8-2018

Strategies to Improve Executive Functioning in Students with Attention Deficit Hyperactivity Disorder

Nicole Brennan

Strategies to Improve Executive Functioning in Students with Attention Deficit Hyperactivity Disorder

by

Nicole Brennan

A Starred Paper

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Master of Science in

Special Education

August, 2018

Starred Paper Committee:
Bradley Kaffar, Chairperson
Kyounghee Seo
Frances Kayona

Table of Contents

List of Tables

Chapter 1: Introduction

Executive functions can be described as being able to focus, hold, and work with information in mind, filter distractions, and switch gears as being like having an air traffic control system at a busy airport to manage arrivals and departures of dozens of planes on multiple runways (National Scientific Council on the Developing Child, 2011). Executive functions have recently been given more attention and has been thought to be directly related to the functional impairments of youth with Attention Deficit Hyperactivity Disorder (ADHD) (Barkley, 2001). Executive functions allow individuals to set goals and take action toward achieving those goals using the functions of planning and organizing. They also help with emotional regulation and response inhibition of suppressing behaviors that are not wanted and allow us to self-evaluate behaviors (Langberg, Dvorsky, & Evans, 2013). According to Dawson and Guare (2010), executive function skills include planning, organization, time management, working memory, and metacognition. Executive skills enable us to manage our emotions and monitor our thoughts in order to work more efficiently and effectively.

Executive function skills are becoming more important for academic success in the middle school years as students are expected to manage classwork, homework, studying for tests, and learning the styles of multiple teachers. According to Biederman et al. (2004), children with ADHD and executive function deficits had significantly lower academic achievement and were more likely to repeat a grade compared to children with just ADHD. According to Barkley (2006), deficits in executive functions have an important role in explaining the problems children with ADHD face in their daily lives. Students with ADHD often show executive function

deficits that negatively impact their planning, goal setting, and persistence which can have negative effects of academic success (Johnson & Reid, 2011).

Attention Deficit Hyperactivity Disorder (ADHD) is defined as a brain disorder marked by an ongoing pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development (National Institute of Mental Health, 2016). By definition, symptoms of ADHD interfere with aspects of social, academic, and work life (American Psychiatric Association, 2013). Executive functioning skills allow us to plan, organize, remember things, prioritize, pay attention, and get started on tasks, and a child with ADHD may lack skills in one or more of the executive functions. It is important to note that executive functioning difficulties do not always equate to an ADHD diagnosis, but are often correlated with other mental health disorders such as depression and anxiety.

Mindfulness refers to the presence or absence of attention to or awareness of what is occurring in present experience (Brown & Ryan, 2003). Research on mindful awareness and executive function has increased in recent years as they both have unique roles for higher order cognitive processing (Riggs, Black, & Ritt-Olson, 2014). It has been suggested that mindful individuals, as compared to those who are less mindful, have more awareness of their cognitive and behavioral scripts leading to greater insight into their behavior (Brown & Ryan, 2003). This means that those who are mindful might have a better ability to use higher order processes such as executive functions to regulate their own behavior. Being mindful involves reflecting on the current object of attention, noticing moment to moment experiences, and non-reactively observing one's thoughts and feelings (Zelazo & Lyons, 2012). Mindfulness training helps to foster healthy self-regulation which is strongly predictive of school readiness.

Physical activity in children and adolescents is important because it may prove to be a simple but important method of increasing aspects of children's mental functioning and cognitive development. Vigorous physical activity has been associated with better grades, and academic achievement in children (Davis et al., 2011). Parents and teachers often report that ADHD symptoms improve after being physically active as it benefits the executive functions by modifying the brain structure and function (Gapin & Etiner, 2010).

Research Question

What strategies can help improve executive functioning skills in students with a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD)?

Focus of the Paper

The review of literature in Chapter 2 includes 10 studies with participants who are considered to have executive function deficits or are diagnosed with ADHD. Participants range from preschool through middle school, with the main focus on effective strategies in school-aged students.

I started the research using the Academic Search Premier, PsycINFO, and Advanced Google searches to locate research articles. Various keywords and combinations of keywords were used to locate appropriate studies: executive functions, attention deficit hyperactive disorder, interventions, self-regulation, sensory integration, mindfulness, metacognition, and exercise. I also found studies by utilizing the references pages of articles and books on executive function and ADHD.

Importance of the Topic

Executive function skills are important for learning development, enable positive behavior and allow us to make healthy choices for ourselves. Children and adolescents need to develop the skills of solving complicated problems, making decisions, persisting at tedious but important tasks, making plans and adjusting them when necessary, recognizing and correcting mistakes, controlling their impulsive behavior, setting goals, and monitoring their progress toward meeting them in order to meet the many challenges they will face on the road to becoming productive and contributing members of society. Executive functions measured in early childhood predict important developmental outcomes, including math and reading skills in preschool and the early school grades. Improving executive functioning skills is related to increased academic and vocational success, reduction of negative symptoms (anxiety and depression), and increases in self-esteem and confidence.

Definition of Terms

As the Starred Paper was created, certain unfamiliar terms were used. To help understanding of the review, several definitions are established below.

