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THE EFFECT STABILITY BALLS HAVE WITH IN-SEAT AND ON-TASK BEHAVIOR WITH STUDENTS IDENTIFIED WITH AUTISM AND ATTENTION DEFICIT HYPERACTIVITY DISORDER: A META-ANALYSIS

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ABSTRACT

Striving to provide students with disabilities the appropriate interventions in the classroom so that they can be successful learners continues to be a challenge for practitioners and educators. This meta-analysis aimed to collect all the current literature that studied the effects stability balls have with in-seat and on-task behavior with students identified with Autism and ADHD. Using nine single-subject design studies and computing eight models based on the moderators, the findings of the study could provide effective treatment interventions across these special populations. Of all the moderators analyzed, the frequency of sitting on a stability ball demonstrated to be the most statistically significant for In-Seat Behavior. While the moderators revealed changes from baseline to intervention sessions, there was no significant changes with any of the other moderators. Even though, frequency was the only moderator yielding a statistical significance, the meta-analysis still provided convincing evidence that the intervention of utilizing stability balls as a modification to the seat for students with Autism or ADHD is effective.

Keywords stability balls, Autism, ADHD, in-seat behavior, on-task behavior

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Dedication

I dedicate this dissertation to my family, my friends, and my co-workers as without each of you, I would have not reached my academic goals. My cousins Nichole Trump and Jennifer Baukol, I thank you both for your wisdom, guidance and support throughout this process. Likewise, I am thankful for my co-workers, Jodi, Scott, Jeff and Jamie as I leaned on them for support, reached out to them for assistance with assignments, solicited assistance with statistics and pleaded with them to read my rough drafts.

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CHAPTER ONE: INTRODUCTION

Introduction

In a typical school day, students sit in hard chairs for approximately 5 hours (Sadr et al., 2017). They sit at their desk, with little movement from the seat, and listen to the teacher, take notes, and complete their daily work. Considering that public schools are open for one hundred eighty days of instruction per academic year according to the Department of Education (2009), maintaining focus and staying engaged remains a challenge for all students as they struggle to find comfort, pay attention, and complete their work. Providing typical equipment for a child with hyperactivity, delayed language and social skills, sensory processing deficits, repetitive movements, and difficulty paying attention creates an unhealthy environment.

It is estimated that 15% of children in the United States have a disability (Lipkin & Okamoto, 2015). Students diagnosed with autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) are some of the 7.2 million that were covered by the IDEA in the school year 2018-2019. As the number of children diagnosed with ASD and ADHD continue to rise, public schools must develop and implement strategies to keep the children in the general education classroom and on the right pathway for success. The Individual with Disabilities Education Act (IDEA) is a federal law that requires children with disabilities to receive a free appropriate public education (FAPE) that is individualized to meet their specific needs (IDEA, 2004). Implementing the requirements of IDEA, schools are challenged everyday with providing interventions to accommodate the needs of students with disabilities.

According to Maenner et al. (2018) in 2018, one in 44 children aged 8 years old is estimated to have Autism. Autism is considered a lifelong neurological and developmental disorder which affects the person's ability to communicate and interact with others. Children with ASD demonstrate difficulty with engagement with peers and with tasks, have difficulty sitting still, and display inappropriate behaviors that can interfere with the learning environment (Bagatell et al., 2010; Brennan & Crosland, 2021; Sadr et al., 2015; Schilling & Schwartz, 2004). Greenspan and Wieder (1997) conducted an extensive chart review of 200 children diagnosed with ASD and concluded that 95% demonstrated a deficit in sensory modulations (Greenspan & Wieder, 1997; Schilling & Schwartz, 2004). The authors suggested these children tend to engage in repetitive behaviors and engagement in perseveration to normalize their sensory system (Greenspan & Wieder, 1997).

Furthermore, ADHD is the most frequently diagnosed neurological disorder in children (Kauffman, 2001, as cited Schilling et al., 2003). The estimated prevalence of US children diagnosed with ADHD was 10.2% in 2016, signifying a significant increase from 5.7 % in 1997-1998 (Xu et al., 2018). Demonstrating a persistent pattern of inattention and hyperactivity that interfere with function are the fundamental criteria for ADHD (Diagnostic and Statistical Manual of Mental Disorders (5th ed; DSM-5; American Psychiatric Association, 2013). Children with ADHD display behaviors that interfere with the classroom instruction and quality of life. Difficulty sitting still and maintaining focus, inability to wait their turn, interrupting others, and talks excessively are symptoms that can be displayed by children with ADHD; however,

exhibiting these unwanted behaviors in the classroom is unacceptable and disruptive (Boston, 2017; Fedewa & Erwin, 2011; Schilling et al., 2003; Taipalus et al., 2016).

Recalling that children are required to sit for approximately 5 hours at their desks in school, many educators and other professionals look for ways to engage students with disabilities and reduce their unwanted behaviors that are disruptive in the classroom.

Sensory processing deficits and integration has been categorized as a main characteristic of ASD which could impact their daily engagement (Schaaf et al., 2012). Likewise, Mulligan (2001) suggested that children with ADHD lack sensory modulation which could account for their lack of attention. Because of the symptoms and prevalence of ASD and ADHD, schools and other professionals must intervene with adequate and appropriate interventions to lessen the symptoms and promote a healthy environment to learn. Modification of the environment to allow for sensory input is something that is rarely discussed in a Functional Behavior Assessment (FBA), which is a common intervention being utilized in school systems today. FBAs is defined as a pre-intervention conducted to develop a hypothesis about the environment that trigger or maintain problem behavior (Anderson et al., 2015). Schilling et al. (2004) noted that most FBAs often ignore the sensory issues that may trigger the behavior as they focus on the "obtain" and "avoid". Likewise, Dunn et al., (2001) noted that some children with autism have limited success because the FBAs are not addressing the underlying sensory issues.

Occupational therapists are one of many healthcare professionals that work in school systems. Recognizing that students with sensory deficits have the inability to sit still or

adequately engage led occupational therapists to look for alternative interventions (Tunstall, 2009). Through a survey conducted with 292 occupational therapists, 99% of them indicated they have integrated sensory strategies into their plan of care with children with ASD (Tunstall, 2009).

Considering how rigid and inflexible a typical desk and chair can be, something as simple as switching out a chair could alleviate unwanted behaviors and improve in-seat and on-task behavior for students identified with ASD and ADHD. Therefore, several studies have been conducted utilizing alternative seating, such as stability balls to enhance sensory integration for children diagnosed with ASD and ADHD to improve their overall performance with on-task behavior (Brennan et al., 2021; Fedewa & Erwin, 2011; Sadr et al., 2015, 2017), academics (Taipalus et al., 2016; Tunstall, 2009), in-seat behaviors (Bagatell et al., 2010; Brennan et al., 2021; Fedewa & Erwin, 2011; Sadr et al., 2015, 2017; Schilling & Schwartz, 2004; Schilling et al., 2003; Stanic et al., 2022), and reduce depression and anxiety (Gaston et al., 2016). Given the number of children receiving services within the school systems under the regulations of the IDEA, there has been a demand to find effective, efficient, and cost-saving measures to meet the individual needs of students with disabilities. An area receiving some useful and influential feedback is the use of stability balls with students with ASD and ADHD to improve their on-task behavior (Brennan et al., 2021; Fedewa & Erwin, 2011; Sadr et al., 2015, 2017) and in-seat behavior (Bagatell et al., 2010; Brennan et al., 2021; Fedewa & Erwin, 2011; Krombach & Miltenberger, 2019; Sadr et al., 2015, 2017; Schilling & Schwartz, 2004; Schilling et al., 2003; Stanic et al., 2022).

From the literature, a few themes have emerged. Using alternative seating, such as a stability ball has exhibited positive improvements with in-seat or on-task behavior during instruction in the classroom with students identified with ASD (Krombach & Miltenberger, 2019; Sadr et al. 2017; Schilling & Schwartz, 2004) and with students identified with ADHD (Boston, 2017; Fedewa & Erwin, 2011; Schilling et al., 2003). A few studies yielded no significant changes with on-task behavior when they compared stability balls to other types of alternative seating (Lemar, 2020; Taipalus et al., 2016). The last major theme that emanated from the studies were the limitations. All the studies were single subject design revealing the need for an ample sample size and the inability to generalize to other populations due to the influence of heterogeneous characteristics of ASD and ADHD can have on the study's results, Additionally, the length or duration of the study and the lack of controlled environment created additional limitations that varied from study to study.

With the growing number of studies conducted on the use of stability balls with in-seat and on-task behavior for students with ASD and ADHD, a meta-analysis with all single-subject designs is not the ideal model. However, single subject designs can assist clinicians in establishing evidence-based practices and help provide treatment effectiveness across populations and different settings and procedures (White et al., 1989, as cited Pustejovsky & Ferron, 2017). Likewise, they can be conducted in various settings including the use of only a few participants (Pustejovsky & Ferron, 2017). Using the inclusion criteria for this dissertation and calculations from the data of single subject designs, this research demonstrates an effect across a wider range of populations and interventions from the individual studies through

statistical synthesis and demonstrate the effect stability balls have with in-seat and on-task behavior with students identified with ASD and ADHD.

A few systematic reviews have been conducted on the effect stability balls have with in-seat and on-task behaviors with students identified with ASD and ADHD. Gochenour et al. (2017) conducted a systematic review determining the effectiveness of alternative seating for students with attention difficulties. Eight articles were included in their review; however, a meta-analysis was not completed due to the variance in methodology. Additionally, Buchner et al. (2014), Lang et al. (2012), and Simmons (2019) conducted systematic reviews of sensory interventions to improve vestibular, tactile, and proprioceptive involvement with students diagnosed with ASD; however, none focused solely on the use of stability balls.

The conducted literature review of this research indicates that no meta-analysis has been completed specifically analyzing the effect a stability ball has with in-seat and on-task behavior with students identified with ASD and ADHD. As a result, this study conducted a meta-analysis that will focus on the effects stability balls have with in-seat and on-task behavior with students identified with ASD and ADHD. The following research questions directed the meta-analysis:

1. What effect does a stability ball have on a student's in-seat and on-task behavior identified with Autism?
2. What effect does a stability ball on a student's in-seat and on-task behavior identified with ADHD?
3. What variables significantly moderate the effects on in-seat or on-task behavior?

CHAPTER TWO: REVIEW OF THE LITERATURE

Chapter 2: Literature Review

Introduction

Following the requirements of IDEA, schools are challenged everyday with providing interventions to accommodate the needs of students with disabilities in the classroom. Students with Autism demonstrate difficulty with engagement with peers and with tasks, have difficulty sitting still, and display inappropriate behaviors that can interfere with the learning environment (Bagatell et al., 2010; Brennan & Crosland, 2021; Sadr et al., 2015; Schilling & Schwartz, 2004). Likewise, students with ADHD exhibit difficulty sitting still and maintaining focus, inability to wait their turn, interrupts others, and talks excessively (Boston, 2017; Fedewa & Erwin, 2011; Schilling et al., 2003; Taipalus et al., 2016). The literature suggests a lack of sensory integration as one of the main characteristics that impact the activities of daily living of students identified with Autism and ADHD (Schaaf et al., 2012). The upcoming literature is intended to provide a comprehensive summary on how modification of the classroom seating by using a stability ball can impact in-seat and on-task behavior of students identified with Autism and ADHD.

In-Seat Behavior Defined

In-seat behavior can be defined as any portion of the child's buttock in contact with the seat portion of the chair and the four legs of the chair in contact with the floor (Bagatell et al., 2010; Krombach & Miltenberger, 2019; Sadr et al., 2015, 2017; Schilling et al., 2003; Schilling

& Schwartz, 2004). In-seat behavior also applies for intervention phases using a stability ball defined any portion of the participant's buttocks in contact with the ball and the ball in contact with the floor, with a minimum of one foot in contact with the floor (Bagatell et al., 2010; Brennan & Crosland, 2021; Krombach & Miltenberger, 2019; Sadr et al., 2015, 2017, Schilling et al., 2003; Schilling & Schwartz, 2004; Taiplaus et al., 2016). Furthermore, Stanic et al. (2022) added to their definition of in-seat behavior as proper behavior when the behavior did not hinder the students writing and solving tasks. Equally important, engagement was intertwined with in-seat behavior and defined as oriented towards appropriate classroom activity, interacting with the teacher, responding to the speaker or peers, singing songs, and using appropriate hand movements (Bagatell et al., 2010; Krombach & Miltenberger, 2019; Schilling & Schwartz, 2004; Taipalus et al., 2016).

