2023

How Movement-Based and Sensory-Based Interventions Impact Emotional and Academic Success in Students with Disabilities (Autism/ADHD)

John Skalitzky
Bethel University

HOW MOVEMENT-BASED AND SENSORY-BASED INTERVENTIONS IMPACT EMOTIONAL AND ACADEMIC SUCCESS IN STUDENTS WITH DISABILITIES (AUTISM/ADHD)

A MASTER'S THESIS

SUBMITTED TO THE FACULTY

OF BETHEL UNIVERSITY

BY

JOHN SKALITZKY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF ARTS IN SPECIAL EDUCATION

MAY 2023

HOW DO MOVEMENT-BASED AND SENSORY-BASED INTERVENTIONS IMPACT EMOTIONAL AND ACADEMIC SUCCESS IN STUDENTS WITH DISABILITIES (AUTISM/ADHD)

BY

JOHN SKALITZKY

APPROVED

ADVISOR: CHARLES S. STRAND, ED.S.

PROGRAM DIRECTOR: KATIE BONAWITZ, ED.D.

MAY 2023

ACKNOWLEDGEMENTS

I would like to acknowledge the people who sacrificed their time and energy for me on this Journey to complete my Master's Degree in Special Education (ASD). First and foremost, I'd like to acknowledge my wife. When the beginning of grad school started, we were newlyweds, we were expecting our first child, just moved into her parents' house, and I started a new position of employment as a special education teacher for a federal setting 4 middle school. She was the definition of a rock. I would come home questioning whether or not I could continue with the program if Special Education was what I wanted to do for the rest of my career. She pressed me to keep going, to finish my degree. My mood changed noticeably, my fuse was shorter. But she showed me love, she showed me patience, & she pushed me. It paid off. I'm nearly at the end, and I have a fantastic new position as a Behavior Strategist, and my job fills me with more grace and humility than I could ask for. I owe it to her.

I would also like to acknowledge my son, Jay. Jay is almost 4 years old and is my purpose for living. When I wasn't working or staying up until 12 am to finish a paper on the weekend. I was with Jay. He kept me sane and allowed me to separate myself from my work (graduate school or professional). Because of Jay, I learned the significance of what is important to me when balancing the demands of being a parent, husband, student, and employee. This allowed me to be balanced in my approach to working towards finishing my master's degree while continuing to take care of what is most important.

Lastly, I would like to acknowledge all the professors and staff at Bethel University for continually guiding me through each one of my graduate classes; being available for any questions, academically or non-academic; providing me with wonderful feedback to encourage

my ability as a student and future teacher. Specifically, I would like to acknowledge Chuck Strand for guiding me in writing this master's thesis and helping me smooth out any rough edges for a finished product I can be proud of. Lastly, I would like to acknowledge Dr. Peggy McCormick for teaching me about the value of relationships in the field of education. I have learned that relationships are a teacher's best intervention to improve student success. For that, I will forever be grateful.

ABSTRACT

Attention Deficit Hyperactivity Disorder and Autism Spectrum Disorder are two of the most prevalent diagnoses in education today. Each diagnosis is individual to the student. However, Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder share similar symptoms. Also, Attention Deficit Hyperactivity Disorder comorbidly exists within the symptomatology of Autism Spectrum Disorder. Both diagnoses present challenges the student has to work through in order to feel emotional and academic success in school. These challenges can be hyperactivity, decreased social skills, sensitivities to the way their body processes sensory stimuli, aggression, impulsivity, as well as decreased executive functioning skills. All of these challenges are aspects of skills needed to feel safe and confident in the educational environment. This thesis will examine how Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder impact students' ability to regulate themselves and the world around them. While also looking at how they can achieve self-regulation in their school environment through interventions that are physical activity-based as well as sensory-based.

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION

Attention Deficit Hyperactivity Disorder

According to the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM - 5), Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder described as impaired levels of inattention, disorganization, and/or hyperactivity-impulsivity. Inattention and disorganization are classified as inability to stay on task, appearing unable to listen, and losing personal belongings/materials when compared to a person at a baseline of the same age and developmental level. Hyperactivity-impulsivity is distinguished as overactivity, a fidgeting body or inability to stay seated, invading others' space, and difficulty waiting (American Psychiatric Association, 2013, p. 32). It can be difficult to distinguish that the behaviors that come with the diagnosis are a symptom of ADHD, not necessarily a subjective choice the student makes in real-time.

The characteristics listed above are the most prevalent, but one area of ADHD that is impacted by a lack of executive functioning skills is emotional regulation. Further research suggests that a student with ADHD presents with a cluster of symptoms related to a lack of ability to regulate emotionally. Those are an incapacity to identify and process emotion, a tendency to be reactionary to emotional events, and lacking skill in using strategies around emotional regulation (Landis et al., 2020). Therefore, students' ability to regulate themselves at an emotional level and carry out executive functioning skills that are expected to be used to succeed academically and socially are impaired if that student is diagnosed with ADHD.

Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is trending upward as one of the most prevalent disabilities in education today. According to the Center for Disease Control's (CDC) most recent data, every 1 in 44 children in the United States has ASD. This means that 1 in 44 children will present with symptoms that include: atypical social skills, inability to communicate effectively, impulsive behaviors, rigid thinking patterns - making the ability of the student to be flexible very difficult - lack of motivation for non-preferred activities, neurological delays, and sensory processing disorders, all of which can lead to dysregulation in those students (Wilkinson, 2010, p. 350).

The dysregulation of a student with ASD stems from the association that the amygdala has with ASD. The amygdala is one of the main affected regions of the brain included in an ASD diagnosis. Furthermore, it is responsible for processing sensory information, along with emotional regulation; our fight, flight or freeze response. From a social-emotional perspective, when the amygdala is affected, there are increased behaviors socially as well as increased aggression in students who have ASD. Not only are increased aggression and maladaptive social behaviors present, but also the impaired ability to process facial expressions along with difficulty processing sensory information (Park et al., 2016). These symptoms present many challenges for students, affecting the efficiency with which they perform academically and emotionally at school.

Emotional Regulation

Emotional regulation involves efforts to modulate emotional arousal in a way that facilitates adaptive functioning (Graziano et al., 2007, p. 2). For instance, when a child's goal is to play with a specific toy, but they see that toy being played with by another child, initially, it is

expected that that child becomes agitated. If the child is able to regulate themselves at an emotional level, they may have some sort of variable inserted into the situation to redirect the behavior of being agitated so the behavior is more brief than extended. This variable may be playing with a different toy, asking the other child to have a turn with the toy, having a parent or trusted adult to redirect them or co-regulate, etc. Then that child is able to return to a preferred emotional state more than likely, and able to regulate themselves. When a child is unable to regulate their emotions and is dysregulated, this can lead to increased levels of behavior for extended periods of time and continuous disruptions throughout the day.

Emotional Dysregulation is found in 20 - 45 % of children with ADHD (Shaw et al., 2014, p. 279). Samson et al. (2015) reported that studies on participants with ASD show less ability to regulate their emotions, possibly leading to increased emotional disturbances. Therefore, if a child is diagnosed with ADHD or ASD, that child's ability to adapt at a functional level will be impacted. Furthermore, Graziano et al. (2007) indicated that adaptive functioning is a major indicator of academic functioning.

Age three is typically the most important time for a developing child. This stage of development is when they start developing executive functioning skills, such as attending, motivation, and memory recall, along with the development of foundational reading and writing skills. When the child's ability to regulate is impaired at this stage of development, research indicates their ability to perform adequately over time will also be limited (Graziano et al., 2007). The impact of this also extends into the relationship between the student and teacher due to teachers having a low tolerance for students with behavioral regulation problems (Graziano et al., 2007). Therefore, it is important for students with emotional or sensory dysregulation issues to have support in learning various strategies to regulate themselves while in the classroom.

Sensory Processing/Regulation

Spielman (2020, p. 27) indicated that sensory processing refers to how we use what we sense to make sense of the world around us. It is critical for psychological well-being and the foundation for building our sense of who we are. This is how we feel, and it is embedded in every aspect of the human experience. Moreover, sensory processing includes the central and peripheral nervous systems, which process external stimuli from our senses. It includes our ability to record and change information and to understand various sensations we are presented with on a daily basis (Gomez et al., 2021, p. 1). A human being's ability to self-regulate means they have the ability to adapt to what experiences are going on inside and outside of their body for the purpose of being able to interact with the environment successfully (Gomez et al., 2021). Therefore, if a human is able to process sensory stimuli, then they are able to regulate with greater efficiency. When there are disruptions in a person's ability to process sensory information correctly, there will be disruptions in their ability to regulate themselves physically, emotionally, and intellectually.

Unfortunately, for people with ASD and ADHD, they will be affected due to the symptomatology of each diagnosis. Research indicated that 90% of children with ASD have atypical sensory behaviors (Chang et al., 2016, p. 1). This means behaviors such as impaired attention, self-stimulation, trouble with daily routines, inappropriate movement, pushing, misuse of objects in their environment, and sensitivity to noise and activities in the classroom, to name a few (Wild & Steeley, 2018). Therefore, interventions that are based on movement and adapt the sensory environment of the student, while also providing natural sensory experiences; can assist in a more regulated student. Even horticulture therapy is reported to provide a sensory-based environment while also increasing social skills (Nevil & Beela, 2022).