Inattention: this refers to when a person wanders off task, lacks persistence, has difficulty sustaining focus, and is disorganized; these problems are not due to defiance or lack of comprehension.

Hyperactivity: this term means a person seems to move about constantly, including in situations in which it is not appropriate; or excessively fidgets, taps, or talks. In adults, it may be extreme restlessness or wearing others out with constant activity.

Impulsivity: this occurs when a person makes hasty actions that occur in the moment without first thinking about them and that may have high potential for harm; or a desire for immediate rewards or inability to delay gratification. An impulsive person may be socially intrusive and excessively interrupt others or make important decisions without considering the long-term consequences.

Executive function skills as defined by Dawson and Guare (2011):

Planning: being able to create a map to reach a goal or to complete a task. It also involves being able to make decisions about what is and is not important to focus on.

Organization: the ability to design and maintain systems for keeping track of information or materials.

Time management: being able to estimate how much time one has, how to divide it, and how to stay within time limits and deadlines. It also involves a sense that time is important.

Working memory: the ability to hold information in mind while performing complex tasks.

Metacognition: it is an ability to observe how you problem solve. It also includes self-monitoring and self-evaluative skills.

Cognitive flexibility: helps us to sustain or shift attention

Self-control: gives us the abilities to set priorities and resist impulses.

Mindfulness: the presence or absence of attention to or awareness of what is occurring in present experience (Brown & Ryan, 2003).

Chapter 2: Review of the Literature

Students with ADHD and executive function deficits experience academic and social and emotional difficulties throughout their school day. This chapter summarizes research that has been provided regarding strategies to improve executive function skills in students with a diagnosis of ADHD. The studies in this chapter were conducted within the last 7 years and are presented in groups based on types of interventions of exercise and sensory integration, mindfulness, and computer based programs. The areas that I have chosen to give more attention to are those that can easily be implemented and practiced in a variety of school settings including the mainstream classroom, special education classes, during social work or counselor sessions and during transition or unstructured times of the students' school day.

Physical Activity and Exercise

Davis et al. (2011) tested the hypothesis that exercise would improve executive function. Sedentary, overweight 7- to 11-year-old children were selected to participate in 13 weeks of an exercise program (20 or 40 minutes/day), or a control condition. Children were randomly assigned to low dose (20 minutes/day) or high dose (40 minutes/day) or to a no exercise control group.

Aerobic exercise intervention. The children in the exercise group were transported to an after school exercise program each day and participated in tasks that emphasized intensity, enjoyment and safety. Average heart rate for each child was recorded daily and they earned points to redeem for prizes for maintaining heart rates of more than 150 beats per minute. Each group's intensity level was the same and they all started and ended with a warm up and cool down. Before the exercise groups started, the researchers conducted cognitive assessments using

the Cognitive Assessment System which measures children's mental abilities in the cognitive processes of planning, attention simultaneous and successive. The children's academic achievement was also measured using forms of the Woodcock Johnson Tests of Achievement III paying specific attention to the Broad Reading and Broad Math clusters. Results of the study indicated that the participants in both of the exercise groups resulted in higher planning scores as well as math achievement. No effects were found on the Broad Reading cluster.

Piepmeier et al. (2014) studied the effect of acute exercise on cognitive performance in children with and without ADHD. Background information in this study indicates research has shown that individuals with ADHD perform significantly worse on neuropsychological tasks requiring executive function than do children without ADHD and determined it is important to explore interventions that may benefit executive function by children with ADHD. The purpose of this study was to further understand the extent to which 20 minutes of moderate intensity exercise impacts various aspects of executive function performance be children relative to their ADHD status.

The participants consisted of 32 adolescents recruited through the use of fliers and emails as well as on site recruitment from a K-12 private school, the local community, and an ADHD clinic. The participants consisted of 14 youth who had been diagnosed with ADHD (five girls and nine boys) and 18 participants who had not been diagnosed with ADHD (seven girls and eleven boys). During the study participants were required to go to the lab on two days at least 72 hours apart in which each participant participated in an exercise condition and a non-exercise condition. During the exercise condition the participants performed 30 minutes of exercise on a recumbent cycle ergometer and used ratings of perceived exertion (RPE) scales to assess

perceived intensity. The resistance was adjusted as necessary to keep the RPE within a certain range. In the non-exercise condition all participants watched the same 30-minute portion of the Planet Earth nature documentary. During both conditions, heart rate monitors were used to obtain readings of heart rate before each condition and every 5 minutes during each treatment condition. The Stroop Test was used to measure inhibition components of executive function and general speed of processing. The planning and problem solving components of executive function were assessed using the Tower of London Task. The set shifting component of executive function and general speed of cognitive processing were assessed using the Trail Making Test (TMT).

The results show that there was a significant difference in ADHD symptoms reported for those diagnosed with ADHD as compared to those who had not been diagnosed with ADHD. Results from the Stroop Task showed that performance was faster in parts A (word) and B (color) compared to part C (word/color). Performance was improved following exercise compared to performance after the control condition. Results from the Tower of London Task showed that an acute bout of exercise did not significantly influence performance. Despite the researchers thinking that exercise would benefit cognitive performance for the children with ADHD, the benefits were equal between the two groups which is consistent with past research.