On-Task Behavior Defined

The definition of on task-behavior has varied throughout the literature. According to Brennan and Crosland (2021) and Sadr et al. (2015, 2017), on-task behavior is the orientation towards appropriate classroom activity, oriented to the teacher or speaker, or interacting with the materials. Goh et al. (2016) described on-task behavior as when the student is attentive to the teacher, actively engaged in an appropriate task, and follows classroom rules. Fedewa et al. (2015) defined it further by adding in group work with peers, independent seatwork, or interaction with the teacher by listening to instructions, talking to the teacher, or answering questions.

Off-task Behavior Defined

Due to off-task behavior, several hours of instruction time in the classroom are lost. Off-task behavior can be defined as the child looking elsewhere and not directing their eye gaze at the teacher (or classroom assistant), the instructional activity, or toward appropriate instructional materials (Godwin et al., 2013). Fedewa and Erwin (2011) observed and defined off-task behaviors in their study as students talking to a peer, gazing, or sleeping. Additionally, off-task behavior can be described as active or passive. Hoyer (2007) described active off-task behavior as disturbing the teacher and affecting the other students in the classroom. In contrast, passive off-task behavior is portrayed when the student is cognitively disengaged without effecting their surroundings.

Effects of Off-Task Behaviors

It has been shown that student inattentiveness (i.e., engagement in off-task behavior during instructional time) is the most significant factor that accounts for the loss of instructional time (Karweit & Slavin, 1981). Loss of instructional time in the classroom can significantly impact the academic success of the students and their peers. The U.S. Department of Education (2004) reported that the number one request for assistance in the classroom from a teacher was related to behaviors. Teachers spend a portion of their time engaging in and trying to correct off-task behaviors; therefore, instructional time is lost (Hollingshead, 2016). Likewise, students displaying disruptive behavior such as speaking without permission, getting out of their seats, making unwanted physical contact, or noncompliance with teacher direction will negatively impact their learning (Guardino & Fullerton, (2010).

Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with social communication and interaction impairments and demonstrates restricted, repetitive patterns of behavior, interests, or activities. The symptoms are present from early childhood and limit or impair functional mobility and interaction in everyday life. Some of the heterogeneous characteristics are difficulty with engagement, attention, and appropriate behavior in the classroom (5th ed.; DSM-5; American Psychiatric Association, 2013). Students with ASD demonstrate the inability to participate, at times, in the educational mainstream classroom (Schilling et al., 2004). Likewise, many students diagnosed with ASD display problems with sensory integration, hyperactivity, and anxiety (Tarr, 2018).

Autism was first described in 1943 in a series of case studies by Leo Kanner, a psychiatrist, entitled "Autistic Disturbances of Affective Contact" (Chaplin et al., 2020). The case studies noted the developmental delay and intellectual disability of the children, along with different methods of communication and tendencies to perform repetitive activities. As researchers and psychiatrists continued to explore these atypical symptoms, the Diagnostic and Statistical Manual of Mental Disorders saw in the 1980s infantile autism added under the generic term persuasive development disorder in the third edition (DSM-III) and added the umbrella term of ASD in the fourth edition (DSM-IV) lumping in Asperger syndrome, childhood autism, atypical autism, childhood disintegrative disorder, and Rett's syndrome.

Through clinical observations and concluded research studies, the definition, criteria, factors, and symptoms of autism underwent several changes. Due to the uncharacteristic

symptoms displayed by children and adults diagnosed with ASD, symptoms were clustered into two categories. One category summarizes difficulties associated with communication and social interaction mainly since they are indistinctly related. The other category comprises restricted and repetitive behaviors, stereotyped speech, and sensory impairments (Chaplin et al., 2020).

Due to the display of different levels of severity and symptoms of the disease, which is the logic for the term "on the spectrum" (Liu et al., 2017, p. 4507), as to suggest a wide range of symptoms, levels of severity were created. According to the American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed; DSM-5), there are three levels for autism spectrum disorder. The levels range from requiring support, requiring substantial support, and requiring very substantial support in social communication and restricted, repetitive behaviors. Children presenting within the first level often are more functional with their communication skills; however, they can demonstrate an inability to maintain conversations and unsuccessful attempts to make friends. Level two requires substantial support as children can demonstrate considerable verbal and non-verbal communication skills; thus, limiting social interactions and repetitive behaviors are more frequent, causing interference to function in everyday life. The last level of severity requires very substantial support. Because they are more profound or severe, the children can demonstrate significant deficits in verbal and nonverbal communication, little to no social interactions, and can demonstrate substantial repetitive behaviors that interfere with all functions (Diagnostic and Statistical Manual of Mental Disorders (5th ed; DSM-5; American Psychiatric Association, 2013).

Documented as a heterogeneous characteristic, ASD has predominantly been labeled idiopathic, meaning having no origin. However, many studies have been conducted by mapping genetics with more than 500 genes and 44 genomic loci associated with ASD (Liu et al., 2017). Although studies have demonstrated a connection between genetics and ASD, no more than 2% of the etiology has been diagnosed from genetics for ASD (Liu et al., 2017; Won et al., 2013). Unfortunately, about 85% of the present cases of ASD are identified as having an unknown cause (Casanova et al., 2020).

Considering all the different characteristics and the mechanisms of ASD, the lack of sensory integration seems to be one of the least studied characteristics; however, Sadr et al. (2017) and Schaaf et al. (2012) noted sensory impairment as one of the main attributes of ASD. Exhibiting a sensory integration impairment will have adverse effects on everyday activities, engagement, and attention span.

Greenspan and Wieder (1997) found that children with sensory modulation difficulties often engaged more in perseveration and stereotypical movements to regulate their sensory deficits. Additionally, the research has found that children with ASD respond differently to sensory stimuli than their typical peers (Bagetell et al., 2010; Dunn et al., 2001). They exhibit deficits in tactile processing and sensory seeking (Bagetell et al., 2010) and the inability to engage in play and sustain attention (Greenspan & Wieder, 1997).

The number of students diagnosed with ASD has drastically rose over the years. In 2004, the Centers for Disease Control reported that the prevalence of ASD was 1 per 250 children (Bertrand et al., 2001). Continually to increase, in 2018, one in 44 children that were eight years

old was estimated to have ASD (Maenner et al., 2018). Zablotsky et al. (2019) noted that the percentage of children aged 3–17 years diagnosed with a developmental disability increased from 16.2% in 2009–2011 to 17.8% in 2015–2017. Advances in diagnostic technology, having a greater understanding of ASD and with more skilled medical professionals sharpening their identification skills seem to be driving the increase in numbers.

Attention Deficit Hyperactivity Disorder

According to the American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed; DSM-5), Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by impaired inattention, disorganization, and hyperactivity. ADHA commonly occurs in children with a prevalence of 3.4% to 7.2 %, affecting males more than females (Kessi et al., 2022) and affecting 8%-12%of children worldwide (Luo et al., 2019). In the United States of America, Danielson et al. (2018) reported in 2016 that an estimated 6.1 million children 2-17 years of age (9.4%) received an ADHD diagnosis from a doctor or other healthcare provider based on parent reports. Likewise, Zablotsky et al. (2019) noted an increase from 8.5% to 9.5% in the prevalence of ADHD from 2009-2011 to 2015-2017.

This heterogeneous disorder can display a diverse variety of symptoms, such as difficulty maintaining attention, poor self-regulatory behavior, problems with social interaction, and hyperactivity-impulsivity that interfere with the activities of daily living (Fedewa & Erwin, 2011; Kessi et al., 2022; Luo et al., 2019; Stanic et al., 2022). Hyperactivity involves fidgeting,

the inability to wait, and intruding into other's activities (5th ed.; DSM-5; American Psychiatric Association, 2013). Children with ADHD demonstrate difficulty staying on task and completing their academic work, which affects engagement in the classroom. The inability to sustain attention and difficulty following rules also interfere with the student's success in the classroom (Taipalus et al., 2016). Displaying these types of symptoms will disrupt the learning process for a child diagnosed with ADHD, can result in the child falling back academically (Barry et al., 2002), and have profound effects on the well-being and social interactions of the children (Kessi et al., 2022).

The etiology of ADHD remains unclear; however, some genetics and environmental risk factors have been linked to the cause of ADHD (Faraone et al., 2015). To diagnose ADHD, set criteria are utilized along with clinical interviewing and observations by a licensed clinician (American Psychiatric Association, 2013). Additionally, imaging of the brain has started to demonstrate another way to identify the disease. Sun et al. (2018) conducted a study utilizing magnetic resonance imaging (MRI) on children newly diagnosed and never treated for ADHD. A control group of healthy subjects was matched for age and sex. The results showed preliminary evidence that cerebral morphometric alterations could be separated between patients to differentiate from healthy brain images. Like other disorders, ADHD has three levels of severity mild, moderate, and severe. The levels are categorized on the number of symptoms and how they impair the individual's functional mobility (Diagnostic and Statistical Manual of Mental Disorders (5th ed; DSM-5; American Psychiatric Association, 2013).

Standard Seating Defined

According to Stanic et al. (2022), typical standard seating in the classroom involves a wooden or metal frame with a backrest and no armrests. Likewise, Udewa and Deitz (2011) defined the chair as a standard classroom chair provided by the school, with each chair having a hard plastic seat and a back with metal legs. Consequently, the seating options offered in most classrooms will provide additional struggles for students with sensory impairments secondary to the rigidness of a wooden or metal chair. These characteristics of a traditional chair in the classroom can create additional difficulties for students that demonstrate an inability to focus and sit still. It is suggested that stability balls can provide sensory input thus helping to reduce the motor movements that can be disruptive in the learning environment. Schilling and Schwartz (2004) demonstrated promising results pre-schools students identified with ASD for in-seat behavior while sitting on a stability ball. Furthermore, Sadr et al. (2017) conducted a study with students in Iran that exhibited improvement for on-task (53%) and in-seat (87%) behavior while sitting on a stability ball compared to a traditional chair.

Stability Balls Defined

The stability ball has been called stability ball chair, alternative seating, dynamic seating, a Swiss ball, a therapy ball, or a therapy ball chair. Alternative or dynamic seating is any device or alteration made to a traditional classroom seat that allows for some movement when seated (Lange, 2000, as cited in Hulac et al., 2020). A stability ball is a large, inflatable ball made of thick rubber, usually around 45-75 centimeters in diameter (Hulac et al., 2020). There are a

range of stability balls, where some stability balls can include legs. The legs are a means to stop the ball from rolling away but provide no stabilization when a person is seated on the stability ball. Students should be correctly fitted for a stability ball, where their feet should be flat on the floor with their hips and knees flexed to 90 degrees (Sadr et al., 2015). Stability balls can provide much needed stabilized movement for children who are showing difficulty focusing inside the classroom.

History of the Stability Ball

In the 1960s, physical therapists in Switzerland used air-filled rubber balls to improve the balance and coordination of children with neurological disorders such as cerebral palsy (Taipalus et al., 2016). Continuing in1988, European schools were using therapy balls and other alternative seating in the classroom to promote healthy backs for students (Illi, 1994, as cited in Schilling & Schwartz, 2004). In 1991, Switzerland researchers started using stability balls to examine the effects on children's back health from prolonged sitting. They found that children undertake extreme postures due to the rigid seating and lack of movement from the traditional classroom furniture (Schilling & Schwartz, 2004). Additionally, a program called "Moving students are better learners" was developed in Switzerland (McBride, 1993, as cited in Schilling & Schwartz, 2004). The program involved students sitting on therapy balls. Results of the program exhibited less boredom, decreased noise at their desk, improved focus, and children with hyperactive characteristics could jiggle without moving the furniture.

Using anecdotal accounts, researchers and healthcare professionals began to shift focus to using therapy or stability balls for sensory impairments for children when in the classroom. Since the early 1980s, occupational therapists have incorporated sensory integration strategies within their plan of care for children with ASD. Into the 1990s, occupational therapists continued using sensory integration interventions; however, the strategies focused on reducing unwanted behaviors. As publications on ASD and sensory integration impairments continued throughout the 2000s, Case-Smith & Abersman (2008) reviewed 49 articles that met their inclusion criteria and concluded with "strong positive evidence" the need for further studies to address environmental modifications and sensory integration outcomes. Umeda and Deitz (2011) were one of the first studies to examine the effects of alternative seating on children diagnosed with ASD. The authors conducted a study for two kindergarten students' in-seat and on-task behavior through a single subject A-B-A-B-C interrupted time series design using a traditional chair and a therapy cushion. Even though the outcome yielded no significant change, the need for future research on environmental modifications was evident, especially to help with sensory integration impairments. Also, Schilling et al. (2003) were one of the first research studies to modify the school environment using stability balls in the general education classroom. Using a single subject, A-B-A-B interrupted time series design, three students diagnosed with ADHD used a chair or therapy ball to sit on during language arts class. The results yielded improvements in in-seat behavior and legible word production when seated on the therapy ball. As the number of students diagnosed with ASD and ADHD continued to increase, and evidence-based studies yielded positive and mixed outcomes, the research involving stability balls to

address sensory integration difficulties was gaining ground (Fedewa & Erwin, 2011; Schilling et al., 2003).