Thesis Writer Experience

This researcher remembers the 1990s. Between the ages of 9 and 11 years old, a typical day on the weekend required waking up, eating a pop tart while rushing past his father and stepmother, shoving his feet into his shoes, exiting the front door, and letting his parents know where he was going as it was half closed. This researcher hopped on his bike, and 3 miles later, he arrived at his cousins. With cousins, this researcher explored, made food, swam, biked around the city, and socialized with other kids and members of the community. When this writer turned 13, he remembered climbing a 100-foot silo. This writer had to get a 10-foot wooden ladder just to reach the ladder attached to the side of the silo. He climbed the cold steel ladder that always left his hands feeling dry with every step that was taken. Then there was the urge not to look down and continue the climb, but he could not help himself. When he got to the top, peace filled this writer. In front of his eyes was the expanse of the countryside. The warm sun, the smell of cow manure, green corn fields, and the wind touched his face and left a sound so sweet sitting in his ears. It was meditative.

It did not just stop at climbing a silo. His mother lived in the city and would ride the city bus downtown and skateboard around until he would arrive at *Jim's Card Corner* looking to invest in a pack of Pokemon cards or a pack of *Fleer* NBA cards, hoping to get a good return on investment years later. If it was not the card shop, it was *Bernie's Rock Shop,* gems and fossils galore as he opened the doors. Then he would take the bus home, grab his fishing pole and tackle box to try to wrangle in a fish at the lake. These youthful, adventurous scenarios described, this writer now realized, helped him regulate himself. He practiced executive functioning skills that he never realized were crucial to his development as a young man and into adulthood. This writer gained confidence in problem-solving, money management, time management, initiating

tasks, self-control, planning, and organizing. He reflected on this time because it was a time when there was a constant need to entertain himself, get energy out, regulate his emotions, and take care of his mental health (even if he did not understand that was what he was doing at the time).

15 years later, this researcher started his first clinical fieldwork as a Certified Occupational Therapy Assistant (COTA) at the Paul Bunyan Education Co-Op. He was nervous, mainly because the fieldwork supervisor went from a COTA to an Occupational Therapist (Master of Occupational Therapy). His name was Erik, and he was quiet, unreadable, a wealth of knowledge, kind, loving, and obsessed with the Minnesota Twins. This researcher remembered his first days vividly. Erik toured him around one of the elementary schools. They stopped outside the door of a 4th-grade classroom. Erik looked at this writer and whispered to him to observe one of the female students in the classroom. She stood out because all of her peers surrounded her during the morning meeting, seated on the floor, either in crisscross applesauce or bent at the knees sitting on their feet. However, she was in a rocking chair. Rocking back and forth in perfect rhythm, her body in the group and focused on the teacher. Erik again leaned in and whispered to this writer. He told this writer she has autism and her vestibular system was under-responsive and needed constant movement to be able to focus in class. Prior to introducing the rocking chair into the classroom, the student could not attend during small group time. Therefore, the “active” classroom philosophy worked in this instance.

Later on in the clinical fieldwork, Erik had this writer review and scored the Sensory Processing Measure (SPM). This writer looked at two different SPMs for the same student. The student was male, around 10 years old, and diagnosed with ADHD. One SPM was filled out by his mother, and the other by his father. Expecting similar results, this writer could not have been

more wrong. The student's mother indicated that the student was dysregulated (jumping uncontrollably throughout the house, having difficulty attending, running, and crashing into walls/furniture). Alternatively, the fathers indicated that the student was more regulated and did not show anything significantly different as a student from that age group. This researcher was very curious about this data and asked Erik why that student would show he was under-responsive at one parent's house and baseline at another's. Erik explained that the father was a machinist. At home, the father and the son engage in skills using tools with weight to them, tinkering with nuts and bolts, grease, etc. A fully immersive sensory experience that is highly motivating to the student. Thus, the results were that when the student engaged in movement and sensory-based stimuli, he could regulate himself to feel more in control and carry out executive functioning skills. Another observation from this thesis writer was the amount of inactivity students are engaging in, especially students who have a diagnosis of ADHD and ASD. These students tended to be more motivated by sedentary activities, engaging with ipads, video games, indoor activities, etc. The increase in sedentary behavior could be due to a lack of executive functioning skills, motor impairments, lack of social skills, sensory processing issues, and increased behaviors within the symptomatology of these diagnoses. One could assume that because of the characteristics listed above, there is less motivation to engage in social and outdoor activities that include physical activity. At one point in his educational career, this thesis writer worked in a Federal Setting 4 middle school teaching a nature-based class. The class carried out various gardening tasks, and the thesis writer noticed that there were decreases in maladaptive behaviors along with increases in appropriate social skills. The students, in that case, could do a meaningful and purposeful activity in a fully submersive sensory experience while also engaging themselves in physical activity. The interventions of physical activity,

outdoor sensory experiences, and various sensory tools to assist in the classroom inspired this thesis writer to explore how movement and sensory-based interventions impact students' emotional and academic success.

Thesis Question

1) **How does incorporating movement and sensory-based interventions in the classroom affect the overall emotional and academic success of students with disabilities, namely Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD)?**

After review of the research, it is important to look at three components. First, it is essential to explore how ASD and ADHD impact emotional and sensory regulation in students and if lack of physical activity is a symptom of both diagnoses while also impacting the ability to regulate themselves. Second, it is important to examine how physical activity interventions and sensory regulation tools impact regulation in students with ASD and ADHD. Third, it is crucial to look at what are impactful sensory and physical activity interventions and what are their outcomes on students' academic and emotional success in school.

CHAPTER II: LITERATURE REVIEW

Research Process

The primary purpose of this research was to explore various scholarly peer-reviewed research pertaining to the study of students with a diagnosis of Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD). Particularly how their diagnoses affect their ability to regulate from an emotional and sensory perspective. Furthermore, this researcher looked at how lack of physical activity pertaining to both ASD and ADHD impacts this ability as well. Based on this research, the researcher explored if movement-based and sensory-based interventions improved academic and emotional success in students who presented with these diagnoses. The research obtained was done so through various research databases located from the Bethel Library. These include ERIC, LIBSearch, Academic Search Premier, JSTOR, Google Scholar, and PubMed. This researcher found 30 journal articles and concluded with 20 for the most accurate compilation of data to answer the researcher's question for this thesis.

Berkovits et al. (2016) Research

With the prevalence of autism being at an all-time high (1 in 44 children) and continuing in that direction, the research around it continues to be imperative to better understand the student populations with ASD, especially because the characteristics of the "spectrum" continue to vary at an individual level. One characteristic is emotional regulation (ER). Berkovits et al. (2016) suggested there is continued research that needs to be done regarding ER in students with autism, particularly from preschool and into 5th grade. The research needs to continue because students with ASD continue to have heightened emotional states and difficulty regulating their emotions.

Berkovits et al. (2016) looked at 108 participants who were diagnosed with ASD and ranged from ages 4 - 7 years old, along with input provided by their chief caretakers. The study looked at the connection between ER and other areas of child development. In order to best describe what emotional inhibitors impact children with ASD, Berkovits et al. (2016) posed these specific questions:

> (1) To what extent does emotion regulation change over time for children with ASD? (2) How does emotional regulation relate to children's overall level of functioning? (3) Does child emotional regulation explain changes in child social and behavioral functioning? (p. 70).

The researchers performed a cross-site longitudinal study with the participants and their caretakers. It was done across a period of two school years with an initial assessment to determine eligibility. The student's eligibility was based on a diagnosis of ASD, either medically or educationally diagnosed; the student meeting the criteria for ASD on the Autism Diagnostic Observation Schedule 2nd edition (ADOS-2); and an IQ of greater than or equal to 50 on the Wechsler Preschool and Primary Scales of Intelligence 3rd edition (WPPSI-III) (Berkovits et al., 2016, p. 71). The dependent variable (DV) measured was the student's emotional regulation capacity.

Across the study, several measurement tools were used to measure the DV. The first was the Emotional Regulation Checklist (ERC). The ERC was done by parents and measured the student's overall mood, ability to identify and express emotions, and ability to show expected emotions in varied preferred or aversive social scenarios. In addition to the ERC, the Child Behavior Checklist (CBCL) was used during the first and second years. This was used to assess

problems in the student's behavior and that relationship in emotional regulation dysfunction. Furthermore, the Social Skills Improvement System (SSIS) was used and filled out by parents during the first and second years to examine social skills in children with autism. The Comprehensive Assessment of Spoken Language (CASL-2), which measures the student's ability to use language in social scenarios, was given prior to the first school year assessment (Berkovits et al., 2016). Lastly, the Social Responsiveness Scale (SRS), a questionnaire given to the students to assess their behaviors including receptive, cognitive, expressive, and motivational aspects of social behavior, was used to assess the severity of the student's autistic symptoms (Berkovits et al., 2016, p. 73). All of these measurements were used in accordance with the study and facilitated the results into three categorical subsets: *Relationships Between Emotion Regulation Measures and Stability Across Time; Relationships Between Emotional Regulation and Child Functioning; Prediction of Social and Behavioral Functioning by Emotional Regulation.*

The findings from Berkovits et al. (2016) over the course of the two school years, indicated that emotional dysregulation is a stable factor in the symptoms of ASD. ER is a skill that without early interventions can lead to increased dysregulation. Moreover, the longitudinal analyses suggested there is a strong correlation that children with ASD present with decreased ER skills, indicating a decrease in their social skills, which can lead to increased symptoms of internalized (sadness, withdrawal, feeling depressed or anxious) and/or externalized behaviors (physical aggression, verbal aggression, impulsivity) (Berkovits et al., 2016, p. 76). This means that if a student with ASD presents with an inability to regulate themselves, it can affect their overall emotional and academic success in school.