Limitations to this study are that it might have been beneficial to have asked participants to perform the cognitive tasks prior to the treatment condition in addition to performing them after the treatment condition. A second limitation is that the participants were instructed to take their medication as they typically would which resulted in variety in the medications being taken by the participants.

Gapin and Etnier (2010) studied the relationship between physical activity and executive function performance in children with ADHD. The study proposes that physical activity benefits executive function by modifying brain structure and function, particularly in the frontal regions of the brain.

Twenty male children who are diagnosed with ADHD and currently taking medication were recruited for this study. Students were instructed to take their medication as usual and to not participate in any physical activity within at least three hours of the testing period. Physical activity (PA) was measured by daily physical activity logs kept by the participants for 7 days as well as wearing an accelerometer at all times except when sleeping, bathing or swimming. If it was left off for periods of time it was to be logged in the daily PA log. At the beginning of the study participants completed four executive functioning tasks in the areas of inhibition, planning, working memory, and processing speed.

Results of the study indicate that physical activity was found to be a significant predictor of planning as assessed with the Tower of London. This is important since planning has been identified as one of the more consistent executive function impairments in children with ADHD. Findings that physical activities were in the hypothesized direction for five of the other six executive functions suggest that the results are likely to be statistically reliable with a larger sample size. It is suggested that executive function tasks need to continue to be examined separately, rather than broadly to further researchers understanding of their relationship with and sensitivity to physical activity.

Limitations of this study include the findings are based on a small sample size (n=18) which likely affected the ability to detect significant relationships. The researchers also were not

able to determine the severity of ADHD to know if they were typical or extreme. Another limitation is that the study used a correlational design which prevented being able to identify a causal relationship between physical activity and executive function performance.

Faramarzi, Rad, and Abedi (2016) completed a study to determine the effect of sensory integration training on executive functions of children with attention deficit hyperactivity disorder. Sensory integration is the way our brains interpret the information from our senses in order to correctly respond to the environment. It is proposed that cognitive impairments and specific impairments in attention and executive functions are some of the main components of ADHD. The study defined ADHD as a complex neurological condition that is characterized by developmentally inappropriate levels of inattention, hyperactivity, and impulsive behavior. Previous studies have shown that sensory integration approaches have improved control of children with ADHD.

Participants in the study were 20 male students with ADHD from an elementary school in Isfahan, India, and took place during the 2014-2015 school year. Ten students were in the case group and 10 students were in the control group. A parent form of the Conner's Scale, which is used to determine the severity of participants ADHD, was used for data collection which includes 27 items using a 4-point Likert scale for scoring. A sensory integration training program was utilized for the intervention which consisted of 12 sessions total having two sessions per week individually for 45 minutes each. Participants were trained in sensory integrations which included but was not limited to balance skills and spatial awareness activities, tactile activities, atrial activities, activities to promote the sense of depth and planning of

movement, bilateral motor coordination, strengthening auditory and visual attention and memory and hand eye coordination.

The results of the study show that the performance of students is impacted by sensory integration training. In order to help develop executive function skills in children with ADHD, appropriate training programs should be designed based on improving these skills. Children with ADHD need to be taught these skills and how to apply them as they are acquired through education and learning. There were no limitations indicated for this study.

Table 1

Summary of Physical Activity and Exercise Studies

Author(s)	Study Design	Participants	Procedure	Findings
Davis, Tomporowski, McDowell, Austin, Yanasak, Allison, & Naglieri (2011)	Quantitative	171 children ages 7-11 years old who were overweight, inactive and had no medical conditions.	Participants were randomly assigned to a low dose (20 min) or high dose (40 min) of aerobic exercise or to a no exercise control. The experiment tested the effect of 3 months of exercise on EF	The exercise groups showed that exposure to either the low or high dose of the exercise program resulted in higher planning scores and math achievement.
Piepmeier, Shih, Whedon, Williams, Davis, Henning, Park, Calkins, & Etnier (2014)	Quantitative	32 adolescents from a K-12 private school, the local community, and ADHD clinic. 14 had been diagnosed with ADHD (5 girls and 9 boys) and 18 who had not been diagnosed with ADHD (7 girls and 11 boys).	Each participant was involved in an exercise condition and non-exercise condition for 30 minutes each on 2 separate days at least 72 hours apart.	Results showed that cognitive performance benefits were equal between those with ADHD and those without the diagnosis of ADHD

Table 1 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
Gapin & Etnier (2010)	Quantitative	Twenty male children who are diagnosed with ADHD and currently taking mediation were recruited for this study	Physical activity (PA) was measured by daily physical activity logs kept by the participants for seven days as well as wearing an accelerometer at all times except when sleeping, bathing or swimming. Participants completed four executive functioning tasks in the areas of inhibition, planning, working memory, and processing speed.	Results of the study indicate that physical activity was found to be a significant predictor of planning as assessed with the Tower of London TMS and TET.
Faramarzi, Arjmandi, & Abedi (2016)	Quantitative	20 male students with an average age of 8	20 students with ADHD were split into 2 groups of a treatment group and control group. The case group received 12 sessions of sensory integration training.	Sensory integration improves executive functions of students of ADHD.

