, level) must be investigated to maximize the effectiveness of the intervention across individuals.. Classroom teachers could use brief periods of exercise with this population of students, but should be sure to conduct formative evaluations to monitor the effectiveness and allow for adjustment of exercise parameters along the way.

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Education

Bachelor of Science in Childhood and Early Adolescent Education
Minor in Special Education

Thesis Title: Effects of Short Durations of Activity for Students with ADHD
Thesis Supervisor: David Lee

Professional Semester

Osceola Mills Elementary School, Philipsburg, PA
Student Teacher-2nd Grade

- Planned and implemented an economics unit that exhibited project-based, student-centered learning and enhanced problem-solving skills of students
- Completed and taught multiple lesson plans in mathematics, social studies, literacy, reading, and science
- Exhibited management techniques and was entrusted to lead the class early into the practicum
- Observed in 3rd and 4th grade classrooms to enhance knowledge of older elementary instructional techniques

Work Experience

Today's Learning Childcare, Greensburg, PA
May 2014-Present
School Age Camp Leader

- Planned educational activities for the summer, including integration of science, technology, engineering, and mathematics in various STEM activities and creative writing projects
- Assisted in organization of field trips and facilitated safety in trips through rules and supervision
- Implemented management techniques to enhance learning opportunities for students and facilitate a safe environment

The Bennet Family Center, State College, PA
August 2015-December 2016
Teacher's Assistant

- Implemented management techniques, including praise and redirection

- Supervised infants and toddlers in a mixed age classroom
- Assisted with cleaning and organization of the classroom

Kids First/Lily Pond, Altoona, PA

October 2014-May 2015

Group Supervisor

- Supervised students in before/after school care
- Motivated students to engage in creative activities including card games and art projects

Community Service Involvement

Vacation Bible School, 2012-2016

- Directed and planned the Vacation Bible School and lead three of the corresponding stations to ensure that the Bible School would continue at the Church for the past five years.

Big Brothers Big Sisters

- Motivated and increased the self-confidence of a student from a non-traditional family background and low socioeconomic status

Professional Accomplishments and Awards

Professional Memberships:

- Kappa Delta Pi, Educational Honors Society
- Pi Lambda Theta, Educational Honors Society
- The National Society of Leadership and Success
- Alpha Lambda Delta, Academic Honors Society

Presentations:

Presented in the Kappa Delta Pi 2015 Convocation, evaluating the effectiveness of the assistive technology app ProLoQuo in student communication.