Shaw et al. (2014) Research

Emotional dysregulation affects not only students with ASD but also students with ADHD. Shaw et al. (2014) pointed out that in a study that compared 105 cantankerous students to 395 non-cantankerous students, all of which had ADHD, discovered increased rates of oppositional defiant disorder (ODD) along with depression in the cantankerous group of students. Shaw et al. wanted to look further into the research and literature in order to conceptualize what the entire landscape of emotional dysregulation looks like within ADHD. Rather than just looking at the egregious cases, the researchers had to look at participants who did not meet the DSM criteria for any diagnoses beyond ADHD. Shaw et al. (2014) conducted a literature review using both qualitative and quantitative methods, looking at articles published prior to 2013. The researchers looked at ADHD in four subsets: *infancy and early childhood, childhood, childhood to adulthood, and adulthood.* The researchers predicted that emotional dysregulation and ADHD are correlated yet distinct dimensions; emotional dysregulation is a core diagnostic feature of ADHD. The combination constitutes a nosological entity distinct from both ADHD and emotional dysregulation alone (Shaw et al., 2014, p. 276).

Through the meta-analysis, the researchers found that in *childhood,* children with ADHD showed an increase in aggression compared to children without ADHD. Furthermore, the children with ADHD showed elevations in negative affect and aggressive outbursts when presented with challenging tasks. The researchers discovered two longitudinal studies regarding *infancy* where 7,140 children, ages 3 - 7, indicated that when the children presented with arduous emotional temperament and obtrusive emotional states at age 3, that was moderately connected to ADHD and emotional dysregulation at age 7 (Shaw et al., 2014). In the *adult* studies, Shaw et

al. (2014) found that in a study that consisted of 950 adults with ADHD compared to 20,000 adults without a diagnosis of ADHD had elevated rates of internal conflict and impeding social conflicts. Contrastingly, another study the researchers pointed out showed 80 adults who reported having rescinded symptoms of ADHD when compared to 55 adults with persistent symptoms of ADHD. The adults with persistent ADHD showed a higher frequency of emotional dysregulation. This would suggest that if ADHD symptoms get better in adults, then emotional regulation may also improve (Shaw et al., 2014).

Emotional dysregulation causes significant impairment, according to Shaw et al. (2014). In a study of 1500 children, the researchers found emotional difficulties had a greater impact on overall happiness and self-worth. In addition, they had more difficulty with peer relationships, family relationships, academic achievement, and obtaining employment. The researchers found that the pathophysiology of emotional dysregulation in persons with ADHD mainly comes from a bottom-up psychological process and top - down psychological process. Meaning that when there is impairment in the areas towards the bottom of the brain in the ventral striatum and orbitofrontal cortex (responsible for reward based action) and the amygdala (emotional processing), and the top of the brain in the ventrolateral and medial prefrontal cortex (reward, motivation, fear) there will be consistencies in emotional dysregulation (Shaw et al., 2014, p. 284).

Lastly, the researchers looked at the most effective form of treatment for persons with ADHD. They found that the number one treatment, psychostimulant, is also linked to an overall improvement in emotional dysregulation. Guanfacine, a medication typically used to treat high blood pressure, has had a positive impact on treating ADHD. Additionally, a diet high in fatty

acids and the use of behavioral therapies, including mindfulness strategies, had a positive impact for children with mixed internalizing and externalizing symptoms (Shaw et al., 2014).

Edossa et al. (2017) Research

Emotional regulation correlates with behavioral regulation in that students with a more difficult time regulating their emotions have more difficulty controlling their behaviors. One might sum up this as *Self-Regulation* (Edossa et al., 2017). Regarding students with ADHD and autism, research showed that students with either diagnosis struggle in their ability to control their ability to self-regulate, and this is based on the neuropathology of their diagnosis and other comorbid factors.

When a person is unable to self-regulate, this means that they will be unable to, at times, alter their emotion and behavior in the process to meet an inherent and/or extraneous challenge (Edossa et al., 2017, p. 192). Therefore, the holistic nature of a student, which is to meet the challenges set forth not just academically but also socially and emotionally, will be quite difficult if the student cannot regulate themselves. Researchers who study self-regulation say that each person has a set of cognitive skills to purposefully navigate their actions and thoughts, this is known as executive functioning skills. These are skills proven in education as skills students need to be successful. The ability of a student to learn and carry out executive function skills starts in childhood and continues throughout their life (Edossa et al., 2017).

Edossa et al. (2017) looked at emotional and behavioral regulation during childhood and how emotional and behavioral regulation can positively impact academic success while comparing the stability between the two. The researchers started by doing a longitudinal study

that begins with children at birth. The research was done in the United Kingdom, with over 50% of the participants being young male participants. The study took into account various ethnic minorities. The data on the various ethnic backgrounds of the participants are as follows: 82% white, 4.8% Pakistani, 2.5% Indian, 2% Bangladeshi, 2% Black African, 1.3% Black Caribbean and 3% were mixed races. The ages of the participants range from 9 months to 11 years old, with data collection sweeps starting at 9 months, 3 years, 5 years, 7 years, and 11 years (Edossa et al., 2017, p. 195).

Edossa et al. (2017) assessed emotional regulation at ages 3, 5, and 7. This was done using the Child Social Behavior Questionnaire (CSBQ). This questionnaire was filled out by parents, 97% being the participants' birth mothers. The questionnaire included five different categorical questions and ratings scales, which included: (1) Does the child show mood swings?; (2) Does the child get overly excited?; (3)Does the child act impulsively?; (4) Does the child get over being upset quickly?; (5) Does the child get easily frustrated? (Edossa et al., 2017, p. 195). Additionally, the researchers measured Behavioral Regulation using the Independence and Self Regulation Scale (ISR) tool, however with different questions including: (1) Does the child persist when faced with difficult tasks?; (2) Does the child move to a new activity after finishing a task?; (3) Does the child see tasks through to the end?; (4) Can the child stop and think before acting? (Edossa et al., 2017, p. 195).

Academic achievement was measured at age 11 and was done by using teacher evaluations. They were assessed in multiple subjects. These subjects included science, information and communication technology, mathematics, and English. The greater values on the rating scales correlated to better performance. What the researchers discovered was that

emotional regulation and behavioral regulation are interconnected and impact each other during the early years of child development. This connection between the two is based on their relationship neurologically. When the areas of the brain that pertain to emotional processing (amygdala) and behavioral processing (prefrontal cortex) are impacted in one system, the other will also be affected when it pertains to child development. Edossa et al. (2017) concluded that self-regulation at age 7 greatly predicted academic achievement at the age of 11. Meaning that the development of the students' skills to regulate themselves positively correlates with their success in school. Students with autism and ADHD have limitations in the ability to self-regulate not just at an emotional level but also at a sensory level. As the amygdala operates as a vessel for processing emotions, it also operates to process sensory information. Because the amygdala is affected in both diagnoses, this correlates with the research that people diagnosed with ASD or ADHD have decreased abilities in self-regulation, pertaining to emotional and sensory regulation.

Crasta et al. (2020) Research

Not only is self-regulation a prominent factor in a student's ability to carry out baseline expectations in school, whether that is from an emotional/behavioral standpoint and/or academic standpoint. But the ability to process sensory information can also correlate to a child's ability to regulate themselves and have success in school academically and emotionally. Regarding autism, one of the diagnostic criteria from the Diagnostic Statistical Manual 5 is sensory processing disorder (SPD). Not only SPD, but also sensory deficits pertaining to hyperreactivity (i.e., abnormally high sensitivity to sounds, textures, etc.) or hyporeactivity (under-responsive or difficulty registering various sensory stimulation) are also sensory deficit characteristics of

autism. When a child may have either an over-responsive or under-responsive sensory system, or SPD, this can lead to impairments in the ability to perform daily occupational performance tasks; including lack of ability to process sight, touch, hearing, smell, digestion, proprioception (where the body is in space), and vestibular (balance/coordination). When this occurs, sensory integration (the ability to take in sensory information, organize it and have a functional response) limits the ability to adapt behavioral outcomes, engage in typical play activities, as well as functional skills needed in school (Crasta et al., 2020, p. 2). Crasta et al. (2020) researched the relationship between sensory processing among children with autism, sensory processing disorder, and typically developing children. Mainly the comparisons between the various groups' ability to attend intertwined with processing sensory stimuli and whether that would predict the above categorical differentiations of autism, the typically developing child and one with sensory processing disorder.