Mindfulness

Riggs et al. (2014) conducted a study to test associations between dispositional levels of mindfulness and executive functions in a diverse sample of 152 early adolescents. Dispositional mindfulness refers to the presence or absence of attention to or awareness of what is occurring in present experience (Brown & Ryan, 2003). The purpose of this study was to simultaneously test associations between dispositional mindfulness and three executive function processes: inhibitory control, working memory, and cognitive flexibility. Participants included 152 seventh and eighth grade junior high students from two schools.

Prior to intervention implementation, the participants completed a 208-item survey that took approximately 75 minutes during the regular school day. The survey was administered aloud by trained data collectors. Dispositional mindfulness was assessed with the 14 items Mindfulness Awareness Scale-Adolescent Version (MAAS-A). Higher mean scores were equal to greater mindfulness. Executive function (EF) was assessed using the Behavioral Rating Inventory of Executive Function, Self-report (BRIEF-SR). The BRIEF assesses eight clinical executive function subscales, three of which are Inhibit, Working Memory, and Shift (includes emotional and cognitive). Results show that each of the executive function processes were significantly correlated with academic grades.

Findings indicated that mindful awareness was positively related with the executive function process of working memory and inhibitory control in early adolescence. The relation between mindfulness and working memory may show that mindful awareness requires engagement of working memory skills in order to help maintain present moment goals. The significant association between inhibitory control and mindfulness suggests that mindful awareness may need to use inhibitory control in order to prevent deep thoughts or emotions.

Limitations of this study are the relatively small sample size may have made it difficult to detect significant associations between mindfulness and cognitive flexibility. A second limitation is that the correlational research design makes it impossible to determine the causation. Potential future directions may be to apply findings to mindfulness-based interventions.

Kuo and Faber Taylor (2004) examined a natural treatment for attention deficit hyperactivity disorder. The researchers indicate that current ADHD treatments show limited

relief from the symptoms and often have serious side effects. For this study, ‘green’ or ‘natural’ settings were examined for their impact on ADHD.

Participants were recruited through advertisements in newspapers, and on a website of children and adults with ADHD. Requirements for the study were children between the ages of 5 and 18 who had received a professional diagnosis of ADHD. Parents were asked to rate their children on four ADHD symptoms of difficulty remaining focused on unappealing tasks, difficulty in completing tasks, difficulty in listening and following directions, and difficulty in resisting distractions. Parents were asked to rate their children on the same activity but in settings of indoors, a green outdoor setting or a built outdoor setting.

Findings of the study show that being in or exposed to natural settings afterschool and on the weekends may be greatly effective in reducing ADHD symptoms in children. Activities that took place outdoors in natural settings had more positive effects on symptoms than the same activities performed indoors.

A limitation of the study is that activities may take on different characteristics when they are done outdoors versus indoors. Another limitation is that parent’s perspectives of different settings could affect their performance ratings. It would be useful if future research confirmed and extended the generality of the current findings.

Table 2

Summary of Mindfulness Studies

Author(s)	Study Design	Participants	Procedure	Findings
Riggs, Black, & Ritt-Olson (2014)	Quantitative	152 7th and 8th graders from two schools.	Mindfulness was assessed using the 14-item Mindfulness Awareness Scale-Adolescent Version and executive function was assessed using the Behavioral rating Inventory of Executive Function, Self-Report	Findings showed that that when modeled simultaneously, working memory and inhibitory control proficiency were significantly associated with greater dispositional mindfulness, but that cognitive flexibility was not.
Kuo & Faber Taylor (2004)	Quantitative	452 parent surveys of children ages 8-18 with a diagnosis of ADHD	Parents were asked to rate their children on the same activity but in settings of indoors, a green outdoor setting or a built outdoor setting.	Being in or exposed to natural settings afterschool and on the weekends may be greatly effective in reducing ADHD symptoms in children.
Razza & Bergen-Cico, and Raymond (2013)	Quasi experimental design	Twenty nine 3-5-year-olds from two preschool classrooms	Mindful yoga intervention was implemented regularly by the classroom teacher along with a pre and posttest.	Direct assessments indicated significant effects of the intervention across all three areas of self-regulation

Computer and Curriculum-Based Studies

Espinet, Anderson, and Zelazo (2013) assessed the role of reflection in executive function, preschool aged children who failed on a pre-training version of the Dimensional Change Card Sort (DCCS). Executive functions measured in early childhood predicts important developmental outcomes including math and reading skills in preschool and the early grades as well as cognitive control and test scores in adolescents. The goal of this study was to isolate the

role of reflection, or the reflective reprocessing of information in EF training in preschool age children.

For this study a total of 113 2-4-year-old children participated. The participants were tested in a university laboratory or at a daycare center in a large metropolitan area. The children were from diverse ethnic backgrounds and parents gave written consent for their children to participate. The study was broken into three experimental groups in which children were randomly assigned to a reflection training condition or a control condition. On the first day all of the participants received a pre training DCCS. Children in experiments one and two received additional pre training tests of a relative clause test and a far-transfer false belief task. On the last day of the experiment all participants received the same pre-training tests. In experiments one and two control training focused on the use of relative clauses. In experiment three, two different control conditions were used including corrective feedback and mere practice.