Effects of Stability Balls

Effects of Stability Balls in the General Education Classroom

Although this meta-analysis focuses on stability balls and their impact on students with ASD and ADHD, a few studies have been completed using stability balls class wide to see if they improve on-task and in-seat behavior. Mercer (2019) conducted a study using an A-B- C design with seventy-seven students in the fourth grade to measure on-task behavior using stability balls compared to traditional classroom chairs. The author concluded significant improvement in on-task behavior in both treatment groups confirming students were more on task when on stability balls. However, Gaston et al. (2016) conducted an experimental study over five months utilizing forty-one second-grade students who were evenly matched for age and sex. Placing the students into an experimental and a control group to examine if sitting on a stability ball improves attention span, reduces hyperactivity, and reduces depression. Although hyperactivity from baseline showed no significant change in the eight-week or five-month follow-up, the use of stability balls for both periods revealed lower inattention scores for the experimental group compared to the control group. Furthermore, Olson et al. (2019) used an A-B-A-B reversal design in a second-grade classroom through direct observation to study the effects of student behavior sitting on stability balls. The results demonstrated that stability balls and traditional chairs showed no significant differences in student behavior but did demonstrate an improvement in writing fluency. Lastly, Hulac et al. (2019) completed a study that focused

on stability balls and on-task behavior with twenty-four fourth-grade students sitting on a traditional chair, stability balls, and a choice during language arts as a class wide intervention. Using the Behavioral Observation System for Students (BOSS), the authors concluded that the students were on-task less on the stability balls than on traditional chairs. However, they noted that stability balls might be appropriate for students with sensory integration impairments.

Effects of Stability Balls on Autism

Modifying the environment, whether in the classroom or at home, for a student with ASD or ADHD can help increase a student's engagement in-seat and on-task behavior (Sadr et al., 2017). The sensory input felt by the students, such as rocking or bouncing, could satisfy and reduce their stereotypical behaviors associated with ASD (Sadr et al., 2017). Occupational therapists have played a vital role in using stability balls to help with sensory integration for students with ASD and ADHD.

A student with ASD can display various characteristics, such as difficulty with engagement, decreased attention, and inappropriate behavior in the classroom. These symptoms and behaviors make it very challenging for the student to participate in the school setting. Educators have sought ways to reduce unwanted classroom behaviors that disrupt students' learning environments. The use of stability balls to improve in-seat and on-task behavior with students with ASD and ADHD has increased over the last 30 years; however, it is still in the preliminary stage.

Schilling, and Schwartz (2004) studied four male preschool students diagnosed with ASD. Through a single-subject design of A-B-A-B for three students and B-A-B for one student, collected data using momentary real-time sampling in the student's natural environment, the authors concluded that three of the four demonstrated significant positive changes in in-seat behavior and engagement when sitting on therapy balls in the classroom.

Similar to their previous research for alternative seating, Sadr et al. (2017) observed fifteen students with ASD following the same three phases, sitting on a traditional chair, sitting on an air cushion, and sitting on a stability ball. Over eight weeks, they studied the effects of in-seat and on-task behaviors in the classroom. The results demonstrated that thirteen out of fifteen students exhibited improvements with in-seat behaviors (86.7%), and eight out of fifteen demonstrated improvements with on-task behaviors (53.3%). Likewise, Krombach and Miltenberger (2019) concluded from their single-subject design of four students with ASD how beneficial sitting on a stability ball can be to increase in-seat and attending behaviors for one-on-one instructional sessions in the home.

Additionally, Bagatell et al. (2010) conducted an A-B-C single-subject design to examine the effectiveness of therapy ball chairs on the in-seat behavior of six boys with autism in the classroom. Employing a 16-minute sampling a day over four weeks and during circle time, the first phase allowed the children to sit on a traditional chair (5 days), phase two comprised sitting on the stability ball (9 days), and the third phase allowed the students the choice (5 days). Unlike Schilling and Schwartz (2004), that demonstrated improvements for their three students, these results were more mixed for Bagatell et al. (2010). The authors deduced that a student with ASD

that is vestibular-proprioceptive-seeking did demonstrate improvements in in-seat behavior; however, some children in the study demonstrated a decrease in engagement. Observation of the children with decreased engagement on the stability balls yielded poor posture, such as slumping, leaning forward, and using their hands to hold up their heads. The authors concluded that this difficulty in maintaining proper posture on stability challenged the students and made it difficult to stay engaged.

In somewhat the same way, Sadr et al. (2015) completed a study aiming to examine the impacts of sitting on a traditional chair, an air cushion, and a therapy ball chair with four students diagnosed with autism. This single-subject design using momentary time sampling for 12 sessions lasting 10 minutes each, recorded the student's behaviors for in-seat and on-task behavior. Once again, the results were mixed with a stability ball chair. Only two of the four students demonstrated improved in-seat behavior when on the therapy ball chair: however, all four demonstrated improvements with in-seat times and on-task behaviors on the air cushion. Again, posture and balance deficits could account for the improved in-seat times on the air cushion as it requires less musculoskeletal involvement compared to the stability ball chair. Lastly, the authors concluded that using some vestibular and proprioceptive stimuli could help alter arousal and attention for students with ASD.

Equally important, Brennan and Crosland (2021) yielded mixed results from their experimental design with alternating treatments across participants in two conditions: standard chair and stability ball chair. The data generated some improvements in on-task behavior with two of the three participants with autism in the clinic setting when sitting on the stability ball.

One of the three exhibited some improvement with in-seat behavior. Discussing the mixed results, the authors agreed that a longer duration to gather more data points differentiation may have occurred. Additionally, the authors suggested the stability can be used as a precursor to help develop positive behaviors.

Regardless of the outcomes, there were various limitations for the studies. Numerous studies reported a few themes with limitations such as small sample size which limits the generalizability to other students (Bagatell et al., 2010; Krombach & Miltenberger, 2019; Sadr et al., 2015, 2017; Schilling & Schwartz, 2004) and the length of time to truly examine the effectiveness when using stability balls (Bagatell et al., 2010; Brennan & Crosland, 2021; Sadr et al., 2015, 2017; Schilling & Schwartz, 2004). Additionally, the setting created a limitation for Krombach and Miltenberger (2019) since the study was performed in the home setting and not in the natural environment of the classroom. Furthermore, the selection of the students emerged as a limitation and the need for stronger design to involve more diverse population based on sensory processing impairments and not specifically the diagnosis (Bagatell et al., 2010; Schilling & Schwartz, 2004)

Effects of Stability Balls on ADHD

The amount of time students is required and expected to sit and be engaged in the classroom continues to increase throughout the years, creating more challenges for educators (Mulrine et al., 2008). According to Fedewa and Erwin (2011), Kessi et al. (2022), Luo et al. (2019), and Stanic et al. (2022), students with ADHD can display difficulty maintaining attention, poor self-regulatory behavior, problems with social interaction, and hyperactivity-

impulsivity that interfere with the activities and instruction in the classroom. Considering the time students sit at a standard desk and chair, the need arises for more dynamic, flexible, and accommodating school furniture.

Using pediatric therapists, Schilling et al. (2003) conducted a single-subject A-B-A-B interrupted time design to observe three students diagnosed with ADHD during language arts class. The students were observed on traditional chairs in phase A, and stability balls for phase B to investigate the effects stability balls would have on in-seat behavior and legible word productivity. Once again, through momentary time sampling and randomly selected students from a list of six potential patterns, the results yielded an increase in in-seat behavior for all three students with an interrater agreement ranged from 95% to 100%. Furthermore, the results concluded that legible word productivity increased when on the stability balls. The authors noted that the student's state of arousal could be due to the sensory modulation while seated on the stability ball, which reduced the student's hyperactivity and difficulty maintaining attention. Likewise, Fedewa and Erwin (2011) utilized the Attention-Deficit Hyperactivity Disorder Test (ADHDT) on eight fourth and fifth-grade students diagnosed with ADHD to measure hyperactivity, impulsivity, and inattentiveness. To target behaviors, the study used a composite score of >120 from the ADHDT test (classified as high or very high for ADHD) to select the students. They were observed at 30-second intervals, three days a week for 30 minutes over two weeks sitting on the stability balls. The findings revealed increased attention, increased time to the task, increased in-seat behaviors, and a decrease in hyperactivity. Although the results are promising, the limitations for both of these studies continue to note small sample size to affect

the generalization to other populations and the length of study may not provide the long-term effects.

In spite of these studies reporting favorable results, three studies concluded no significant change in in-seat or on-task behavior when seated on a stability ball. Stanic et al. (2022) reported that the eleven students diagnosed with ADHD demonstrated the highest level of psychological arousal when on the stability balls according to the electrodermal activity monitored through the seven inertial measurement units placed along their bodies. However, their study concluded that the active seat, made of a metal frame, flexible seat and back, armrest, and padded footrests, produced the most significant outcomes for in-seat behavior, secondary to its provision of the most movement. Likewise, Taipalus et al. (2016) aimed to investigate the effects of therapy balls with on-task behavior and academic performance and found no significant effect using an alternating design. Observing four students from third and fourth grade diagnosed with ADHD, the students sat on a standard chair for five days, alternating between the standard chair for five days and the therapy ball for five days and five days, sitting on the device of their choice. Although a few students did demonstrate a slight improvement in engagement, the authors concluded that no effect was found using the stability balls for on-task behavior or academic performance. The lack of positive outcomes from both of these studies generated a few limitations. Taipalus et al. (2016) reported a significant limitation in the assessment of effectiveness for on-task behavior secondary to the study used independent time instead of instructional time. The type of assignments or tasks were not consistent across the participants. Likewise, Stanic et al. (2022) reported limitation in the selection of their

measurement tool and age of the participants. Students were observed touching their face which could have affected data for arousal. Further studies suggested use of different methods to measure arousal such as heart rate, regulated by the autonomic nervous system. Lastly, the lack of sample size was not representative of a diverse age.

Furthermore, Lemar (2020) conducted her dissertation using a multiple baseline intervention study to examine if stability balls increased on-task behavior in the classroom. Two participants in a rural elementary school in Maine diagnosed with ADHD, over six weeks were observed sitting on traditional chair or stability ball during writing in the Special Education classroom. At the conclusion of the study, the author concluded no significant changes noted with on-task behavior. The author noted that the lack of control of the environment and perceived acceptability by the teacher could have impacted participants behavior; thus, yielding no changes.

Purpose

This meta-analysis aims to provide a quantitative review of the effect stability balls have on in-seat and on-task behavior with students with ASD and ADHD. Due to the symptoms associated with both diagnoses, utilizing alternative seating that can provide sensory input is gaining promise with evidence-based research. Sadr et al. (2017) noted that applying therapy balls as an alternative chair may provide chances for students with sensory integration deficiency to settle better on chairs in class and engage in the class task. Several studies demonstrated significant outcomes for students with ASD and ADHD by improving their in-seat or on-task behavior.

Considering the amount of time that students are required to sit and be engaged in the classroom continues to increase throughout the years, creating more challenges for educators (Mulrine et al., 2008). According to the Pennsylvania Department of Education (2009), all public schools are to be open for one hundred eighty days of instruction for students for an academic year. Given the time students sit in the classroom at a standard desk and chair, the need arises for more dynamic, flexible, and accommodating school furniture. The focus of this meta-analysis is to examine the strength of the evidence of the effectiveness of stability balls with in-seat and on-task behavior with students with ASD and ADHD.

Research Questions

This meta-analysis aims to provide a quantitative review of the effect stability balls have with in-seat and on-task behavior with students with ASD and ADHD. The following questions directed the meta-analysis:

4. What is the effect of a stability ball on a student's in-seat and on-task behavior of a student identified with ASD?
5. What is the effect of a stability ball on a student's in-seat and on-task behavior of a student identified with ADHD?
6. What variables significantly moderate the effects on in-seat or on-task behavior?

Need for the Study

Given the number of students receiving services under the IDEA, the symptoms impacting academic success and the prevalence of ASD and ADHD, schools and other professionals must intervene with adequate and appropriate interventions to lessen the symptoms, meet the needs of the individual students, and promote a healthy environment to learn. The purpose of the meta-analysis is to provide a quantitative review of the current research on the effect stability balls have with in-seat and on-task behavior with students with ASD and ADHD. The primary objective will be to report the effect size using aggregate data from single-subject research study designs and analyze the impact stability balls have as an intervention with in-seat and on-task behavior. This study is relevant due to the increased prevalence of ASD (Maenner et al., 2018) and ADHD (Zaplotsky et al., 2019). It is important to find ways to modify the environment in the general education classroom to provide each student with the tools and resources that they need to be successful. Utilizing stability balls as an alternative seating in the classroom allows students with ASD and ADHD a strategy to improve their sensory impairments and possibly lead them to further success in the classroom by improving their engagement, in-seat, and on-task behavior. This research will contribute to the millions of students dealing with these heterogenous diseases that are impacting their academic performance and quality of life daily (Danielson et al., 2018; Zablotsky et al., 2019).