The researchers studied 69 children between the ages of 6 and 11 years old. They were broken up into three groups. The first group had an autism diagnosis, all diagnosed medically by their primary care physician. The first group had 5 female participants and 19 male participants with an average age of 8 years old. None of the participants in the first group had any comorbid diagnosis. The second group had a total of 15 male participants and 6 female participants with an average age of 7 years old. All of the participants had a diagnosis of sensory processing disorder, all diagnosed by an Occupational Therapist. Again, this group did not have any comorbid diagnosis. The last group was typically developing children, meaning they had no diagnosis of any kind. This group included 17 male participants and 7 female participants with an average age of 7.5 years old (Crasta et al., 2020, p. 3).

The researchers used multiple methods of measurement. The participants were given neuroimaging and behavioral tests (Crasta et al., 2020, p. 3). They were also given the Short Sensory Profile (SSP), the Test for Everyday Attention for Children (TEA-Ch), and Wechsler's Abbreviated Scale of Intelligence (WASI). The WASI was used to measure the intelligence quotient of each student to make sure there were no major deviations from one participant to the next for their IQ levels. The SSP and TEA-Ch were done on the first visit and the WASI on the second visit.

The researchers reported that the SSP measures auditory filtering, low energy/weak, sensory seeking/sensory avoidant, movement sensitivity, touch, taste/smell, and visual/auditory. Measured on a 5-point scale, higher numbers would indicate that those participants could function and adapt to their environment better than those who scored lower. The TEA-Ch measurement was used to measure sustained and controlled attention amongst the three groups of participants. They used a multivariate analysis of variance to then look at the differences of each group based on the variables of attention from the TEA-Ch and the score from the SSP. (Crasta et al., 2020, p. 4 - 5). The results from the study are indicated in the table below.

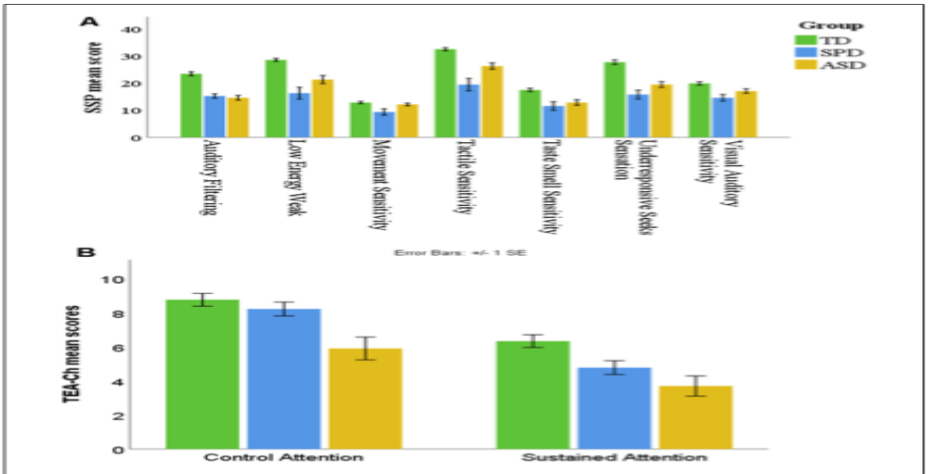


FIGURE 1 | Comparisons of group differences for the two behavioral assessments: **(A)** the mean response of each group for each of the seven sensory domains of the Short Sensory Profile (SSP); **(B)** the mean response of each group for the attention subtypes derived from the Test of Everyday Attention for Children. The error bars represent 1 standard error of means (SE). Nonoverlapping error bars indicate the probable likelihood of significant differences between groups with a $p < 0.05$ if tested.

According to the bar graphs, each area measured from the SSP and the TEA-Ch amongst the participants from the three different groups indicated that the yellow participants (ASD) and the blue participants (SPD) compared to green participants (typically developing peers) showed noticeably lower mean scores in all sensory processing categories. Furthermore, there was a noticeable difference in their ability to have sustained or controlled attention. Amongst the participants who had SPD, the SPD groups indicated more deficits in sensory processing than their peers with ASD. In addition, the ASD group had much more difficulty in sustained and controlled attention compared to the other two groups.

This would mean that sensory processing for students with ASD impacts them at a far greater level overall than typically developing peers. Mainly, they will be limited in their ability to carry out executive function skills. Moreover, as the affected amygdala is involved in processing emotions as well as sensory stimuli, how they are able to interact with their environment to feel regulated will also be impacted. When children with ASD or ADHD are limited in their ability to interact with their environment, they miss out on essential fun activities and are less likely to get the physical activity they need to stay regulated. Research suggests that children with ASD and/or ADHD get less physical activity than typically developing peers.

Mercurio et al. (2021) Research

Physical activity is important for the ability of a person with autism or ADHD to regulate themselves. When students with ADHD are able to regulate themselves to a degree suitable enough so that they are able to feel comfortable in their environment, they will have a greater ability to carry out necessary tasks pertaining to executive functioning, attention, emotional regulation, and sensory regulation. Mercurio et al. (2021) indicated that there is an opposing

relationship between ADHD and physical activity; and an increased risk for screen time, being overweight, and depression. Additionally, the researchers point to multiple studies that indicate there is a positive link between physical activity and improving the symptoms of ADHD.

Mercurio et al. (2021, p.1188) sought to examine the engagement in physical activity in the ages of children 6 to 17 years old who present with an ADHD diagnosis. Furthermore, the researchers wanted to look at the relationship between physical activity and ADHD symptom severity. The researchers hypothesized that children with ADHD would be more likely to get 60 minutes of exercise per day compared to those without a diagnosis due to the benefits of the symptomatology of ADHD. The methodology they used in the study is a retrospective cross-sectional study that used data from the National Survey of Children's Health (NSCH). The data from the NSCH is from parent/caregiver reports. The main outcome measurement was physical activity which was measured based on the question: "In the past week, how many days did the child participate in physical activity for 60 minutes 7 days a week." There were multiple covariates in the study including age, race, poverty status, and digital media exposure.

What the researchers found after looking at the data is that 11.7% of U.S. children from ages 6 to 17 had a lifelong diagnosis of ADHD. 14.3% of children with ADHD reported 0 days of physical activity a week compared to those with no diagnosis. Furthermore, of the recommended 60 minutes of daily physical activity, 21% had a lower adjusted odds ratio of participating in physical activity compared to peers without a diagnosis. The researchers found that various covariates such as being female, from ages 12 - 17 years old, and more time spent with digital media all contributed to less physical activity. Moreover, the researchers found that the participants who reported having average symptoms of ADHD were the least likely to not

engage in physical activity versus participants who reported milder or extreme symptoms. In addition, a study by Zang (2019) examined the benefits of physical activity on children and reported that physical exercise significantly improved internalizing mental health problems (depression and anxiety), aggression, social problems, and hyperactivity.

Zang (2019) Research

The main treatable mechanism for ADHD showing positive results in treating the symptomatology is pharmacological drugs, mainly stimulants. One of those main stimulants is Adderall. Adderall, which is known to have positive benefits for people with ADHD is also known to have potentially adverse potential and can limit its effectiveness in particular cases (Zang, 2019). Therefore, Zang (2019) wanted to examine the benefits of physical activity on children with ADHD by conducting a meta-analysis using sources from *Medline, Google Scholar, EMBASE, and Cochrane Central.*

The symptoms of ADHD that were assessed, as impacted by physical activity were as follows: hyperactivity, impulsivity, anxiety and depression, inattention, oppositional symptoms, aggression, social problems, and thought problems. The participants in the meta-analysis consisted of 574 children with ADHD. 276 children were included as the physical activity group set. 298 children were considered as the control group (no physical activity). The average age of the children in the study was 8 to 16 years old. What the data showed regarding the impact of physical activity on children with ADHD, is that hyperactivity and/or impulsivity, were slightly improved with physical activity. However, they were not significantly impacted. Problems around thought processing and aggression were effectively improved. Moreover, children with depression and anxiety also showed improvements in those symptoms with physical activity. The

main physical activities that showed the most improvement in the children were yoga and physical aerobic activity (Zang, 2019).

Lastly, Zang (2019) found a significant correlation between students with ADHD and social skills acquisition due to participation in an athletic activity twice a week for 90 minutes. This is important because students with ADHD and ASD can struggle with their social skills and this can lead to increased negative internalizing behaviors. The benefits of physical activity are extremely beneficial for ADHD children, leading to an increased quality of life due to the impact on the symptomatology of the diagnosis. Not only is physical activity beneficial to people with ADHD but also to those with ASD.

Lee & Hodge (2017) Research

From aerobic activities, sports, play, and general exercises that provide strength and input to the bones and muscles (proprioceptive sense), many different modalities can be used to enhance a person's health by engaging in these activities. Moreover, these activities are very important to facilitate the growth and development of specific symptoms of ASD that may be hindered from having a diagnosis (Lee & Hodge, 2017). For instance, research confirms that participation in physical activity with other children can increase gains in positive experiences with neurotypical peers (Lee & Hodge, 2017). As evidenced by previous research articles, not only do students with ADHD spend less time engaging in physical activity but also students with ASD. Lee and Hodge (2017) reported that children with ASD spent less time engaging in physical activity due to engagement in more screen time activities.