Children who failed the DCCS were randomly assigned to the experimental or control condition, performance was assessed by people who were uninformed about the participants' conditions, and they used repeated-measures analyses of variance (ANOVAs) to test for group (reflection training vs. control) x time (pre-vs-post training) interactions in children's EF performance.

The findings of this study suggest that performance on measures of EF such as the DCCS responds readily to top down teaching strategies. The study shows that effective strategies for inducing flexible, adaptive behavior as well as transfer include encouraging children to reflect on their rule representations rather than simply telling then when a behavior is incorrect or

inappropriate. The results of this study also suggest that the development of EF can be facilitated in the preschool years. There were no noted limitations of this study.

Dovis, Van der Oord, Wires, and Prins (2015) determined that training multiple executive functions (EF's) might be a potentially more effective strategy to reduce EF related ADHD symptoms. Typically EF interventions focus on a single cognitive domain, but other studies show that most children with ADHD have weaknesses on multiple EF's that are related to different brain areas. There were 89 children ages 8-12 with a clinical diagnosis of ADHD involved in the study. The children were recruited from 14 outpatient mental health care centers and the study was conducted in the Netherlands. To be eligible for the study the participants had to meet the following conditions; a) have a prior DSM-IV-TR diagnosis of ADHD; b) score within the clinical range (95^{th} to 100^{th} percentile) for ADHD on the parent and teacher scales of the Disruptive Behavior Disorder Rating Scale (DBDRS); c) meet ADHD diagnostic criteria in the Diagnostic Interview Schedule for Children, parent version; d) do not have conduct disorder; e) an IQ score > than 80 identified by using the short version of the Wechsler Intelligence Scale for Children (WISC-III); f) the absence of any neurological disorder; g) not taking any medication other than Methylphenidate or Dextroamphetamine; and h) parents had to agree to maintain the dose of ADHD medication from intake to the 3-month follow-up sessions.

The children were randomized into three conditions of a full active condition, a partially active condition, or a placebo condition. In the full active condition working memory, inhibition and cognitive flexibility were all in training mode. Training mode means that after each block of training tasks, the difficulty level of the training task was automatically adjusted to the child's level of performance. In training mode: a) the working memory task had five training levels: the

first level targeted visuospatial short term memory only and the other four levels targeted combinations of visuospatial short term memory, updating and manipulating of information; b) the inhibition task was designed to decrease the time needed to inhibit a prepotent response; c) the cognitive flexibility task was designed to decrease the time a child needs to adapt his/her behavior when rules change. In the partially active condition the inhibition and cognitive flexibility tasks were in training mode and the working memory task was in placebo mode. Placebo mode means that only the first level of the working memory task was presented and the difficulty level was not adjusted to the child's level of performance. The placebo condition meant that working memory, inhibition, and cognitive flexibility were all in placebo mode. In placebo mode the inhibition task and the cognitive flexibility task were presented the same way as in training mode except that the stop trials and switch trials were replaced by go trials and non-switch trials and the difficulty level was not adjusted. Performance measures of Stop Task, Stroop, and Corsi Block Tapping Task (CBBT) were used. The stop task was used to measure the time needed to inhibit an ongoing response and trials of go trials and stop trials were used. During go trials an arrow pointing left or right was presented and participants were to press a response button that corresponded to the direction of the stimulus as quickly as possible. Stop trials were same as go trials except a stop signal was added, which indicated that the participant had to withhold his ongoing response. The Stroop Color and Word Test measures interference control and consists of three pages with words and colors. The Corsi Block Tapping Task (CBBT) assessed the capacity of visuospatial short term memory and working memory.

Once the participants met the DBDRS inclusion criteria, the parent and child were to partake in a pretest and startup session and were randomized to one of the three treatment

conditions. During the 5-week, home based training, a coach made weekly calls to the participating families to monitor progress, motivation and compliance. One to 2 weeks after the final training session a post test was scheduled and again 3 months after the final training session and the teacher completed the BDBRS at both times.

Results indicated that only children in the full active condition showed improvement on measures of visuospatial short term memory and working memory. Inhibitory performance and interference control only improved in the full active condition and the partially active condition. These findings suggest that improvements on inhibition and visuospatial short term memory and working memory were specifically related to the type of treatment received. It is suggested that future studies should also include direct measures of behavior.

Tamm, Epstein, Peugh, and Nakonezny (2013) completed the study to determine if the "Pay Attention!" intervention was effective in improving trained and untrained executive functions. Participants include 132 children ages 7-15 years old. Participants were recruited from outpatient clinics at Children's Medical Center at Dallas, the community, and Shelton School. Those eligible to participate completed a semi-structured clinical interview with the parents and the student to determine ADHD diagnosis. Parents completed several rating scales assessing attention, executive function, and behavior, while participants were administered several tests assessing a variety of executive functions including planning, behavioral inhibition, visual spatial abilities, and working memory. Participants were randomized into an intervention group or a waitlist control group. Those in the intervention group attended twice weekly 30-minute sessions for 8 consecutive weeks. "Pay Attention!" materials were used in the

intervention group, which are designed to train sustained, selective, alternating and divided attention using visual and auditory stimuli.