Summary

Based on the supporting evidence of the current literature, one can infer that using stability balls could improve the in-seat and on-task behavior of students diagnosed with ASD

and ADHD. However, the current literature using stability balls in place of the traditional rigid chair for students diagnosed with Autism and ADHD has concluded some mixed results. For ASD, three out of the six conducted research studies yielded positive outcomes for in-seat behavior for students with ASD (Krombach & Miltenberger, 2019; Sadr et al., 2017; Schilling & Schwartz, 2004). Three out of six conducted research studies concluded positive outcomes for on-task behaviors (Brennan & Crosland, 2021, Sadr et al., 2015). However, Sadar et al. (2015) and Bagatell et al. (2010) reported mixed results for in-seat behavior. The authors noted posture of one student and balance deficits of another student could have increased the difficulty using the stability balls; therefore, forcing the students to use different muscles to maintain balance on the stability balls. Likewise for ADHD, the conducted research studies were split down the middle. Three out of the five research studies yielded positive results for in-seat behavior when using a stability ball (Boston, 2017; Fedewa & Erwin, 2011; Schilling et al., 2003). However, Taipalus et al. (2016) and Lemar (2020) both concluded no effect when using a stability ball to improve in-seat behavior. Both authors suggested lack of controlled environment as a huge limitation and Taipalus et al. implied the different independent work of the participants could have altered the outcome for the participants sitting on the stability ball. Regardless of the diagnosis, the majority of the studies (90%) reported a limitations of small sample size. Additionally, seven out of eleven studies cited the length of the study as a limitation due to the inability to examine the effectiveness when using stability balls for long term.

Even with the limitations and no two individuals displaying the same symptoms or characteristics due to the heterogenous diseases, the use of stability balls in the classroom as an

intervention with students diagnosed with ASD and ADHD shows potential to help with sensory modulation. Continuing to research this problem, occupational therapists, educators, and other researchers need to continue using alternative seating like a stability ball to incorporate sensory-based interventions in their treatment plans to help students to counteract such symptoms and characteristics as sensory integration impairments, hyperactivity, anxiety, restricted and repetitive patterns of behavior, impaired inattention, and disorganization.

Using the existing research data and completing a meta-analysis will provide a more generalized estimation of the effect size and provide consistency of the current research involved with the use of stability balls and the effect it has on in-seat and on-task behavior with students identified with Autism and ADHD.

CHAPTER THREE: METHODOLOGY

Introduction

Taipalus et al. (2017) reported that physical therapists used stability balls to improve balance and maintain coordination in children with cerebral palsy. As the need to reduce stereotypical behaviors such as hyperactivity, anxiety, restricted and repetitive patterns of behavior, impaired inattention, and disorganization with specific intellectual disabilities, such as ASD and ADHD, continue to grow, researchers, clinicians, and educators have started to examine the use of stability balls to reduce stereotypic behaviors in students identified with ASD and ADHD. The current study conducted a meta-analysis to examine the effects of stability balls on in-seat and on-task behavior with students with ASD and ADHD. A meta-analysis will synthesize and summarize all the relevant research articles to answer the specific research questions using statistical data (Gogtay & Thatte, 2017). Completing a meta-analysis will provide a more generalized estimation of the effect size and provide consistency within the current research.

The current meta-analysis will examine the effects of stability balls with in-seat and on-task behavior with students identified with Autism and ADHD. Approval for the investigation was granted by the Slippery Rock University Institutional Review Board (IRB). To my knowledge, no meta-analysis has been completed specifically analyzing the effects of stability balls with in-seat and on-task behavior with students with ASD and ADHD.

As mentioned, Gochenour et al. (2017) conducted a systematic review to examine the effects of solely using stability balls to improve sensory impairments in students with ASD. Assessing peer-reviewed articles from 2003 to 2016, the researchers found six studies that examined alternative seating using stability balls to improve attention with students diagnosed with Autism. The results yielded improvements in student attention and in-seat behavior in four of the six studies; however, they did not complete a meta-analysis due to a lack of statistical data. Also, they felt that the methodology used by the individual studies varied significantly. Additionally, Buchner et al. (2014), Lang et al. (2012), and Simmons (2019) conducted systematic reviews of sensory interventions to improve vestibular, tactile, and proprioceptive involvement with students diagnosed with Autism. Bucher conducted their study focusing on the most used sensory interventions implemented by occupational therapists. Likewise, Lang et al. (2012) conducted their systematic review focused on sensory integration therapy; however, only three of the twenty-five studies used some form of alternative seating with students with Autism. The authors concluded that the systematic review yielded insufficient evidence to support using sensory integration therapy with students with Autism due to methodological limitations.

This meta-analysis aims to provide a quantitative review of the effects of stability balls on in-seat and on-task behavior with students with Autism and ADHD. The following questions directed the meta-analysis:

1. What is the effect of a stability ball on a student's in-seat and on-task behavior identified with Autism?

2. What is the effect of a stability ball on a student's in-seat and on-task behavior identified with ADHD?
3. What variables significantly moderate the effects on in-seat or on-task behavior?

The methodology for this meta-analysis will follow the reporting guidelines described by Preferred Reporting Items of Systematic Reviews and Meta-analyses 2020 (PRISMA) (Page et al., 2021). The PRISMA methodology guidelines include (1) Describing the rationale through a literature review, (2) Developing and stating the inclusion and exclusion criteria for the meta-analysis, (3) Identifying all the databases used to uncover the studies and the date each was searched, (4) Specify the screening methods used to assess the risk of bias in the included studies that they met the inclusion criteria, (5) Data extraction method used for coding and obtaining statistical data, (6) Calculating the effect size and variances of each study, and (7) Methods used to prepare data from each study for synthesis.

Inclusion Criteria

The current meta-analysis examined the effects of stability balls with in-seat and on-task behavior with students with Autism and ADHD. The current meta-analysis included research articles if they met all the following inclusionary criteria: (1) The research article was written in English. (2) The research article was written between 2001 and 2022. (3) The research article must have included stability balls as the independent variable. (4) The research article must have included in-seat or on-task behavior as the dependent variable. (5) The research article must have included students identified with Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADHD). (6) The research article cannot add additional behavior

assessment methods that may alter the student's vestibular or sensory modulation. (7) The research must have included the effects of stability balls with in-seat and on-task behavior with students with ASD or ADHD and expressed quantitatively and/or visually so that necessary data could be extracted, and effect sizes could be calculated (See Appendix A for Inclusionary Criteria Data Sheet).

Using all single-subject designs, the current meta-analysis aimed to determine the strength of the evidence that stability balls have with in-seat and on-task behavior for students identified with Autism and ADHD. Understanding that single-subject designs can provide limited support for populations may limit generalization and are not meant to be analyzed using aggregate scores, this researcher acknowledged the importance of including single-subject designs due to functional analysis. Hanley and Iwata (2003) defined functional analysis methodology as the focus on identifying variables that influence a behavior's occurrence. The authors reviewed studies conducting pre-treatment assessments and direct observations as measurement tools. They analyzed those behaviors under different conditions to demonstrate a relationship between an environment and behavior. Additionally, single-subject design studies are particularly appropriate in Special Education due to the heterogenous populations such as Autism and ADHD. Based on the findings of that study and the single-subject design studies selected that met the inclusionary criteria the current meta-analysis will include single-subject designs using statistical data to compute aggregate scores to determine the effects of stability balls on in-seat and on-task behavior with students identified with Autism and ADHD.

Search Sources and Search Terms

The current meta-analysis searched research articles from within multiple databases. The search started using PennWest California Louis L. Manderino Library and the EBSCO database. This database allowed this researcher to select multiple reliable databases housed in one common place. For additional search sources, this researcher utilized Google Scholar, PubMed, ProQuest and the reference lists of systematic and comprehensive reviews related to stability balls with students identified with Autism and ADHD.

Using the above databases, in the fall of 2022, this researcher conducted an extensive search on multiple occasions for articles that met the inclusion criteria for the current meta-analysis. The search was restricted to the years 2001 to 2022. From the inclusion criteria, the following search terms were used stability balls, therapy balls, swiss balls, therapy ball chair, stability ball chair, flexible seating, dynamic seating, alternative seating, Autism, autism spectrum disorder, ASD, attention deficit hyperactivity disorder, ADHD, in-seat behavior, on-task behavior, engagement, and classroom behavior. To increase the odds of finding relevant material that met the inclusion criteria, this researcher used Boolean text search with the "OR," "AND," and quotation marks to combine for all possible search outcomes. A Microsoft Excel spreadsheet documented a comprehensive list of combinations for each search in the electronic databases.

PennWest California Louis L. Manderino Library

This researcher used the search engine for the PennWest California Louis L. Manderino Library in November 2022 using the EBSCO database. This researcher searched databases MEDLINE, PsycINFO, PsychARTICLES, ERIC, Education Source, and Psychology & Behavioral Sciences using the library research guides. Limiting the searches to peer-reviewed articles, the specific timeframe from 2001 to 2022, and placing the keywords into the advanced search. The exhaustive search of the databases mentioned above yielded 356 articles. However, using the database searches and selecting them all together, the university search is set up to automatically remove duplicates between the selected databases. After removing the duplicates, 73 articles remained.

This research skimmed the abstracts of the articles for crucial inclusion criteria. Many articles reviewed failed to have the exact inclusionary criteria, thus limiting them from this meta-analysis. Some studies focused on sensory interventions but not on stability balls. Likewise, some studies focused on improving academic performance or specific behaviors. In contrast, this meta-analysis aimed to determine the impact of stability balls have on in-seat and on-task behavior for students with Autism and ADHD. Because they did not specifically address in-seat or on-task, the articles were excluded.

Google Scholar

In November 2022, this researcher used the Google Scholar search engine. Following the inclusionary criteria and using the exact search key terms from the previous searches, 65 articles

were found. Four articles were duplicates from the university library, leaving 61 articles for review. After skimming and reading through the abstracts of the remaining articles, no additional articles were not found to meet the inclusionary criteria.

PubMed

Using the same inclusionary criteria and search terms combinations, this researcher systematically searched the electronic database PubMed in November 2022 and found 77 articles. This researcher found five duplicate articles that were discovered in the previous searches in other databases. After removing the duplicates, reviewing the abstracts, and scanning the remaining articles, this researcher found no additional articles for this meta-analysis.

ProQuest

In the same way as the other searches, this researcher systematically searched the electronic database ProQuest using the same inclusionary criteria and search terms combinations, finding 19 articles. Reviewing for duplicates, this researcher discovered one of the dissertations in a previous search using the PennWest California Louis L. Manderino Library. After removing the duplicate and reviewing the abstracts, this researcher found one additional article. The second article is a master's thesis for the Master of Arts in Special Education.

Reference Page Search

Finally, this researcher reviewed the reference page of systematic and comprehensive reviews that studied sensory interventions and their effects on vestibular, tactile, and proprioceptive involvement with students diagnosed with ASD and a review determining the effectiveness of alternative seating for students with attention difficulties (Buchner et al., 2014;

Gochenour et al., 2017; Lang et al., 2012; Simmons, 2019). No additional articles were found using this search.