Lee & Hodge (2017) looked at the need to engage children with ASD in physical

activities. More specifically, they compare the physical activity levels of children with ASD and their neurotypical peers. They looked at what barriers children with ASD face in their ability to carry out physical activities; and what positive impacts physical activity can have on a student with ASD. Lee & Hodge (2017) used numerous databases to locate studies that involved 3 different areas related to physical activity and children with ASD. The first encapsulated teaching students with ASD; second, engagement of students with ASD in physical activities (exercise, sports, recreation/leisure, and health); third, included a physical activity intervention for students with ASD. The researchers concluded with 35 peer-reviewed journal articles. All of these articles revolved around the aforementioned criteria above. They first looked at engagement in physical activity amongst those with ASD and those without. The studies included 53 participants with ASD versus 58 who were neurotypical. They compared the physical activity levels between both participants. They found that the 53 participants with ASD engaged in less physical activity than their peers. Next, the researchers looked at studies in which they compared physical activity levels during recess versus gym. Again, comparing the differences in physical activity in each activity between those with ASD versus those who do not have any diagnosis. There were 24 ASD and 24 neurotypical students, who all wore accelerometers (measures the amount of acceleration of an object in motion). They discovered that the students with ASD participated more in gym class, physically, versus at recess. This was due to the structured (gym class) versus unstructured (recess) activities. In fact, the results between the ASD students and neurotypical students were similar when they were in gym class. Moreover, the researchers found that age was a factor regarding those with ASD and the frequency with which they were physically active. They discovered that students with ASD in first and second grades were more likely to engage in physical activity versus the middle grades

(3rd and 4th) and upper grades (5th and 6th) (Lee & Hodge, 2017).

Another imperative aspect of the correlation between physical activity and sensory processing that Lee & Hodge (2017) found in their research was done by taking 32 children with ASD and giving them the Short Sensory Profile (SSP) as well as the Movement ABC- 2 (MABC-2). The SSP examined the sensory processing of each participant and the MABC-2 examined the gross motor skills of the participants. The research showed that if there were delays in sensory processing, there were also delays in gross motor skills. These two ideas combined manifest what can be known as sensorimotor. Sensorimotor is a stage in development when the infant begins intentionally interacting with their environment through their body. Therefore, the need for the body to be able to interact with its environment through movement can lead to a more regulated self. The research revealed that those with ASD had delays in gross motor skills along with sensory processing skills compared to their neurotypical peers.

The most important information Lee and Hodge (2017) found was the benefits of physical activities and exercise interventions for students with ASD. One of the studies examined the effects of exercise on 3 children with ASD to see if patterns of stereotypic behaviors would be reduced by exercise programs. These patterns included: body rocking, running away from tasks, and shaking their body. It was discovered that exercise in the forms of snowshoeing, walking, and jogging in fact reduced these symptoms. Additionally, Lee and Hodge (2017) found research related to high-intensity interval training (HIIT exercises), which also consisted of a warm-up with resistance training and a cool-down. They did a 12-week intervention on 6 participants with ASD that indicated the students expected behavior increased greatly while non-preferred behaviors decreased, as well as achieving better sleep. Furthermore, Lee & Hodge

2017) reported that researchers examined the effects of swimming, specifically a swimming program that consisted of 16 children with ASD. They were also given a School Social Behavior Scale (SSBS-2) that they would use to assess their social skills and saw improvements in their ability to develop their social skills while utilizing the swimming program. Overall, the researchers found data to support the idea that children with ASD are impacted by decreased levels of physical activity and that increasing their physical activity positively impacts their lives. Their lack of interest in physical activities because of symptoms of their diagnosis, age, and environment along with increased screen time shows a need for increased physical activity throughout their day. Not only for the regulatory benefits but also because of the inclusivity of various social groupings that increase their ability to participate socially, especially in a structured environment like school. Furthermore, the coinciding of a child's need to use their body in a physically active way to interact with their environment and experience the world from a sensory perspective is also impaired. But when provided with physical activity, which engages the senses, most specifically the proprioceptive system, they are providing input to those systems which help to regulate them. While these interventions focused solely on intense physical activities, sensory tools used in the classroom and sensory garden exposure also impact students with autism and ADHD and their ability to regulate and carry out executive functioning skills.

Yussop & Mohd Yassin (2020) Research

Autism and ADHD are two of the most prevalent diagnoses in education today. Furthermore, both diagnoses have comorbidity with sensory processing deficits. Yussop & Yassin (2020) researched the effectiveness of children’s exposure to a sensory garden and how that impacted social development, emotional development, cognitive development, and

focus/attention based on the idea that providing a submersive sensory experience through a sensory garden would have a positive effect on those developmental categories. They set out to answer two research questions: (1) What is the effect of learning in the sensory garden on students with autism? (2) How far does the sensory garden stimulate autistic students' multisensory (Yussop & Mohd Yassin, (2020, p. 2)?The sensory garden acts to stimulate the 5 senses (touch, taste, smell, sight, and auditory). Yussop & Mohd Yassin (2020) first examined various literature reviews on sensory gardens. They discovered that the sensory garden works to provide a space for children to explore outside through physical gross motor movements, social interactions, and sensory stimulation. Specifically, children with ASD showed improvements in behavior, understanding, and focus, thus making the learning process have a positive impact on academic success.

The researchers' methodology was to examine the effects of learning while in a sensory garden and its effects on students with ASD and other health disabilities. The researchers used structured observations and interviews to examine the effects of learning in a sensory garden, all of which were verified by special education teachers. The participants would engage in visual input, auditory input, tactile input, olfactory input, and oral motor input while being taught in the sensory garden. The participants would be interviewed for 15 minutes to see if the sensory activities they engaged in showed positive or negative effects on learning while in the sensory garden (Yussop & Mohd Yassin, 2020, p. 4). What the researchers were looking for were changes in the 9 participants (6 - Autism, 1 - Dyslexic, 1- ADHD, 1-Learning Disabled) regarding their behavior. Specifically in the students with ASD, where they showed increased behavior and inability to attend in the typical classroom.

What the results indicated was an increase in focus and preparedness after two weeks. Additionally, an increase in positive behavior and social skills, along with an increased positive demeanor and motivation to learn were the benefits of learning in a sensory garden. Because of the hands-on experiences in the sensory garden, the participants' abilities to explore and learn through various sensory-stimulating experiences intertwined with the academic curriculum made it easier for them to retain the information they were learning (Yussop & Mohd Yassin (2020). Yussop & Mohd Yassin (2020) recommended that schools should use sensory gardens as an approach to engage the learner and grab their attention to increase their focus on learning along with regulating their emotions and increasing social skills.

In order to feel regulated in the classroom, sensory tools are a way for students to adapt to their learning environment easily, based on if they have an over-responsive or under-responsive sensory system. For example, they will benefit from earplugs in order to decrease the sounds of their environment if they are sensitive to sounds. They may also need active seating in order to get active movement while sitting because they are under-responsive and need stimulation to "wake-up" and increase focus/attention. Research shows that these tools can assist in helping ASD and ADHD students regulate while learning.

Van der Wurff et al. (2020) Research

A lot of people regulate the sensory stimuli around them by adding or removing stimulation. An easy example would be someone who wears sunglasses on a sunny day to reduce the effects of a bright sun. Imagine a student with light sensitivity in a normally lit environment. They will not be able to wear sunglasses, but they could use a sensory tool, such as a light cover. This is a behavioral strategy that can be used by students with ASD and ADHD (Van der Wurff

et al., 2020).

Research points to sensory processing disorder as a lead symptom of ASD and ADHD. Sensory processing issues can then lead to issues with behavior in those with a diagnosis. Furthermore, there is a positive correlation with sensory processing and reading, spelling, and math. Van der Wurff et al. (2020) wanted to look at the effect of three sensory processing tools, Tangle fidgets (plastic noodle chain), earmuffs (noise-canceling headphones), and a wobble seat cushion (inflatable seat cushion that allows for movement while sitting), on the student's ability to have academic success, specifically in math and their ability to attend. The participants of the study were a group of 275 2nd-grade students in the Netherlands who were neurotypical, meaning they did not have a diagnosis of ADHD or ASD. Van der Wurff et al. (2020) did a randomized controlled trial where the 2nd graders engaged in a test on attention and mathematics over a period of one time a week for four weeks. While engaged in the tests they were given the three sensory tools listed above. The researchers compared that group with a control group that had no sensory tools during the mathematics and attention tests. The sensory tools were given randomly. After each test session, the children filled out a questionnaire, giving their opinion on the tools they used. They were given the Sensory Profile, Dutch version (SP-NL), with additional questionnaires to assess their overall sensory processing skills. The SP-NL contains 125 questions, and it is filled out by the student's caregiver. The parents rate how the child responds to a specific behavior related to sensory processing. This is done on a 5-point scale (1-always, 2-frequently, 3-occasionally, 4-Seldon, 5-Never) when rating how often the specific response to the sensory variable occurs.

The results of the study showed counterproductive effects, and the use of the Tangle

fidget, ear muffs, and wobble cushion did not show any significant improvement in performance for attention or overall arithmetic scores. The researchers hypothesized that this could be due to the novelty of the items. They did discover there were positive correlations to the subcategory of *registration* involved with sensory regulation. The researchers found that based on the data students who already receive optimal amounts of sensory stimuli did not need the sensory tools. Therefore, it will be imperative to assess students with more severe sensory processing issues who lack exposure to sensory stimulation, typically children who are more sedentary and those that have a diagnosis of ADHD and ASD (Van der Wurff et al., 2020).