The results of this clinical trial of "Pay Attention!" in children with ADHD suggests that the intervention was successful in impacting attentional sub processes targeted by training. The data shows that the intervention improved ADHD symptoms by parent and clinician report, reduced impairment by clinician report, improved executive functioning including inhibition, shifting, planning, and self-monitoring by parents report, improved child self-report ability to focus and shift attention, and improved child performance on a task measuring planning efficiency.

Limitations of this study include the use of a waitlist control group which resulted in the lack of blinding to condition could have resulted in a Hawthorne effect or inflated ratings by parent, child and clinician. Another limitation was the lack of teacher data. Further work is necessary to investigate individual differences in response to treatment and to identify potential moderators.

Table 3

Computer and Curriculum-Based Summaries

Author(s)	Study Design	Participants	Procedure	Findings
Espinet, Anderson, & Zelazo (2013)	Quantitative	132 2-4 year old children	Children were split into three experimental groups and randomly assigned to a reflection training condition or a control condition.	Performance on measures of EF such as the DCCS responds readily to top-down teaching strategies

Table 3 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
Dovis, Van der Oord, Wires, & Prins (2015)	Quantitative	Children ages 8 to 12 years with a prior DSM-IV-TR diagnosis of ADHD and absence of any autism spectrum disorder. Children were recruited from 14 outpatient mental health care centers in the Netherlands.	A computer game called Braingame Brian was used as home-based EF training. BGB consists of 25 training sessions. Within each session the player can create inventions by completing two blocks of three training tasks. Each session takes about 35-50 minutes	Results indicated that only children in the full active condition showed improvement in measures of visuospatial STM and WM.
Tamm, Epstein, Peugh, & Nakonezny (2013)	Quantitative	132 7-15 year olds recruited from outpatient clinics at Children's Medical Center at Dallas, the community, and Shelton School, a private school for learning differences.	Participants randomized to the intervention attended twice-weekly 30-min sessions for 8 consecutive weeks (for a total of 16 sessions). Individuals randomized to the waitlist control condition were asked to not begin any new treatment for ADHD during the wait period	The intervention was successful in impacting attentional sub-processes targeted by training (i.e., observed improvement on tasks assessing aspects of sustained, selective, divided and alternating attention like visual detection, response speed, etc.).The study adds to the growing body of literature suggesting cognitive training may improve executive function and behavior in children with ADHD.

Summary

The studies in Chapter 2 indicate that executive function skills in children with ADHD can be improved by physical exercise, mindfulness, and computer based training. These findings are critically examined in Chapter 3.

Chapter 3: Summary of Literature

The purpose of this paper was to determine effective strategies to improve executive function skills is school aged students with Attention Deficit Hyperactivity Disorder (ADHD). I chose to explore more about this topic because a large population of the students that I currently work with have diagnoses of ADHD and deficits in their executive functioning skills are apparent through their study habits, organizational skills, and inability to control their impulses and emotional responses. In my experience, students with executive function deficits tend to have more difficulties once they reach the middle school grades when classes are less guided, they have more homework and tasks to manage, and go from one or two teachers to five or six different teachers and more class materials to organize. By the middle grades they are expected to already have these skill sets in place and less direct teaching and reinforcement of these skills tend to occur as the curriculum rigor and expectations increase. Through the literature review I have been able to identify a variety of strategies that can be incorporated into my study skills classes such as mindfulness, sensory integration and providing opportunities for physical activity throughout the school day to help increase executive function skills for the students on my middle school caseload.

Chapter 3 is organized into four subsections based on the literature review. The first is conclusions drawn from important findings. The second is recommendations for future research. The third is implications for practice, and a fourth is an overall summary.

Conclusions

Based on the review of literature in Chapter 2, I found evidence that executive function skills can be improved in school aged children with ADHD through mindfulness, sensory

integration, exercise, and structured video games. The areas that I have chosen to give more attention to are those that can easily be implemented and practiced in a variety of school settings including the mainstream classroom, special education classes, during social work or counselor sessions and during transition or unstructured times of the students' school day. Ways in which I have started adding some of these strategies into my classroom will be discussed in more detail later in this chapter.

Findings from Chapter 2 indicate that exercise and physical activity had a significant difference in ADHD symptoms (Piepmeier et al., 2014) and students in exercise groups resulted in higher planning scores as well as math achievement (Davis et al., 2011) which suggests exercise and physical activity are beneficial to increase executive function skills. Implementing various forms of physical activity in classes can be easily done through purposeful movement activities such as across the room buddies to share and pair where the students have to pick a partner that requires them to get up and move to a new spot in the room, have students act out vocabulary words, toss a ball back and forth while skip counting, air writing spelling words, and playing large motor games to address a multitude of skills.

Other findings indicated that mindful awareness was positively related with the executive function process (Riggs et al., 2014) and that being in or exposed to natural settings afterschool and on the weekends may be greatly effective in reducing ADHD symptoms in children (Kuo & Faber Taylor, 2004). Practicing mindfulness within a classroom can be as simple as walking students through a focusing activity of looking out the window and having them focus on finding shapes in the clouds or within the branches or leaves on the trees to be present and focused.