Completed Comprehensive Search

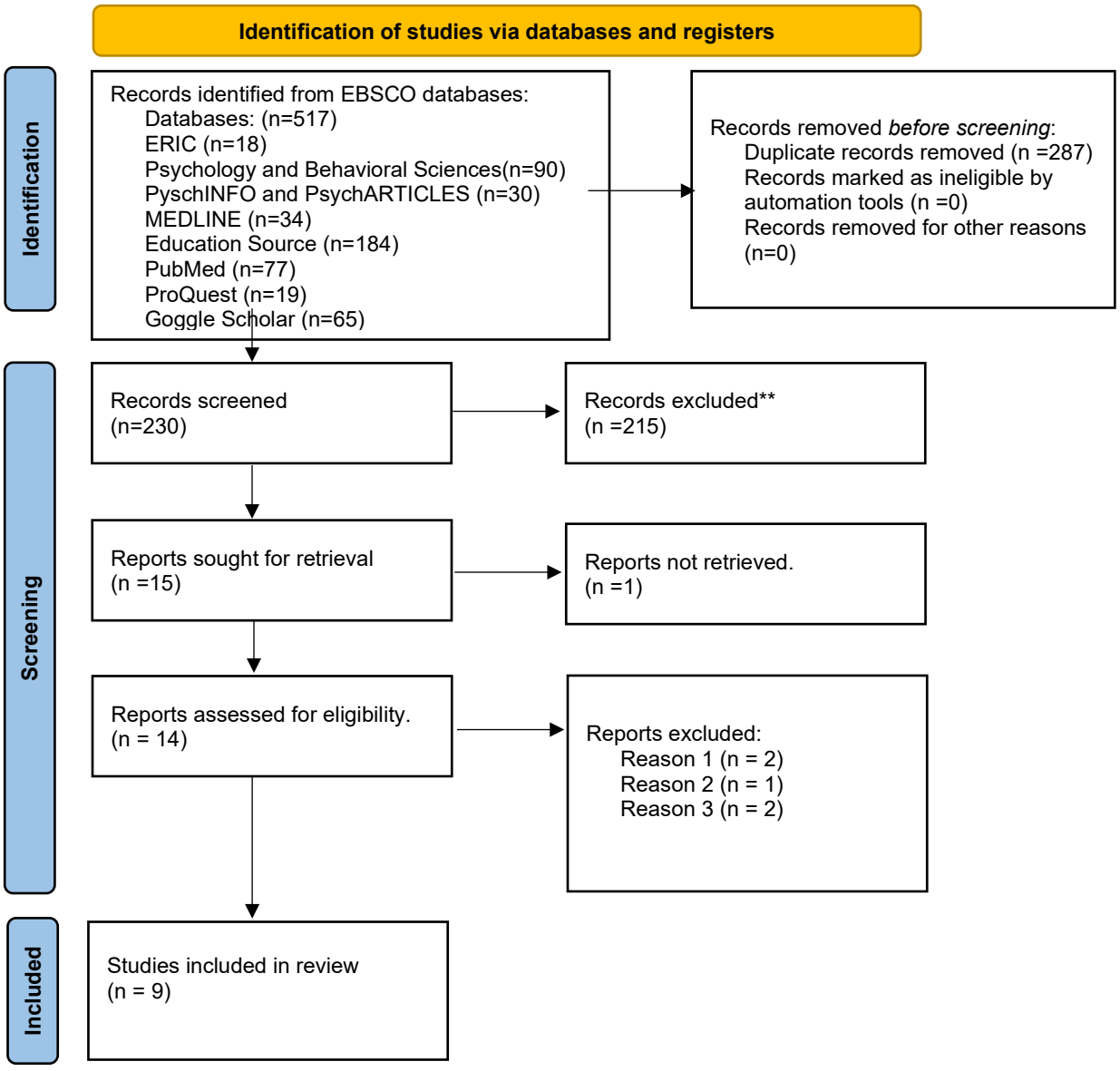
The final comprehensive database search yielded five hundred and seventeen articles. Excluding the two hundred and eight seven duplicates, screening the abstracts of two hundred and thirty articles, fifteen articles were sought for retrieval. One article found in a PT pediatric journal from a conference presentation could not be retrieved as this researcher reached out to the author and other databases but was unsuccessful in finding the full article.

Fourteen studies were selected to assess for eligibility from a combination of the multiple electronic searches that included PennWest California Louis. L. Manderino Library using the selected databases mentioned above, Google Scholar, ProQuest, and reference page searches. This researcher used a checklist developed to determine if a study meets all the inclusionary criteria. The checklist involved questions about the inclusionary criteria for the reviewer to mark yes or no. If the article met all seven criteria with a yes, it was deemed to have met the inclusionary criteria and moved forward to the full review process through a screening process. If the article did not meet all seven criteria with a yes, it was deemed to have not met the inclusionary criteria and excluded from the meta-analysis.

Using the checklist, ten articles were moved forward in the screening process. Of the fourteen articles, two studies completed by the same author in different years could not be utilized for this meta-analysis as the necessary data was not expressed quantitatively and/or visually so that the data could be extracted, and effect sizes could be calculated. Multiple emails

and phone calls to the authors and the university in Iran were attempted; however, unsuccessful to retrieve the necessary data from the authors. Additionally, two of the studies added additional behavior assessment methods that may alter the student's vestibular or sensory modulation; thus, interfering with the effects of the stability ball on in-seat and on-task behavior (Stanic et al.

Figure 1. PRISMA Flow Sheet



Screening of Proposed Studies

Once the articles met the inclusionary criteria, each was evaluated to assess its quality and determine if it was an acceptable exemplar of a single-subject research study (Horner et al., 2005). Since all the studies included in this meta-analysis were single-subject designs and included a heterogenous diagnosis of Autism or ADHD, the *Evaluation Method for Determining EBP in Autism* designed by Reichow et al. (2008) was utilized to evaluate if the article was deemed evidence-based research.

First, a rubric was utilized to examine the research rigor. Reichow's method involves two levels of methodological elements: primary and secondary quality indicators. The primary quality indicators assess the study's validity on a trichotomous scale (high, acceptable, and unacceptable). Common primary indicators used in this rubric are participant characteristics, independent variables, dependent variables, baseline conditions, visual analysis, and experimental control. The second quality indicators are interobserver agreement, procedural fidelity, generalization, and social validity. Although they are not seen as vital for the validity assessment, they are deemed essential to testify as evidence or no evidence (See Appendix B for Evaluation Method Scoring Rubric).

The second part of the evaluation provides guidance for synthesizing the ratings from the rubrics into single strength for the research. This part includes three levels of a research report, including a strong research report strength, an adequate research report strength, and a weak research report strength. For research to meet a strong research report, it must demonstrate

distinct evidence of high quality in all primary quality indicators and show evidence of three or more of the secondary quality indicators. An adequate research report strength exhibits strong evidence with four or more primary quality indicators, no unacceptable quality grades and showed evidence of at least two secondary quality indicators. Lastly, a weak research report signifies receiving fewer than four high quality grades on primary quality indicators or showed evidence of less than two secondary quality indicators.

To test the reliability of the rubrics, Reichow et al. (2008) tested the rubrics in field tests with articles from 2001 to 2005. The results from the inter-rater agreement concerning the reliability of the rubrics ranged from good to almost perfect. Likewise, the rubrics exhibited concurrent validity by using the definitions linked with the previous evidence-based practice definitions, leading to face validity.

As further evidence, Wendt and Miller (2012) completed a study to assess the quality of seven assessment tools for single-subject designs. The authors determined that the *Evaluation Method for Determining EBP in Autism* appeared to be one of the most rigorous and identified a study's weaknesses and how to distinguish between weak and adequate evidence. Also, the separation of primary and secondary quality indicators sets this method apart from the other six methods, which allows for the incorporation of group designs and single-subject designs into a comprehensive assessment (Tarr, 2018). Based on the current research and the included design, this current meta-analysis will utilize the *Evaluation Method for Determining EBP in Autism to* assess the quality of articles (See Appendix C for Strength of the Research).

After completing the analysis of each article with the rubric and synthesizing those ratings to correlate with the strength of the research, one article was deemed weak and unacceptable due to errors in the second quality indicators of interobserver agreement and procedural fidelity. Nine articles have been selected for this meta-analysis.

Coding

The final step before conducting a meta-analysis is to code each study included in the meta-analysis. After ensuring each single-subject design study meets the inclusionary criteria and is deemed evidence-based quality, coding is the next essential step. According to Pigott and Polanin (2019), coding serves two purposes in a meta-analysis. The first purpose of coding serves to highlight the contexts, participants, and methods utilized for each study. The second purpose for coding in a meta-analysis is to examine effect size from the contexts, participants, methods, and other characteristics of the studies included as moderators. Since coding is a detail-oriented process, this researcher developed an excel spreadsheet to code primary and peripheral moderators from each study (See Appendix D for the Coding Primary and Peripheral Moderators and See Appendix E for the Completed Coding Primary and Peripheral Moderators). Furthermore, coding was completed and verified by this researcher only since this is a dissertation authored by one person.

The moderators were selected to demonstrate the relationship between the independent and dependent variables. A moderator is the third variable that can change the strength or the direction of the relationship between two constructs (Hair et al., 2021). For this meta-analysis,

this researcher dissected each article into the following primary moderators; sex of the participants, age of the participants, Autism or ADHD, location of the study, frequency of use of the stability balls, length of time on the stability balls, duration of the study, in-seat or on-task behavior, or both, behavior assessment method, and measurement techniques. The peripheral moderators for this meta-analysis included the area of expertise and the quality of the study.

Sex of the Participants

According to a systematic review conducted by Faheem et al. (2022), ADHD, although historically thought to be a male-dominant disorder, is currently demonstrated to affect females equally. On the other hand, another systematic review conducted by Zeidan et al. (2022) found the male-to-female ratio to be 4:2 from the 71 studies reviewed in the study. For this meta-analysis, the sex of the participant will be male or female.

Age of the Participants

The current meta-analysis found and included 9 studies based on the inclusionary criteria about the effects of stability balls on in-seat or on-task behavior for students identified with Autism and ADHD. From within the inclusionary criteria, the age was limited from three to twenty-one years old. All of the ages within the single-subject design studies were determined by the participants identified with Autism and ADHD for each study and coded by their age during the study. This current meta-analysis coded the ages as 3-6 years old, 7-10 years old, 11-14 years old, and not listed.

Type of Diagnosis

From the inclusionary criteria, the participants needed to have been identified or diagnosed with Autism or Attention Deficit Hyperactivity Disorder. For this meta-analysis, the type of diagnosis of the participant will be either Autism or Attention Deficit Hyperactivity Disorder.

Location of the Study

The majority of previous and current research on stability balls to improve in-seat or on-task behavior has occurred in the school setting or at home. For this meta-analysis, each study will be coded as general education classroom, special education classroom, private applied behavior analysis clinic or home.

Frequency of Use of the Stability Balls

Many of the studies within this current meta-analysis were conducted a few days a week to weeks in length. For this meta-analysis, this researcher coded either the number of days varied from 2-4 days a week, two days a week, three days a week, four days a week, five days a week, or not listed.

Length of Time on Stability Balls

Many of the studies included in this meta-analysis ranged from 5 to 40 minutes per session. For this meta-analysis, this researcher coded the minutes per session as 1-10 minutes, 11-20 minutes, 21-30 minutes, and 31-40 minutes.

Duration of the Study

The studies within this current meta-analysis were conducted from four weeks to a range of 15-20 weeks or a number of sessions. For this meta-analysis, this researcher coded the number of weeks as four weeks, five weeks, six weeks, eight weeks, twelve weeks, 15-20 weeks, 15 sessions, or not listed.

Type of Behavior Assessed

Children with autism display difficulty with engagement with peers and tasks, have difficulty sitting still and display inappropriate behaviors that can interfere with the learning environment (Bagatell et al., 2010; Brennan & Crosland, 2021; Sadr et al., 2015; Schilling & Schwartz, 2004). Likewise, children with ADHD lack sensory modulation which may affect their attention (Mulligan, 2001), and display behaviors such as difficulty sitting still, inability to maintain focus, inability to wait their turn, interrupting others, and talking excessively (Fedewa & Erwin, 2011; Schilling et al., 2003; Stanic et al., 2022; Wu et al., 2022). Because of the heterogeneous symptoms children display with both disorders, this current meta-analysis coded either in-seat or on-task behavior or both behaviors depending on the assessment within each study. Additionally, the type of intervention or educational class (Math class, circle time, independent seat work, etc.) was each noted.

Behavior Assessment Method

The studies within this current meta-analysis were single-subject designs that assessed the use of stability balls via direct observation or recording of the participants. Being that Autism and ADHD are heterogenous disorders, direct observation or recording to review for accuracy by

a qualified individual is essential for the study's external validity. For this meta-analysis, this researcher coded each study as direct observation or recorded.

Measurement Techniques

Hintze et al. (2002) described best practices for directly observing student behavior. From the studies within this current meta-analysis, five of the studies utilized momentary time sampling, two used whole-interval recording measurement, and two used interrupted time series design. All the studies included in this meta-analysis were some forms of direct observations. Seven of the studies employed an observer or observers in the classroom; however, four of the studies selected to record the sessions as their direct observation method. For this meta-analysis, this researcher coded each study as direct observation or recorded and either momentary time sampling, whole-interval recording, or interrupted time series design.

Area of Expertise

To determine if any differences based on the area of expertise affected the outcomes of stability balls on in-seat or on-task behaviors with students identified with Autism or ADHD, this researcher coded the various researchers from different backgrounds or degrees. For this meta-analysis, this researcher coded each study as either classroom instructor aides, pediatric therapists, behavior analysts, recorders (observers), graduate assistants/graduate student, and research assistants.