CHAPTER III: APPLICATION OF RESEARCH

This Application of Research is based on this researcher's analysis of various interventions and his own personal experience as a COTA/L, Special Education Teacher, and now Behavior Strategist. This researcher would like to look at three various interventions to decrease the negative impacts of the symptomatology of ASD and ADHD in students ages 11 - 18. The students chosen for the study will need to have a diagnosis of ASD and ADHD. The diagnosis can either be a medical diagnosis and/or educational. Furthermore, the students who

participate will need to be given a formal Sensory Profile (SP) to assess for various sensory processing issues. Based on the data from the SP, the qualification for moving forward with participation in the interventions would be 2 or more standard deviations (SD) from the baseline. Two or more SDs show a greater under-responsive or over-responsive sensory system compared to peers in that age group. The SP also takes into account sensorimotor processing, which is how the student's sensory system responds to any feedback that revolves around their body in space or using their body in their environment. This researcher predicts that movement-based and sensory-based interventions provided over a 6-week period would provide data to support an increase in emotional and academic success in students.

The first intervention will be a High-Intensity Interval Training (HIIT) exercise program focused on providing input to the frontal regions of the brain which helps control the emotional regulatory system (amygdala). The HIIT exercises will also provide input to the sensory system of students with ASD and ADH in order to increase regulatory behavior and decrease symptoms of each diagnosis. The second intervention will incorporate pre-determined sensory tools in each of their classrooms including earplugs/noise-canceling headphones, light fixture covers, oral motor devices (gum/chewy pencil tops), movement furniture/active seating (rocking chairs, wobble stools, exercise balls) and access to weighted lap pads. Lastly, this researcher would like to incorporate a nature-based gardening class into the students' week to increase social-emotional skills and provide sensory input for regulatory behavior.

Each student with ASD and/or ADHD will engage in two 30-minute HIIT exercises two times throughout their school day followed by a 5-minute cool-down period. Each class will be equipped with sensory tools to be utilized by each participant. Their Sensory Profile (SP) will help determine which tools will be most beneficial based on how they respond to sensory

stimulation, whether they are over-responsive or under-responsive. This can help determine which sensory system needs which kind of input or lack thereof.

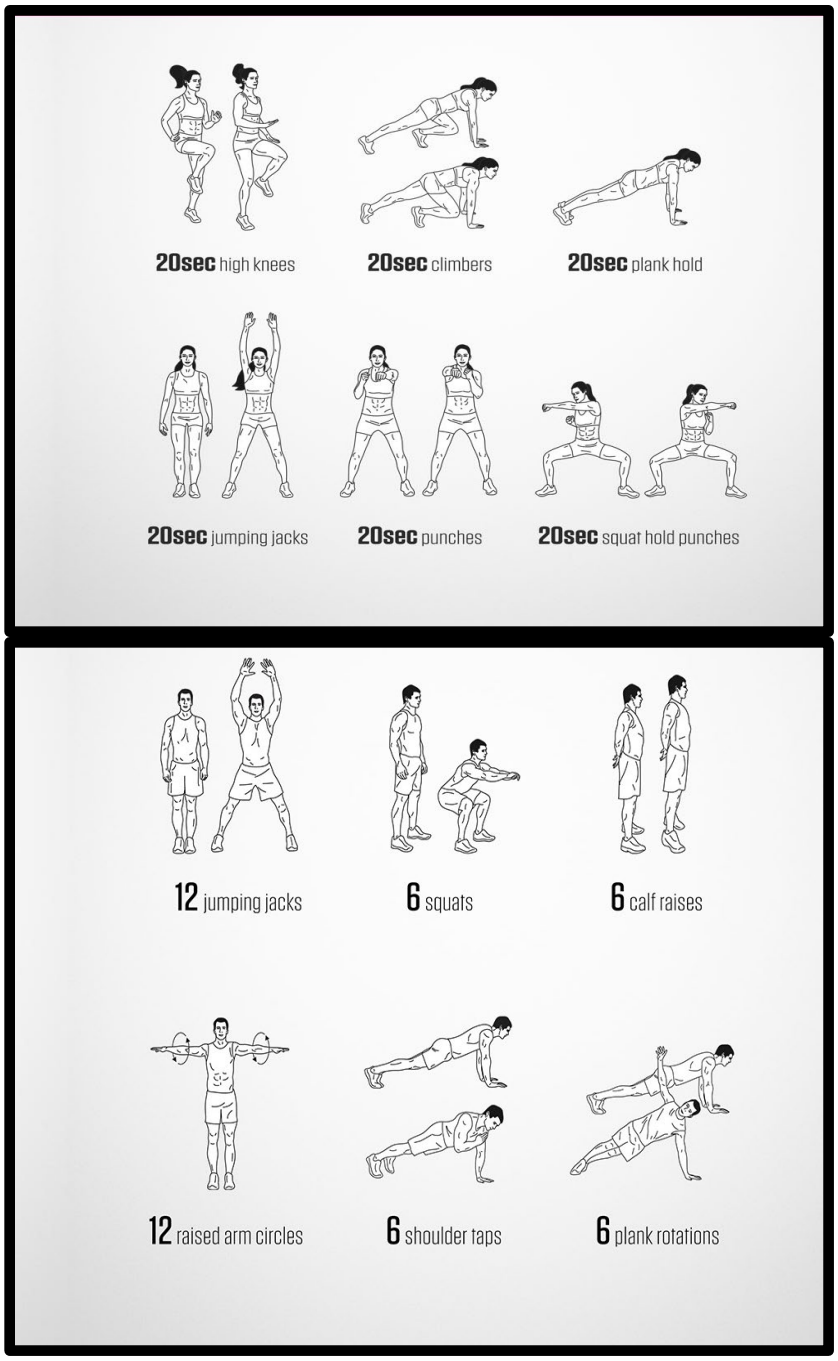
Physical Exercise (HIIT) Program

Due to the positive correlations between intense physical activity and the regulatory benefits that physical activities have for candidates with ASD and ADHD, this researcher chose a HIIT exercise intervention as one of the primary interventions for the application of research. HIIT exercises are high-intensity interval training exercises. They are time-efficient exercises that go between high intensity and low intensity. The exercises can be adapted for age groups and overall gross motor ability. Each student will have to be assessed for where their baseline performance level is in order to start at the appropriate level of HIIT exercises. Below are examples of a beginner HIIT routine. The exercises will be done over a period of twenty minutes. Depending on the physical tolerance level of the participant, the participant would most likely attempt 1 row of 20 seconds of high-intensity physical activity followed by a 30-second rep of low-intensity jogging or running in place. They would then continue with high intensity.

Again, these times and intervals can be adapted based on the ability of the participants.

Examples of beginner HIIT exercises are shown below:

(https://darebee.com/)



The equipment needed for the HIIT exercise routine is as follows: (1) yoga mat, (2) exercise clothing, (3) athletic sneakers, (4) interval timer, (5) video or visual displays of exercises, and (6) water. Before the exercises begin a student questionnaire will be given in order to assess how the participants are feeling regarding their ability to focus, whether they have an increased amount of energy that results in fidgeting, how they are feeling emotionally, etc. Then they will be given the same questionnaire post-exercise during the cool-down period. The cooldown period will consist of low-impact stretching and 4-7-8 breathing (4 seconds inhale through the nose, 7 seconds hold, 8 seconds exhale out of the mouth) as various breathing techniques can be an effective method to reduce pain and stress (Busch et al., 2023). Afterward, data will be taken on academic performance and the ability to be engaged and attend in class in the form of a teacher observational questionnaire. Further assessment will be done based on the completion of assignments and grades of assignments collected by the teacher.

Sensory Tools

In an article written by Temple Grandin, a renowned member of the ASD community and Doctor of Animal Behavior, Grandin stated, “I was very sensitive to sudden loud noises, I hated balloons at parties because I feared the sudden noise of one popping, I still have a strong startle reaction to noises such as a gunshot or balloon popping” (Grandin, 1984, p. 156). Children with ASD and ADHD typically have sensory processing issues that affect their ability to focus, sit still, and engage in their academic classes. They also have emotional dysregulation issues that are directly correlated to sensory processing issues (Wurff et al., 2021). Most people will actively regulate themselves by adding or removing stimulation. Data is limited on the overall effect of sensory tools and their effects on students with sensory processing issues. Mainly

because when these tools are introduced for a limited period of time, there is a novelty when using them and this can lead to more distractions. However, this researcher believes there is a natural need to adjust sensory stimuli for typically developing persons. Likewise, a person with ADHD or ASD, whose sensory deficits can be more severe, can benefit from using tools to adjust sensory stimuli. Some of those tools include light fixture covers (to decrease overhead lighting that is too intense in the classroom), earplugs or noise-canceling headphones (to decrease noisy environments), gum/chewy pencil tops (to increase oral motor proprioceptive input), active seating (to provide vestibular and proprioceptive sensory input) and lastly, weighted lap pads (for tactile and proprioceptive input).