Limitations of the research studies reviewed in Chapter 2 include small sample sizes for several of them making it difficult to detect significant relationships. Another limitation identified is medication use and the variety in medications being taken as well as the severity of participants levels of ADHD. Gapin and Etiner (2010) and Riggs et al. (2014) identified that a correlational research design made it difficult to impossible to determine the direction of association or causal relationship. There is also limited research that has compared the effects of acute exercise on cognitive performance between children with and without ADHD. A limitation of computer based programs is that they are not likely to be replicated outside of the lab or sustained over a longer period of time. Some of the computer based studies are good at increasing the specific skill they are targeting but do not generalize to other unpracticed executive function skills.

Recommendations for Future Research

Based on the research articles summarized in Chapter 2, there are several recommendations for future research to further explore the topics of executive functioning skills and ADHD. Gapin and Etiner (2010) suggested that executive function tasks need to continue to be examined separately rather than broadly in order to further an understanding of the executive function skills relationship with and sensitivity to physical activity. Dovis et al. (2015) suggested that future studies also include direct measures of behavior as they pertain to executive functioning skills. More research should be done in regards to the effectiveness of a classroom based mindful yoga intervention with preschoolers.

Implications for Practice

As evidenced in the research studies of Chapter 2, mindfulness, sensory integration, and exercise can increase executive function skills in students with ADHD and are easily implemented into daily or weekly activities and routines. In my classroom setting, I have focused on structuring my classes and groups to include a variety of executive function strategies with all of my students and especially those with an ADHD diagnosis. Once a week during structured study skills, I lead my students through mindfulness activities that focuses on being present, self-control, and a positive sense of wellbeing. I have utilized a variety of tools including guided mindfulness videos, scripts, visual imagery, and activities and games followed by purposeful discussions with my students. Surprisingly, the group of preteen males have been receptive to practicing mindfulness and seem to look forward to the activities. I have noticed an increase in one of my student's confidence since starting the mindfulness activities as evidenced by him independently approaching teachers to ask questions about his tasks and assignments. Previously the student was shutting down and refusing to seek out assistance due to fear of rejection and lack of self-confidence. The group of four seventh-grade males includes three with an ADHD diagnosis and all of them appear to have better focus for the 30 minutes of study skills and homework completion following our mindfulness sessions.

In consultation with the district's occupational therapist, I have implemented sensory integration strategies with a group of three of my sixth grade students, including one female and two males who all have a diagnosis of ADHD and one who also has an Autism Spectrum Disorder (ASD). The three students all display hyperactivity and inattentiveness throughout their school day that impacts their abilities to maintain focus on classroom activities and impacts

other students due to the distractibility. Sensory integration activities that have been implemented include compression exercises, crossing the midline activities and breathing strategies. Currently, these activities are implemented and guided by a paraprofessional, with the overall goal for the students to recognize when they need a sensory integration break, to advocate for their needs, and independently perform the activities and strategies that are most effective for them in regulating their bodies and minds.

Another strategy I have found to be an effective learning tools for my students includes playing games that have been shown to increase various executive function skills. Some of the games used include Blurt which focuses on self-control and metacognition, Scrabble to improve planning and organization, Pictionary addresses flexibility and time management, Jenga to address self-control, flexibility and planning, and other independent activities or tasks including Brain teasers or Sudoku to address perseverance, working memory and flexibility. In using games to teach these skills, it is also important to explain to students the skills that they are focusing on which participating in the games to make the learning experience relevant and meaningful. One of my students who has difficulties in controlling impulses and tends to excessively blurt in class, has been able to utilize the self-control strategies learned while playing the game Blurt and apply strategies to a classroom setting with reminders and prompts. To address some of the components of planning and organizing, I have helped my students set up a Google extension program called Google Keep which is essentially digital post-it notes of assignments or tasks to be completed for each of their classes. This allows the students to recall what needs to be completed and they can use it to help them remember items needed to bring

home for the day, they can arrange the tasks by list of importance to help them prioritize their tasks, and are able to cross the tasks off once completed to have a sense of accomplishment.

Since beginning my starred paper and developing a greater understanding of executive function skills and the impacts deficits in those areas impact our students daily lives, I have been more purposeful to structure my lessons and activities to address the various components in various way. It has also helped me to intervene in the general education classrooms to put various supports in place in areas that my students have been having difficulties. Simple strategies that I have shared with the general education teachers include chunking larger assignments, providing duration timers so students work for a certain amount of time then earn a break for following through, utilizing binder systems to organize subjects, and simple strategies for how they display notes and items on the board to be more visually appealing.

The strategies that I have implemented in my classroom setting and with my students are all reflective of the research findings from Chapter 2. I am using the research to emphasize approaches of mindfulness, sensory integration and playing games in ways that can be easily put into practice and carried through in a variety of school settings. It has been encouraging to notice the positive effects on students' executive functioning skills in the short amount of time that the strategies have been used.