Quality of the Study from the Rubric

This current meta-analysis reviewed each single-subject design study utilizing a rubric developed by *Evaluation Method for Determining EBP in Autism* (Reichow et al., 2008). Based

on the data and scores from all three instruments developed by Reichow et al., each article included was coded as strong, adequate, or weak (See Appendix D for the strength of the research).

Dependent Variable

For this current meta-analysis, in-seat and on-task behavior, or in-seat behavior or on-task behavior were used as the dependent variables. Within each study, the dependent variable was measured by through recording or direct observation using momentary-time sampling, whole interval or interrupted time design by qualified and trained areas of expertise observers.

Effect Size Calculations for Single Subject Design Studies

Every article included in this meta-analysis was a single-subject design. It is common in the social sciences for researchers to utilize single-subject designs, especially for heterogeneous disorders such as Autism and ADHD. Although most researchers were reluctant to synthesize effect sizes from single-subject designs, Shadish et al. (2008) noted that it is necessary for single-subject design studies to embrace meta-analytic approaches to fully join the evidence-based practice movement.

First, all nine articles met the inclusionary criteria and were evaluated for quality and deemed evidence-based research. In order to gather the most relevant information to calculate the effect size, this researcher used the sample size along with the pre- and post-intervention scores from the single-subject design studies that published their data. For the studies that did not publish the statistical data needed to calculate the effect size, this researcher contacted them via

email to gather the raw statistics. Some researchers did not respond to an email; however, a few did and provided the statistical data via Excel spreadsheet.

Continuing to gather data, this researcher utilized the published graphs containing statistical data from the remaining single-subject design studies. Employing WebPlotDigitizer software to extract the pre- and post-intervention data from the points on each published graph, this researcher retrieved and used the data to calculate the pre- and post-mean intervention scores and their standard deviation for each participant from each study.

Aggregating the Single Subject Design Studies

Single-subject design studies are well suited for behavior research and within Special Education (Alnahdi, 2013) but not as recognized for a meta-analysis (Burns, 2012). Single-subject design studies have strong internal validity, reliable and power due to repeated measurements; however, these types of designs are not analyzed using aggregate scores. It is possible for single-subject design data to be standardized across studies and synthesized across a common metric (Shadish et al., 2014).

For the aggregation of each single-subject design, the Tau-U analysis method was selected to calculate the outcome variables for in-seat and on-task behavior for the primary and peripheral moderator. The Tau-U analysis method is a quantitative approach for analyzing single-case designs through a nonoverlap method (Lee & Cherney, 2018). The use of a nonoverlap method is a way to compute the differences between scores for a baseline and intervention phase in a study

(Parker & Vannest, 2009) while using a percentage of nonoverlapping data (Alresheed et al., 2013).

In order to support the model used to convergence the sample of data, the primary and peripheral moderator were assigned into four models. The four models are child characteristics which included sex, age, and Autism or ADHD, independent variables which included stability ball, location of study, frequency, and length of time, peripheral moderators which included areas of expertise and quality of study and lastly other dependent measures that computed in-seat/on-task behavior assessment methods and behavior techniques. Additionally, two originally identified potential moderator variables were not included in the analysis: Duration and Behavior Assessment Methods. The models would not converge with both Frequency and Duration, or with both Behavior Assessment Techniques and Behavior Assessment Methods due to high multi-colinearity among this data.

Basic Meta-Analysis Calculation

With all single-subject design studies utilized in this meta-analysis, this researcher could choose two ways to conceptualize the meta-analysis: fixed or random effects models. According to Field and Gillett (2010), the fixed effect assumes the studies in a meta-analysis are sampled from the population where the average effect size is fixed and should be homogeneous. Additionally, Haidich (2010) discussed the fixed effect model, where the effect from each study is expected to be the same; there are no differences in the underlying study population, no differences in subject selection criteria, and treatments are applied the same way. On the other hand, the random effects model assumes that the true effect could vary from study to study due

to the heterogeneity differences (Borenstein et al., 2009; Field & Gillett, 2010). Gogtay (2017) suggested that the random effects model is based on the assumption that a large number of studies with the same research question using a pre-set criteria would be distributed about a mean; thus, the studies in a meta-analysis are believed to represent a random sample from a larger number.

Furthermore, weighing each model's differences and potential limitations for this meta-analysis, both models can demonstrate an amount of error. The fixed effect model results in higher Type I error as compared to the random effect model (Hunter & Schmidt, 2000); however, the fixed effects model allocates weight based on the sample size, whereas the random effects model assumes that each is unique and has its own size. The fixed effect model can be easier to manage and is used more frequently than the random effect model (Hunter & Schmidt, 2000). Since the studies in this meta-analysis were conducted with heterogenous populations such as Autism and ADHD, this researcher used the fixed effects model due to the populations having varied effect sizes.

In conjunction with Dr. Karen Larwin, Ph.D., professor at Youngstown State University, this researcher used the Hierarchical Linear Modeling (HLM) to analyze the small sample and individual participant level data. HLM analysis is best described as an advanced multiple regression application in which multiple metric levels of data can be analyzed simultaneously. This approach results in good power when synthesizing data across multiple studies (Shadish, 2014). Throughout the analysis, data was analyzed separately for the two outcome variables: in-

seat behavior and on-task behavior to compute the basic meta-analysis using multi-level model. The detail of the calculations for each model that was computed are provided in the next chapter.

P-Value

This current meta-analysis selected to use the P-value to demonstrate statistical significance. The P-value is the probability of rejecting or failing to reject the null hypothesis. The values of the P-values cannot indeed prove or refute the null hypothesis; however, the values can represent if the null hypothesis has a likelihood of being correct. The lower the P-value, the more substantial the evidence (These et al., 2016). Common P-values are $P<.10$, $P<.05$, and $P<.01$. To test each moderator level, this current meta-analysis has selected the broadest P-value of $P<.05$.

CHAPTER FOUR: RESULTS

Introduction

The current investigation examines the effects of stability balls on in-seat and on-task behavior with students with Autism and ADHD. The following questions will be addressed by the research analysis:

1. What is the effect of a stability ball on a student's in-seat and on-task behavior for students identified with Autism?
2. What is the effect of a stability ball on a student's in-seat and on-task behavior for students identified with ADHD?
3. What variables significantly moderate the effects on in-seat or on-task behavior?

Hierarchical Linear Modeling (HLM) was used to analyze the small sample, individual participant level data. Throughout the analysis, data was analyzed separately for the two outcome variables: in-seat behavior and on-task behavior. For each outcome variable, four models were computed in order to support model convergence with the sample of data:

Child Characteristics: including Sex, Age, and Autism or ADHD

Independent Variables: Stability Ball, Location of Study, Frequency, Length of Time

Peripheral Moderators: Areas of Expertise and Quality of Study Score

Other Dependent Measures: In-Seat/On-Task Behavior Assessment Methods and Behavior Techniques

Two originally identified potential moderator variables were not included in the analysis: Duration and Behavior Assessment Methods. Duration was multi-collinear with Frequency; Behavior Assessment Methods is multi-collinear with Behavior Assessment Techniques. The models would not converge with both Frequency and Duration, or with both Behavior Assessment Techniques and Behavior Assessment Methods. Results are presented for the multiple models for the in-seat behavior followed by the on-task behavior.

Results: In-Seat Behavior

In-Seat Behavior was examined across eight studies. Results of the Tau-U analysis for these studies demonstrates that six of the eight studies reveal statistically different levels of outcomes within the study ($\alpha<.05$). These results by study are presented in Table 1.

Table 1.

Tau-U Effect Estimates by Study

Study	S	PAIRS	TAU	TAUb	SDtau	Z	Sig.
Bagatel	-75	335	-0.24	-0.22	0.14	-1.73	0.083
Boston	96	140	0.69	0.69	0.20	3.45	**0.001**
Brennan	81	123	0.63	0.66	0.20	3.17	**0.002**
Krombach	1210	1462	0.83	0.83	0.10	8.08	**0.001**
Lemar	-15	63	-0.25	-0.24	0.26	-0.97	0.332
Schilling 2003	319	1113	0.26	0.29	0.12	2.26	**0.024**

Schilling 2004	207	433	0.41	0.48	0.14	2.92	**0.004**
Taipalus	88	276	0.32	0.32	0.16	2.00	**0.045**

Since significant differences were revealed at the study level, the Tau-U estimates were examined for each student in each study. These results are presented in Table 2.

Table 2.

Tau-U Effect Estimates by Student within Study

Study	Student	S	PAIRS	TAU	TAUb	SDtau	Z	P Value
Bagatel								
	Alex	-56	60	-0.93	-0.93	0.32	-2.95	0.003
	Jack	-52	70	-0.74	-0.74	0.31	-2.41	0.016
	Omar	50	70	0.71	0.71	0.31	2.31	0.021
	Rol	18	70	0.26	0.26	0.31	0.83	0.405
	Sam	-35	65	-0.54	-0.54	0.31	-1.73	0.085
Boston								
	Issac	32	48	0.67	0.67	0.34	1.94	0.052
	Mart	28	48	0.58	0.58	0.34	1.70	0.090
	Trev	36	44	0.82	0.82	0.35	2.35	0.019
Brennan								
	Ben	6	24	0.25	0.25	0.41	0.61	0.540
	Mark	48	54	0.89	0.89	0.31	2.83	0.005
	Luke	27	45	0.60	0.60	0.33	1.80	0.072
Krombach								
	Alex	386	396	0.97	0.97	0.20	4.85	<.001
	Brand	384	420	0.91	0.91	0.20	4.68	<.001
	Carl	288	486	0.59	0.59	0.18	3.34	0.001
	Dan	152	160	0.95	0.95	0.28	3.38	0.001
Lemar								
	Girl	1	35	0.03	0.03	0.35	0.08	0.935
	Boy	-16	28	-0.57	-0.57	0.38	-1.51	0.131
Schilling 2003								

	Em	319	455	0.70	0.70	0.19	3.70	<.001
	John	-8	348	-0.02	-0.02	0.20	-0.11	0.909
	Mike	8	310	0.03	0.03	0.21	0.12	0.903
	David	127	171	0.74	0.74	0.24	3.12	0.002
Schilling 2004	Ry	56	100	0.56	0.56	0.29	1.90	0.057
	Sam	58	72	0.81	0.81	0.36	2.24	0.025
	Luke	-34	90	-0.38	-0.38	0.27	-1.39	0.165
Taipalus	St1	-15	75	-0.20	-0.20	0.31	-0.65	0.513
	St2	9	75	0.12	0.12	0.31	0.39	0.695
	St3	75	75	1.00	1.00	0.31	3.27	0.001
	St4	19	51	0.37	0.37	0.37	1.01	0.315

As indicated above, the number of data points of comparison for each student varies. HLM is the most appropriate analysis procedure when the number of sessions varies across cases, as it adjusts for autocorrelation that may be present (Shadish, 2014). As indicated above, four models were analyzed to assess the impact of stability ball use on in-seat behavior.

Model #1: In-Seat Behavior and Child Characteristics

The Child Characteristics of gender, age group, and Autism or ADHD were analyzed with the variables centered fixed effects model.

The Level-1 Model: $SEAT_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$

where SEAT is a measure of in-seat behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(SEX_j) + \gamma_{02}*(AGE_j) + \gamma_{03}*(AUTISMOR_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

where SEX indicates gender, AGE indicates age group, and AUTISMOR indicates Autism or ADHD. The Mixed Model:

$$SEAT_{ij} = \gamma_{00} + \gamma_{01}*SEX_j + \gamma_{02}*AGE_j + \gamma_{03}*AUTISMOR_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij} .$$

After six iterations, the results variance indicated $\sigma^2 = 872.28$ with a strong reliability estimate of .903. The results of the fixed effects model are presented in Table 3.

Table 3.

Fixed Effect Estimates of Child Characteristics

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	57.88	5.26	11.01	13	<0.001
SEX, γ_{01}	20.76	17.88	1.16	13	0.266
AGE, γ_{02}	35.33	24.18	1.46	13	0.168
AUTISMOR, γ_{03}	-22.50	30.14	-0.75	13	0.469
For SESSION slope, β_1					
INTRCPT2, γ_{10}	0.52	0.17	3.09	373	**0.002**

As indicated above, results of the intervention were significant from baseline to intervention session. No differences were found in the effectiveness when considering the students gender, age group, or diagnosis.

Model #2: In-Seat Behavior and Independent Variables

The Independent Variables including Stability Ball, Location of Study, Frequency, Length of Time were analyzed with a variables uncentered fixed effects model.