It will be very important to measure each student's tolerance for each sensory tool. Therefore, the SP will need to be done prior to the interventions used. The SP will be used to direct the prospective participants in which intervention to be used in each class. For instance, if a student is under-responsive and they need movement to increase stimulation and focus, then active seating can be used for them. The participants will be assessed on how they feel from a sensory and emotional standpoint prior to starting the interventions. This will be done using a student questionnaire rating scale and a student questionnaire given to them weekly after using their sensory tools in class. Data will be collected on academic performance prior to starting the sensory tools interventions and then following the weekly progress on attention, engagement, and academic performance. This will be collected using a teacher questionnaire on observable changes as well as monitoring their progress academically in class through assignment completion and grade improvement. The data will be taken weekly and assessed each week to see if any adjustments need to be made with using the sensory tools. The students will be using

the sensory tools every day. This thesis writer predicts that daily use will limit the novelty of items used and be more effective than the minimal past research shows.

Horticulture Class

The last intervention used will be to implement a horticulture class one time a week for the participants of the study. Sensory gardens are found to have a positive impact on student success, behaviorally and academically. Therefore, this researcher would like to incorporate that concept as part of the science/biology curriculum for the participants of the study. The participants will learn about horticulture while being able to immerse themselves outside, being engulfed in the natural world around them. They will have exposure to various sensory stimuli, mainly revolving around touch, smell, sight, sound, and taste. The class will be interactive, and students will be engaged in planting various herbal plants (lemongrass, basil, lavender, etc.) while also being able to eat edible plants grown by the class. They will be able to expose themselves to tactile input by being able to work with various tools, as well as dirt and plants. The overall idea is to learn about plants 4 days a week in the classroom and then purposefully interact with them one day a week in their natural environment, carrying over learning objectives from the class during the week.

Student questionnaires will be given after the 4th day of in-class instruction and learning, assessing the students' overall mood, sensory tolerance, and ability to focus. Then, a student questionnaire will be given after each day of exposure to the outdoor horticulture class. It will assess the same criteria as stated above along with their opinion of the outdoor experience. Lastly, a teacher questionnaire will be provided that assesses the overall performance of the

student in the four-day-a-week indoor class from an attention/regulation standpoint as well as the overall completion of assignments and assessment of grades.

Collection/Assessment of the Data

All assessment tools (student/teacher questionnaires) other than the SP will be developed by the thesis writer. Academic performance data will also be collected by teachers' typical grading practices. It will be imperative to look at the academic performance data prior to the interventions and compare it to the data after using the interventions while also assessing on-task and engagement. The initial action taken for assessment will need to be the SP, and it needs to show 2 standard deviations away from the baseline. Additionally, assessing the physical stamina of the student by engaging them in beginner HIIT routines needs to be done with assistance from a DAPE instructor. This is to assess for safety as well as to understand where their baseline is physically for tolerance of the exercises. This will help assist in determining which exercises can be accomplished with the most consistency in order to retain student engagement in the HIIT routine. Once this data is collected, we can add specific sensory tools to their classrooms and have a formidable exercise plan moving forward. As stated before, student questionnaires will be given prior to and after the sensory interventions are used for each class over a week of using them. The questionnaires will consist of how the student feels emotionally before entering the classroom, which tools helped keep them regulated and engaged in the class itself, and if they felt the tools were counterproductive. These will be done with open-ended questions as well as a 5-point rating scale. The same data collection method will also be used for the sensory garden and taken one time a week as well.

CHAPTER IV: DISCUSSION AND CONCLUSION

SUMMARY OF LITERATURE

The focus of this thesis was to look at two main diagnoses, Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD). Each diagnosis comes with its own symptomatology, but ADHD can also run comorbidly with autism. Therefore, some strategies that are used to impact a positive response in one diagnosis can also be used for the other. This researcher decided to focus on these two diagnoses because the literature states that these are two of the most prevalent diagnoses in education today. The thesis writer first looked at literature that outlined how each diagnosis affects students' abilities to regulate their emotions. Emotional dysregulation is found to be a stable factor in symptoms of ASD (Berkovitz et al., 2016). Additionally, the researchers pointed to early interventions as a staple of treatment in students with ASD. The sooner skills are acquired to manage symptoms of a diagnosis the easier it will be to carry over these skills later in life. ADHD holds this same premise. Shaw et al. (2014) reported that managing emotions and having emotional outbursts are much more prevalent in those with ADHD, and if they are taught skills to manage at an early age, they can be more successful as adults in managing their diagnosis and the symptoms that encompass it.

In order to understand how the student's ability to emotionally regulate affects their academic performance in school, the thesis writer explored literature to examine that effect. Edossa et al. (2017) found that when a student has emotional dysregulation symptoms at an early age, the result was shown to be disruptions in academic performance that continued as they got older. Because the ability to stay emotionally regulated is not the only factor contributing to overall regulation, it was also imperative to look at another symptom of both ADHD and ASD,

which was sensory processing and sensory regulation or, in the case of students with one or both diagnoses, sensory dysregulation. Crasta et al. (2020) pointed to executive functioning skills being impacted by sensory processing issues. Executive functioning skills are essential in a student's ability to focus in school, to organize themselves and their work, to problem solve and come up with solutions to problems they face, as well as to make positive decisions regarding their behavior. Because of this effect on skills needed in the classroom, there will be negative impacts on a student's ability to be successful in school.

This thesis writer's experience as a COTA/L and Special Education teacher, made it more apparent in noticing how less frequent physical activity is offered in schools. Furthermore, based on experience and research, this thesis writer discovered the overarching benefits that physical activity has on mental health and being able to get the necessary sensory input from the environment to assist in being able to regulate. If there is less physical activity in these students' lives, what impact does that have on them? Mercurio et al. (2021) found that students with ADHD did in fact engage in less physical activity. Moreover, girls more than boys engaged in less physical activity. A major factor contributing to less physical activity was increased preferred screen time. Zang (2019) also found that there were major benefits in students engaging in physical activities that helped reduce the symptomatology of ADHD. Those symptoms that were reduced were aggression and anxiety while also improving social skills and thought processing. Lee & Hodge (2017) looked at physical activity in the ASD population, finding that people with ASD engaged in less physical activity than typically developing peers, even though there were benefits from physical activity not just emotionally, but also from a sensory perspective. Lee & Hodge (2017) pointed out that because our sensory system contributes to our motor functions, a deficit in sensory processing can be concurrent with a

deficit in our motor abilities. So providing physical activity can also improve sensory processing. The indication from the research points to the significance of which intense physical activity had the greatest impact on the symptomatology of ASD to reduce unexpected behavior and increase expected behaviors. It was a regulating activity for these students.

Based on past experiences of the thesis writer stated in the introduction, sensory tools, physical activity, and engagement in the outdoors were three areas of interventions the writer wanted to consider. Zang (2019) and Lee & Hodge (2017) discussed the vast improvements in behavior and a child's ability to regulate when engaged in physical activity. HIIT exercises were one of the most effective interventions. Yussop and Yassin (2020) research explored how incorporating a sensory garden into the science curriculum would impact learning on students with a diagnosis of ASD as well as other health disabilities (OHD). They found that students' executive functioning skills were improved. For example, their ability to be prepared for class improved. They also saw improvements in behavior and social skills. The researchers of this study recommended that sensory gardens be included in the curriculum of any educational establishment to increase students' overall ability to attend, stay motivated, regulate and, most importantly, feel comfortable in their educational environment.

Sensory tools are another intervention that the thesis writer wanted to explore as an intervention. Sensory tools are widely used in schools to help students regulate, resulting in sustained attention and focus. Typically, people think of "fidgets," but there are a lot more environmental adaptations that can exist. Other helpful adaptations are light covers to dim intrusively bright classroom lights; earplugs or noise canceling headphones for students with sensitivity to sound; gum or oral chewing devices to provide proprioceptive input and increase focus and attention; as well as active seating. Wurff et al. (2020) looked at three different sensory

tools. Their research on neurotypical students found that the fidget had either no impact or a negative impact on focus and attention. This was mainly due to the novelty of the item. Students were more interested in using it as a fun toy versus a tool; therefore, it lost its functional purpose. The active seating had a positive effect on a student's ability to register sensory information. The researchers in this study pointed to the limited studies done with sensory tools, especially their effect on students with a diagnosis. Therefore, this researcher wanted to continue looking at various tools that could help students with ASD and ADHD feel more comfortable in their environment and thus have academic and emotional success in school.

LIMITATIONS OF RESEARCH/IMPLICATIONS OF FUTURE RESEARCH

Research databases used for completing this thesis mainly consisted of ERIC, LIBSearch, Academic Search Premier, JSTOR, Google Scholar, and PubMed. Within these databases, most information needed for this thesis was easily obtainable. One area that was limited was the use of sensory tools, specifically as a tool for students with ASD/ADHD. For example, Wurff et al. (2020) reported that there are no studies related to sensory tools and whether they help with increasing attention and increased academic performance. Thus, that is why they moved forward with their study. Moreover, another limitation within the research articles themselves, specifically on regulation, was parental bias when it came to filling out assessments pertaining to emotional regulation. Berkovits et al. (2016) reported this is a limitation in their research. Similarly, Edossa et al. (2017) stated that limiting the study to longitudinal questionnaire data would also limit the quality of their research. The researchers pointed out that being able to study the neurobiology of the participants of the study along with having observational data to examine regulation in the participants is paramount rather than only limited to parent questionnaire data.