Summary

Executive functioning skills in school aged children with a diagnosis of ADHD can be improved through various methods as identified throughout this paper. The methods of mindfulness training, exercise and sensory integration have been successful when implemented in my classroom setting when done with purpose. There are other methods identified through the

research in Chapter 2 that requires specific programs, testing and training that increase aspects of executive functioning that would be better utilized in non-school programs or completed under parents supervision at home. To be most effective, strategies need to be taught, practiced and followed up on with the students in multiple school settings to give them an opportunity to practice them. I will continue to use the programs and strategies I already have in place and plan to further my knowledge of effective strategies to use in my classroom and within general education classes to help my students with and without ADHD increase their executive function skills and be more aware of their skills, strengths, and deficits.

Practicing mindfulness has not only been beneficial for the students I work with but has helped improved my own level of calm when things get busy. Incorporating mindful strategies with nature such as looking out windows, smelling the fresh flowers in my classroom and watching and listening to sounds of nature seem to bring my class and myself to a greater level of peace and increases our abilities to focus on the tasks at hand.

Executive function skills and be increased with students with ADHD by teaching the students the strategies and practicing them often. All classrooms can take simple steps to set up their environments and curriculum to foster greater development of these essential executive function skills.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders.* (5th Ed.). Arlington, VA: American Psychiatric Publishing.

Barkley, R. A. (2001). The executive functions and self-regulation: An evolutionary neuropsychological perspective. *Neuropsychology Review, 11,* 1-29.

Barkley, R. A. (2006). *Attention deficit hyperactivity disorder: A handbook for diagnosis and Treatment.* (3rd Ed.). New York: Guilford Press.

Biederman, J., Monuteau, M., Seidman, L., Doyle, A. E., Mick, E., & Wilens, T. (2004). Impact of executive function deficits and ADHD on academic outcomes in children. *Journal of Consulting and Clinical Psychology, 72,* 757-766.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological wellbeing. *Journal of Personality and Social Psychology, 84,* 822-848.

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., & Naglieri, J. A. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized controlled trial. *Health Psychology, 30,* 91–98.

Dawson, P., & Guare, R. (2010). *Executive skills in children and adolescents: A practical guide to assessment and intervention* (2nd Ed.). New York, NY: Guilford Press.

Dovis S., Van der Oord, S., Wires, R. W., & Prins, P. J. M. (2015). Improving executive function in children with ADHD: Training multiple executive functions within the context of a computer game. A randomized double blind placebo controlled trial. PLoS ONE 10(4):e0121651.doi:10.137/journal.pone.0121651

Espinet, S. D., Anderson, J. E., & Zelazo, P. D. (2013). Reflection training improves executive function in preschool-age children: behavioral and neural effects. *Developmental Cognitive Neuroscience, 4*, 3-15.

Faramarzi, S., Rad, S. A., & Abedi, A. (2016). Effect of sensory integration training on executive functions of children with attention deficit hyperactivity disorder. *Neuropsychiatry & Neuropsychology, 11*(1), 1-15.

Gapin, J., & Etnier, J. (2010). The relationship between physical activity and executive function performance in children with attention-deficit hyperactivity disorder. *Journal of Sport and Exercise Psychology, 32*, 753-763.

Johnson, J., & Reid, R. (2011). Overcoming executive function deficits with students with ADHD. *Theory into Practice, 50*, 61-67.

Kuo, F. E., & Faber Taylor, A. (2004). A potential natural treatment for attention-deficit/ hyperactivity disorder: Evidence from a national study. *American Journal of Public Health, 94* (9), 1580-1575.

Langberg, J. M, Dvorsky, M. R, & Evans, S. W. (2013). What specific facets of executive functioning are associated with academic functioning in youth with attention-deficit/ hyperactivity disorder? *Journal of Abnormal Child Psychology, 41*(7), 1145-1159.

National Institute of Mental Health. (2016). *Attention deficit hyperactivity disorder*. Retrieved from https://www.nimh.nih.gov/health/topics/attention-deficit-hyperactivity-disorder-abhd/index.shtml.

National Scientific Council on the Developing Child. (2011). *Building the brain's "air traffic control" system: How early experiences shape the development of executive function: Working paper no. 11*.http:// www.developingchild.net.

Piepmeier, A. T., Shih, C. H., Whedon, M., Williams, L. M., Davis, M. E., Henning, Park, S., … Etnier, J. L. (2015). The effect of acute exercise on cognitive performance in children with and without ADHD. *Journal of Sport and Health Science, 4*, 97-104.

Razza, R. A., Bergen-Cico, D., & Raymond, K. (2015). Enhancing preschoolers self-regulation via mindful yoga. *Journal of Child and Family Studies, 24*, 372-385

Riggs, N. R., Black, D. S., & Ritt-Olson, A. (2015). Associations between dispositional mindfulness and executive function in early adolescence. *Journal of Child and Family Studies, 24*, 2745-2751.

Tamm, L., Epstein, J., Peugh, J., & Nakonezny, P. (2013). Preliminary data suggesting the efficacy of attention training for school-aged children with ADHD. *Developmental Cognitive Neuroscience, 4*, 16-28.

Zelazo, P. D., & Lyons, K. E. (2012). The potential benefits of mindfulness training in early childhood: A developmental social cognitive neuroscience perspective. *Child Development Perspectives, 6*(2), 154-160.