The Level-1 Model: $SEAT_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$

where SEAT is a measure of in-seat behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(STABILITY_j) + \gamma_{02}*(LOCATION_j) + \gamma_{03}*(FREQUENCY_j) + \gamma_{04}*(LENGTHOF_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$

where STABILITY measures the intervention device, LOCATION measures the location of the intervention, FREQUENCY measures the intervention, and LENGTHOF measures the length of the intervention application. The Mixed Model:

$$SEAT_{ij} = \gamma_{00} + \gamma_{01}*STABILITY_j + \gamma_{02}*LOCATION_j + \gamma_{03}*FREQUENCY + \gamma_{04}*LENGTHOF_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r$$

After four iterations, the results variance indicated $\sigma^2 = 872$. with a high reliability estimate of .86. The results of the fixed effects model are presented in Table 4.

Table 4.

Fixed Effect Estimates of Independent Variables

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					

INTRCPT2, γ_{00}	93.88	28.42	3.30	12	0.006
STABILITY, γ_{01}	6.68	7.88	0.84	12	0.413
LOCATION, γ_{02}	-8.03	11.94	-0.67	12	0.514
FREQUENCY, γ_{03}	-15.21	4.44	-3.42	12	**0.005**
LENGTHOF, γ_{04}	7.89	5.04	1.56	12	0.143
For SESSION slope, β_1					
INTRCPT2, γ_{10}	0.52	0.17	3.06	373	**0.002**

As indicated above, results of the intervention were significant from baseline to intervention session. No differences were found in the effectiveness when considering the LOCATION, or LENGTHOF moderators. However, FREQUENCY was revealed to be statistically significant across different reported in-seat scores. Specifically, the Tau-U average values for the different levels of Frequency are presented in Table 5.

Table 5.

Mean Tau-U Effect Size Estimates by Level of Frequency

Level	Mean	Std. Dev.
1. Days varied from 2-4	-0.27	0.42
2. Two times a week	0.86	0.18
3. Three times a week	0.43	0.55
4. Four times a week	0.46	0.36
5. Five times a week	-0.25	0.70

As indicated above, the greatest Tau-U estimate is with two times a week. Both two to four times a week and five times a week resulted in negative Tau-U estimates.

Model #3: In-Seat Behavior and Peripheral Moderator Variables

The Peripheral Variables including Areas of Expertise and Quality of Study Score were analyzed with a variables uncentered fixed effects model.

The Level-1 Model: $SEAT_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$

where SEAT is a measure of in-seat behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(AREASOFE_j) + \gamma_{02}*(QUALITYO_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$

where AREASOFE represents areas of expertise and QUALITYO represents the quality measure of the study. The Mixed Model:

$$SEAT_{ij} = \gamma_{00} + \gamma_{01}*AREASOFE_j + \gamma_{02}*QUALITYO_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij}$$

After five iterations, the results variance indicated $\sigma^2 = 872.30$ with a high reliability estimate of .88. The results of the fixed effects model are presented in Table 6.

Table 6.

Fixed Effect Estimates of Peripheral Variables

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	57.98	4.87	11.91	14	<0.001
AREASOFE, γ_{01}	-4.34	3.25	-1.34	14	0.202

QUALITYO, γ_{02}	46.69	15.57	2.99	14	**0.010**
For SESSION slope, β_1					
INTRCPT2, γ_{10}	0.54	0.17	3.19	373	0.002

As indicated above, results of the intervention were significant from baseline to intervention session. No differences were found in the effectiveness when considering the areas of expertise. However, quality of the study was revealed to be statistically significant across different reported in-seat scores. Specifically, the Tau-U average values for the different levels of Quality of Study are presented in Table 7.

Table 7.

Average Tau-U Estimates by Quality of Study

Level	Mean	Std. Deviation
Adequate	0.38	0.57
Weak	-0.27	0.42

As indicated above, only two levels of Quality of Study Score are represented. The difference in the Tau-U estimate supports the statistically significant difference indicating Weak studies have weaker outcomes.

Model #4: In-Seat Behavior and Research Measures Model

The Research Measures Variables including the Assessment Methods and Behavior Technique were analyzed with a variables uncentered fixed effects model. The Level-1 Model:

$$SEAT_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$$

where SEAT is a measure of in-seat behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(INSEATBE_j) + \gamma_{02}*(BEHAVIOR_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$

where INSEATBE represents the different types of in-seat behavior measured and BEHAVIOR represents the different approaches used to measure/analyze the in-seat behavior. The Mixed Model:

$$SEAT_{ij} = \gamma_{00} + \gamma_{01}*INSEATBE_j + \gamma_{02}*BEHAVIOR_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij}$$

After six iterations, the results variance indicated $\sigma^2 = 873$ with a high reliability estimate of .86. The results of the fixed effects model are presented in Table 8.

Table 8.

Fixed Effect Estimates of Measurement Variables

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	57.96	4.38	13.23	14	<0.001
INSEATBE, γ_{01}	7.24	1.92	3.77	14	**0.002**
BEHAVIOR, γ_{02}	2.51	1.01	2.48	14	**0.027**

For SESSION slope, β_1					
INTRCPT2, γ_{10}	0.54	0.17	3.17	373	**0.002**

As indicated above, results of the intervention were significant from baseline to intervention session. Additionally, the moderator of INSEATBE and BEHAVIOR were revealed to be statistically significant. Specifically, the Tau-U average values for the different levels of in-seat behavior are presented in Table 9.

Table 9.

Average Tau-U Estimates by In-Seat Behavior Measured

Level	Mean	Std. Dev
1.During circle time	-0.25	0.70
2. One-on-one instruction	0.58	0.32
3. Instructional activities	0.86	0.18
4. Teacher selected activity based on individual	0.43	0.55
5. Middle 40 minutes of Language arts class	0.24	0.40
6. Rotation between Mathematics, Social Studies and Language Arts	0.69	0.12
7. Math activity	-0.27	0.42
8. Academic blocks and independent work	0.33	0.58

As indicated above, Instructional Activities, followed by Rotation between Mathematics, Social Studies, and Language Arts, revealed the largest Tau-U estimates. Table 10. provides a breakdown of the levels of Behavior Measurements.

Table 10.

Average Tau-U Estimates by Measurement Approach

Level	Mean	Std. Dev.
1. Momentary time sampling (MTS)	0.05	0.60
2. Whole interval design	0.74	0.27
3. Interrupted time design	0.69	0.12

As indicated in Table 10., Whole Interval Design revealed the largest average Tau-U estimate while Momentary Time Sampling revealed the lowest average Tau-U estimate.

Results: On-Task Behavior

On-Task Behavior was examined across five studies. Results of the Tau-U analysis for these studies demonstrates that four of the five studies reveal statistically different levels of outcomes within the study ($\alpha<.05$). These results by study are presented in Table 11.

Table 11.

Tau-U Effect Estimates by Study

Study	S	PAIRS	TAU	TAUb	SDtau	Z	P Value
Brennen	48	120	0.397	0.400	0.201	1.977	**<.001**
Krombach	852	1462	0.580	0.583	0.102	5.667	**<.001**
Lemar	-54	56	-0.967	-0.964	0.269	-3.591	**<.001**

Schilling 2004	323	433	0.694	0.746	0.141	4.930	**<.001**
Taipalus	116	300	0.387	0.387	0.001	0.153	0.253

Since significant differences were revealed at the study level, the Tau-U estimates were examined for each student in each study. These results are presented in Table 12.

Table 12.

Tau-U Effect Estimates by Student within Study

Study	Label	S	PAIRS	TAU	TAUb	SDtau	Z	P Value
Brennen	Ben	9	21	0.43	0.43	0.42	1.03	0.31
	Mark	32	54	0.59	0.59	0.31	1.89	0.06
	Luke	7	45	0.16	0.16	0.33	0.47	0.64
Krombach	Alex	234	396	0.59	0.59	0.20	2.94	0.00
	Brand	236	420	0.56	0.56	0.20	2.88	0.00
	Carl	306	486	0.63	0.63	0.18	3.54	0.00
	Dan	76	160	0.48	0.48	0.28	1.69	0.09
Lemar	Girl	-33	35	-0.94	-0.94	0.35	-2.68	0.01
	Boy	-21	21	-1.00	-1.00	0.42	-2.39	0.02
Schilling	Dave	151	171	0.88	0.88	0.24	3.71	0.00
	Ry	96	100	0.96	0.96	0.29	3.26	0.00
	Sam	72	72	1.00	1.00	0.36	2.78	0.01

	Luke	4	90	0.04	0.04	0.27	0.16	0.87
Taipalus	ST1	-15	75	-0.20	-0.20	22.91	0.31	-0.65
	ST2	9	75	0.12	0.12	22.91	0.31	0.39
	ST3	75	75	1.00	1.00	22.91	0.31	0.33
	ST4	47	75	0.63	0.63	22.91	0.31	0.21

As indicated above, four models were analyzed to assess the impact of stability ball use on students on-task behavior.

Model #1: On-Task Behavior and Child Characteristics

The Child Characteristics of gender, age group, and Autism or ADHD were analyzed with the variables centered fixed effects model.

The Level-1 Model: $ON\text{-}TASK_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$

where ON-TASK is a measure of on-task behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(SEX_j) + \gamma_{02}*(AGE_j) + \gamma_{03}*(AUTISMOR_j) + u_{0j} \quad \beta_{1j} = \gamma_{10}$$

where SEX indicates gender, AGE indicates age group, and AUTISMOR indicates Autism or ADHD. The Mixed Model:

$$ON\text{-}TASK_{ij} = \gamma_{00} + \gamma_{01}*SEX_j + \gamma_{02}*AGE_j + \gamma_{03}*AUTISMOR_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij}\ .$$

After five iterations, the results variance indicated $\sigma^2 = 287.8$ with a strong reliability estimate of .949. The results of the fixed effects model are presented in Table 13.

Table 13.

Fixed Effect Estimates of Child Characteristics

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	63.34	4.83	13.11	9	<0.001
SEX, γ_{01}	19.84	14.36	1.38	9	0.201
AGE, γ_{02}	5.83	5.68	1.02	9	0.331
AUTISMOR, γ_{03}	-23.28	21.84	-1.07	9	0.314
For SESSION slope, β_1					
INTRCPT2, γ_{10}	1.11	0.17	6.49	225	**<0.001**

As indicated above, results of the intervention were significant from baseline to intervention session. No differences were found in the effectiveness when considering the students' gender, age group, or diagnosis.

Model #2: On-Task Behavior and Independent Variables

The Independent Variables including Stability Ball, Location of Study, Frequency, Length of Time were analyzed with a variables uncentered fixed effects model. The Level-1 Model: $ON\text{-}TASK_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$

where ON-TASK is a measure of on-task behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(STABILITY_j) + \gamma_{02}*(LOCATION_j) + \gamma_{03}*(FREQUENCY_j) + \gamma_{04}*(LENGTHOF_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$

where STABILITY measures the intervention device, LOCATION measures the location of the intervention, FREQUENCY measures the intervention, LENGTHOF measures the length of the intervention application. The Mixed Model:

$$ON\text{-}TASK_{ij} = \gamma_{00} + \gamma_{01}*STABILITY_j + \gamma_{02}*LOCATION_j + \gamma_{03}*FREQUENCY + \gamma_{04}*LENGTHOF_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij}$$

After three iterations, the results variance indicated $\sigma^2 = 256$ with a high reliability estimate of .93. The results of the fixed effects model are presented in Table 14.

Table 14.

Fixed Effect Estimates of Independent Variables

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					

INTRCPT2, γ_{00}	114.55	27.64	4.15	8	0.003
STABILITY, γ_{01}	-4.54	7.27	-0.63	8	0.549
LOCATION, γ_{02}	-19.91	14.33	-1.39	8	0.202
FREQUENCY, γ_{03}	0.01	0.02	0.79	8	0.450
LENGTHOF, γ_{04}	-4.43	6.23	-0.71	8	0.497
For SESSION slope, β_1					
INTRCPT2, γ_{10}	1.11	0.17	6.50	225	**<0.001**

As indicated above, results of the intervention were significant from baseline to intervention session. No differences were found in the effectiveness when considering the STABILITY, LOCATION, LENGTHOF, and FREQUENCY moderators.

Model #3: On-Task Behavior and Peripheral Moderator Variables

The Peripheral Variables including Areas of Expertise and Quality of Study Score were analyzed with a variables uncentered fixed effects model.

The Level-1 Model:

$$ON\text{-}TASK_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$$

where ON-TASK is a measure of on-task behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(AREASOFE_j) + \gamma_{02}*(QUALITYO_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$

where AREASOFE represents areas of expertise and QUALITYO represents the quality measure of the study. The Mixed Model:

$$ON\text{-}TASK_{ij} = \gamma_{00} + \gamma_{01}*AREASOFE_j + \gamma_{02}*QUALITYO_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij}$$

After four iterations, the results variance indicated $\sigma^2 = 246$ with a high reliability estimate of .940. The results of the fixed effects model are presented in Table 15.

Table 15.