Another area of limitation includes small sample sizes of students. The research done by Crasta et al. (2020) indicated this was a limitation in their study. Various studies in the Lee & Hodge (2017) research also had limited participants. What this does is limit the universal findings of the studies. In regard to the diagnosis of ADHD and ASD, there are limitations in the data surrounding the research because of comorbidities that can exacerbate symptoms or affect other areas where the participants are limited, and limit them further. Therefore, more research regarding symptom severity is recommended by Mercurio et al. (2019). The length of time of the study was also a limitation in some studies. Nevil & Beela (2023) indicated that their study on the effects of horticultural therapy on students with ASD and other health disabilities would have been even more effective if it had been longer.

There is a lot of future research that can be done regarding emotional and sensory regulation and what interventions can impact increasing students' success in school. The limitations that existed in the studies researched for this thesis encouraged this thesis writer to personally carry out the use of observational data in the classroom and incorporate a horticultural class as a sensory intervention for students. Therefore, after examining all of the various studies, "outside of the box" thinking is what will really help increase the academic performance and emotional success of students with ASD and ADHD. Furthermore, an increased number of studies revolving around outdoor classrooms should continue to be explored. Along with schools that use movement throughout the entire class period. Lastly, carrying out research on the most effective sensory tools, as the ability to shape the environment around an individual with sensory processing issues will be imperative. This is due to the increase in the identification of sensory processing issues within the diagnosis itself, as well as the prevalence of sedentary habits and

thus lack of sensory exposure for that person to experience, building less tolerance of the environments they need to function in.

PROFESSIONAL APPLICATION

After reviewing the research articles in this thesis; the past experiences of the thesis writer; a belief in the fundamental idea that movement increases overall health and quality of life; and a belief that engaging in the natural world is a good recipe for the human being to regulate themselves, this thesis writer chose to carry over three ideas for the *Application of Research*. (1) To use High-Intensity Interval Training (HIIT) exercises and incorporate a 15-minute routine twice a day for the participants to regulate sensory and emotional processing. (2) To incorporate sensory tools in each participant's classroom to adapt their sensory environment for regulation. (3) To use a horticultural class that occurs outside and provides a fully immersive sensory experience for the participants to increase regulation. These various interventions will help assist the participants in feeling successful emotionally and academically in their education setting.

CONCLUSION

This thesis writer has spent the last 9 years exposed to a world of working with a variety of people with various diagnoses, developmental skills, and trauma with the goal of developing work skills, skills to regulate themselves, social skills, skills of daily living, and executive functioning skills. It has helped this writer see how much we need each other while learning from one another and about ourselves. For instance, this year, this thesis writer worked a lot with students on reframing negative thoughts, using strategies such as breathing and meditation to

help regulate their nervous systems. This motivated the thesis writer to practice these skills as well, in order to carry over modeling the skills, but also holding myself accountable with the practices I teach. The benefit of interventions in education is paramount. A lot of students are impacted by things outside of an educator's control, so coming up with strategies to incorporate into their everyday school life will be beneficial to their success.

This led this writer to answer the question: *How do movement-based and sensory-based interventions impact students' emotional and academic success, specifically for students with ADHD and ASD?* Based on the research this writer found as well as past experience, there is a lot of evidence to suggest that intense physical activities, using tools to add or remove debilitating sensory input, as well as providing increased time outside in an active and sensory immersive environment can help regulate students with ASD and ADHD. Based on the application of the research listed above, this researcher believes those interventions will be successful in positively impacting the emotional and academic success of those students.

REFERENCES

American Psychiatric Association (2013). Diagnostic and Statistical Manual of Mental Disorders. *Diagnostic and Statistical Manual of Mental Disorders*, *5*(5). https://doi.org/10.1176/appi.books.9780890425596

Berkovits, L., Eisenhower, A., & Blacher, J. (2016). Emotion regulation in young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *47*, 68–79. Springer. https://doi.org/DOI%2010.1007/s10803-016-2922-2

Chang, Y.-S., Gratiot, M., Owen, J. P., Brandes-Aitken, A., Desai, S. S., Hill, S. S., Arnett, A. B., Harris, J., Marco, E. J., & Mukherjee, P. (2016). White matter microstructure is associated with auditory and tactile processing in children with and without sensory processing disorder. *Frontiers in Neuroanatomy*, *9*. https://doi.org/10.3389/fnana.2015.00169

Chang, Y.-S., Owen, J. P., Desai, S. S., Hill, S. S., Arnett, A. B., Harris, J., Marco, E. J., & Mukherjee, P. (2014). Autism and sensory processing disorders: Shared white matter disruption in sensory pathways but divergent connectivity in social-emotional pathways. *PLoS ONE*, *9*(7), e103038. https://doi.org/10.1371/journal.pone.0103038

Crasta, J. E., Salzinger, E., Lin, M.-H., Gavin, W. J., & Davies, P. L. (2020). Sensory processing and attention profiles among children with sensory processing disorders and autism spectrum disorders. *Frontiers in Integrative Neuroscience*, *14*(22). https://doi.org/10.3389/fnint.2020.00022

Edossa, A. K., Schroeders, U., Weinert, S., & Artelt, C. (2017). The development of emotional and behavioral self-regulation and their effects on academic achievement in childhood. *International Journal of Behavioral Development*, *42*(2), 192–202. https://doi.org/10.1177/0165025416687412

Gomez, I. N., Calsa, A. P., Esguerra, J. T., Penetrante, P. J. H., Porlucas, K., Santos, M. E., Umali, C. B., & Lai, C. Y. Y. (2021). Psychometric properties of the sensory processing and self-regulation checklist: English version. *Occupational Therapy International*, *2021*, 1–9. https://doi.org/10.1155/2021/6658786

Grandin, T. (1984). My experiences as an autistic child and review of selected literature. *Journal of Orthomolecular Psychiatry*, *13*(3), 144–174.

Graziano, P. A., Reavis, R. D., Keane, S. P., & Calkins, S. D. (2007). The role of emotion regulation in children's early academic success. *Journal of School Psychology*, *45*(1), 3–19. https://doi.org/10.1016/j.jsp.2006.09.002

Landis, T. D., Garcia, A. M., Hart, K. C., & Graziano, P. A. (2020). Differentiating

symptoms of ADHD in preschoolers: The role of emotion regulation and executive function. *Journal of Attention Disorders*, *25*(9), 108705471989685. https://doi.org/10.1177/1087054719896858

Lee, S. H., & Hodge, S. R. (2017). Children with autism spectrum disorder and physical activity: A descriptive synthesis. *Academic Journals*, *8*(1), 1–23. https://doi.org/10.5897/JPESM2016.0284

Mercurio, L. Y., Amanullah, S., Gill, N., & Gjelsvik, A. (2021). Children with ADHD engage in less physical activity. *Journal of Attention Disorders*, *25*(8), 1187–1195. https://doi.org/10.1177/1087054719887789

Nevil, W., & Beela, G. (2023). Impact of horticultural therapy in social intelligence of people with autism spectrum disorder. *International Journal of Autism*, *3*(1), 06-13. Research Gate. www.rehabilitationjournals.com

Park, H. R., Lee, J. M., Moon, H. E., Kim, B.-N., Kim, J., & Paek, S. H. (2016). A short review on the current understanding of autism spectrum disorder. *Experimental Neurobiology*, *25*(1), 2–13. https://www.en-journal.org/journal/view.html?doi=10.5607/en.2016.25.1.1

Samson, A. C., Wells, W. M., Phillips, J. M., Hardan, A. Y., & Gross, J. J. (2015). Emotion regulation in autism spectrum disorder: Evidence from parent interviews and

children's daily diaries. *Journal of Child Psychology and Psychiatry*, *56*(8), 903–913. https://doi.org/10.1111/jcpp.12370

Samson, A. C., Wells, W. M., Phillips, J. M., Hardan, A. Y., & Gross, J. J. (2015). Emotion regulation in autism spectrum disorder: Evidence from parent interviews and children's daily diaries. *Journal of Child Psychology and Psychiatry*, *56*(8), 903–913. https://doi.org/10.1111/jcpp.12370

Spielman, V. (2020, January). *The interplay of regulation, relationships and sensory processing: Impact on function and participation*. Sensoryintegrationeducation.com; researchgate.net. https://www.researchgate.net

Van der Wurff, I., Meijs, C., Hurks, P., Resch, C., & de Groot, R. (2021). The influence of sensory processing tools on attention and arithmetic performance in Dutch primary school children. *Journal of Experimental Child Psychology*, *209*, 105143. https://doi.org/10.1016/j.jecp.2021.105143

Wild, G., & Steeley, S. L. (2018). A model for classroom-based intervention for children with sensory processing differences. *International Journal of Special Education*, *33*(3), 745–765.

Wilkinson, L. A. (2010). Facilitating the identification of autism spectrum disorders in

school-age children. *Remedial and Special Education*, *31*(5), 350–357. http://ras.sagepub.com. https://doi.org/10.1177/0741932509338372

Yusop, S. Z., & Mohd Yasssin, M. H. (2020). Sensory garden approach to increase autism students' learning focus in primary schools. *Journal of ICSAR*. Research Gate. https://doi.org/0123774282

Zang, Y. (2019). Impact of physical exercise on children with attention deficit hyperactivity disorders. *Medicine*, *98*(46), e17980. https://doi.org/10.1097/md.0000000000017980