Fixed Effect Estimates of Peripheral Variables

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	57.15	34.76	1.64	10	0.131
AREASOFE, γ_{01}	6.44	3.96	1.63	10	0.134
QUALITYO, γ_{02}	-10.26	12.72	-0.81	10	0.438
For SESSION slope, β_1					
INTRCPT2, γ_{10}	0.54	0.17	3.19	373	**0.002**

As indicated above, results of the intervention were significant from baseline to intervention session. No differences were found in the effectiveness when considering the areas of expertise or the quality of the study.

Model #4: On-Task Behavior and Research Measures Model

The Research Measures Variables including Assessment Methods and Behavior Technique were analyzed with a variables uncentered fixed effects model. The model would not converge because of multicollinearity between the variables, so this model was analyzed with On-Task behavior. The Level-1 Model:

$$ON\text{-}TASK_{ij} = \beta_{0j} + \beta_{1j}*(SESSION_{ij}) + r_{ij}$$

where ON-TASK is a measure of on-task behavior and SESSION is a measure of intervention session (i.e. baseline, intervention, etc.). The Level-2 Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(ONTASKBE_j) + u_{0j} \qquad \beta_{1j} = \gamma_{10}$$

where ONTASKBE is the different types of on-task behavior measured. The Mixed Model

$$ON\text{-}TASK_{ij} = \gamma_{00} + \gamma_{01}*ONTASKBE_j + \gamma_{10}*SESSION_{ij} + u_{0j} + r_{ij}$$

After five iterations, the results variance indicated $\sigma^2 = 279.6$ with a high reliability estimate of .95. The results of the fixed effects model are presented in Table 16.

Table 16.

Fixed Effect Estimates of Measurement Variables

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					

INTRCPT2, γ_{00}	59.80	5.76	10.37	11	<0.001
ONTASKBE, γ_{01}	0.01	0.01	1.11	11	0.292
For SESSION slope, β_1					
INTRCPT2, γ_{10}	1.11	0.17	6.49	225	**<0.001**

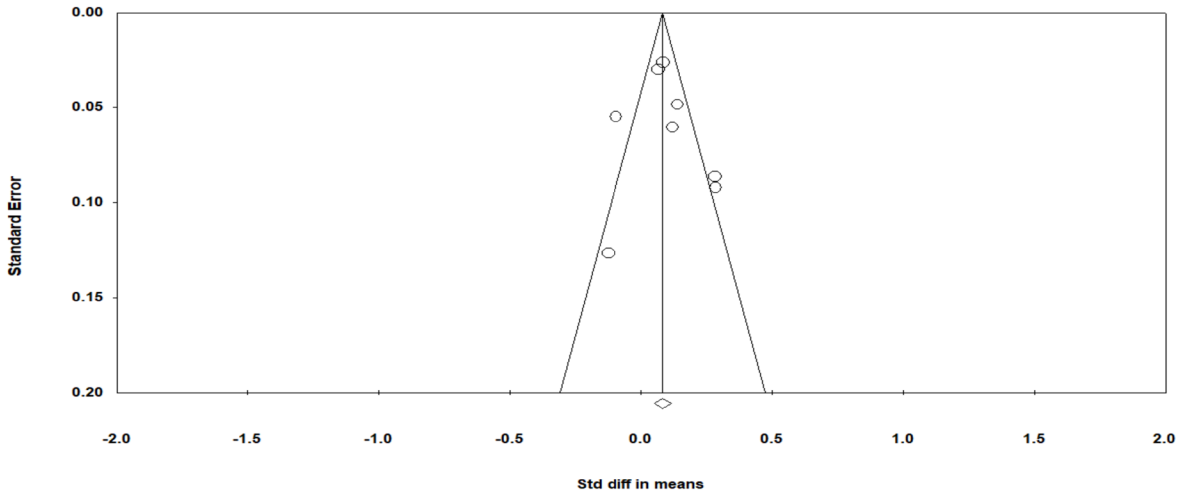
As indicated above, results of the intervention were significant from baseline to intervention session.

Publication Bias

A funnel plot is a type of scatterplot utilized for investigating publication bias in meta-analytic studies. Furthermore, funnel plots are, "…a measure of study size on the vertical axis as a function of effect size on the horizontal axis." (Borenstein, 2005, p. 194). A funnel plot representing a study with a large sample would appear towards the top of the graph and cluster near the mean effect size, while due to greater sampling variation in effect size, studies with small sample sizes would appear toward the bottom of the graph with estimates dispersed across a range of values (Sterne & Hardbord, 2005). The funnel plot examining publication bias for in-seat behavior is presented in Figure 2.

Figure 2

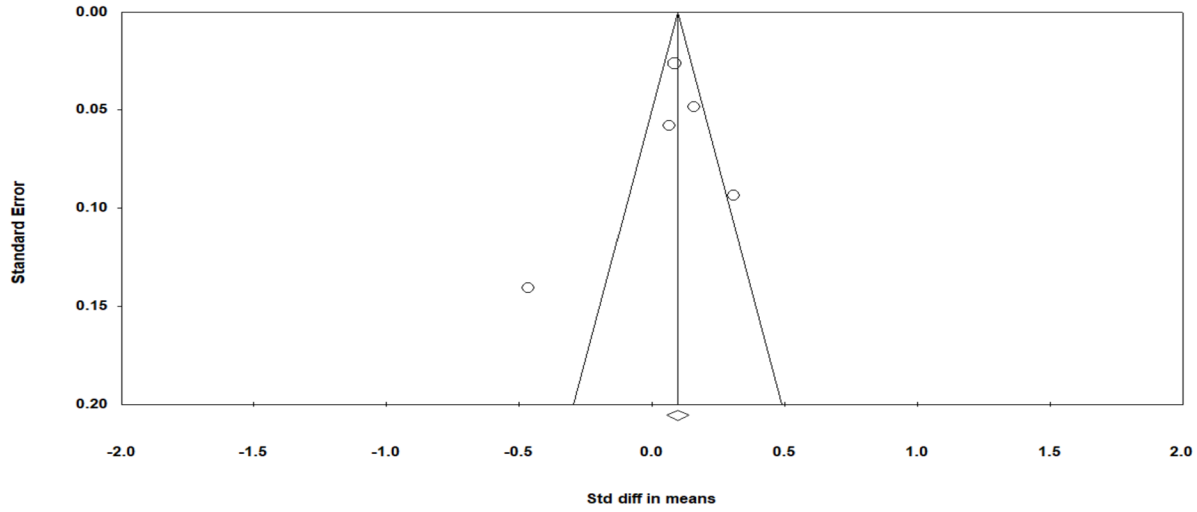
Funnel Plot: Point Effect Size Estimate for In-Seat Behavior



The funnel plot examining publication bias for on-task behavior is presented in Figure 3.

Figure 3

Funnel Plot: Point Effect Size Estimate for On-Task Behavior



For both figures, the small sample size is represented by the funnel towards the bottom of the graph. In cases where publication bias is absent, one would expect the studies to be distributed symmetrically about the combined effect size. If bias were present, one would expect the bottom of the plot to reveal a high concentration of studies on one side of the mean in comparison to the other. Both figures reveal a cluster of studies that is generally equal on both sides, demonstrating little or no publication bias and reducing the likelihood of a file drawer problem in either outcome variable examined in the current investigation.

Summary

The research questions for this investigation examined if there is an effect of the stability ball interventions on students in-seat and on-task behavior, specifically for students with Autism and ADHD. Additionally, the impact of variables in moderating the in-seat and on-task behavior was also examined. Variables of interest were analyzed in four models: child characteristics, identified independent variables, peripheral variables, and research measurement variables.

Results indicate that neither Autism and ADHD were significantly related to the level of in-seat or on-task behavior. Four variables were found to significantly moderate in-seat behavior: frequency, quality of study, in-seat behavior measure, and behavioral measurement used. None of the variables were found to be significant moderators of on-task behavior.

Finally, the results of the funnel plots, examined separately for in-seat and on-task behavior, reveal well distributed estimates of the effects, based on a Tau-U and standard error of

Tau-U. Therefore, it is unlikely that publication bias exists within the two outcome measures utilized. These results and the implications will be discussed in Chapter 5.

CHAPTER 5: CONCLUSIONS

Introduction

This final chapter explains and supports the results from this meta-analysis that aimed to examine the effects of stability balls on in-seat and on-task behavior with students with Autism and ADHD. This chapter will also discuss the limitations that this researcher and other researchers face when studying these heterogeneous diagnoses. Lastly, this chapter will focus on the recommendations for future research so that professionals working with students with intellectual disabilities will be better equipped to provide the necessary accommodations and modifications for those students to be successful in the classroom.

Discussion

The main purpose of this meta-analysis was to examine the effects of stability balls on in-seat and on-task behavior with students with Autism and ADHD. A secondary question aimed to look at what variables significantly moderate the effects on in-seat or on-task behavior. Since only systematic reviews have been conducted on this subject, this meta-analysis will be the first to analyze the effects stability balls have with students with Autism and ADHD to improve in-seat and on-task behavior. Practitioners, occupational therapists, behavioral therapists, and educators following along the guidelines of the IDEA have studied different sensory interventions that have been incorporated in the classroom to improve the academic and behavioral performance of students with intellectual disabilities. Stability balls continue to be one type of intervention utilized by the above-mentioned professionals. Because of the number of variables selected to examine in this meta-analysis and using the Hierarchical Linear Modeling (HLM), one model could not be run. Due to the limited size of the sample and not

having the necessary power to converge, Dr. Karen Larwin, PhD and this researcher broke the moderators into four separate models for analysis. Also noted, that two of the originally identified potential moderator variables Duration and Behavior Assessment Methods were not included in the analysis as they are multi-collinear and would not converge. From the analysis of the four models, this researcher was able to detect which variables significantly moderate the effects on in-seat or on-task behavior.

This meta-analysis had three research questions:

RQ1: What is the effect of a stability ball on a student's in-seat and on-task behavior for students identified with Autism?

The results of the intervention looking at child characteristics, such as gender, age group, and Autism were analyzed and were significant from baseline to intervention session; however, no differences were found in the effectiveness when considering the students gender, age group, or diagnosis. It must be noted that no females were participants in any of the Autism studies conducted. Additionally, the age group revealed no significant differences; however, the age groups did not represent across all age groups as 82.35% fell in 3-6 years old, 11.76% of the participants age was not listed in the studies, 25% fell in the 7-10 age group, 0.058 % fell in the 11-14 age group. Similarly, no differences were found in the effectiveness when considering the location or length of time for the moderators and when considering the areas of expertise. However, quality of the study was revealed to be statistically significant across different reported in-seat scores. It must be noted that all nine studies utilized within this meta-analysis received a score of adequate for quality of the study deeming the evidence to be notable and important.

Lastly, Whole Interval Design revealed the largest average Tau-U estimate while Momentary Time Sampling revealed the lowest average Tau-U estimate. This analyze infers that observing the whole time a student is on the stability ball versus momentary time sampling that only observes a small estimation of the time on the stability ball may help to identify more improvements with In-Seat Behaviors.

RQ2: What is the effect of a stability ball on a student's in-seat and on-task behavior for students identified with ADHD?

The results of the intervention looking at child characteristics, such as gender, age group, and ADHD were analyzed and were significant from baseline to intervention session; however, no differences were found in the effectiveness when considering the students gender, age group, or diagnosis. Unlike, the studies with Autism in this meta-analysis, females represented the majority of the studies with 75% and males 25% of the participants. Looking at age group, it was underrepresented across the age groups with 35% falling in 7-10 age group, 0.05% falling in 11-14 age group and 60% of the participants age not listed. Equally, to Autism, no differences were found in the effectiveness when considering the stability, location, length of time on the stability ball.

RQ3: What variables significantly moderate the effects on in-seat or on-task behavior?

The most significant finding from the four models computed to support model convergence with the sample of data was frequency. Frequency was revealed to be statistically significant for In-Seat Behavior; however, no differences were found in the effectiveness when considering frequency with On-Task Behavior. With In-Seat Behavior, the moderator of

frequency for two days a week (Tau-U mean 0.86 and p=0.005) demonstrated the most effectiveness while on a stability ball. The evidence is demonstrating that the intervention is working, validating improvements with In-Seat Behavior and providing evidence-based research for practitioners and educators to utilize in the classroom.

Furthermore, even though only nine studies were utilized in this meta-analysis, publication bias was absent, as shown in the inverted symmetrical funnel plot. It was revealed that not all the studies in this meta-analysis yielded statistical significance.

Implications

Conducting a meta-analysis will synthesize and summarize all the relevant research articles to provide a more generalized estimation of the effect size and provide consistency within the current research (Gogtay & Thatte, 2017). Although completing a meta-analysis with all single-subject designs is not the ideal model, combining these evidence-based studies and practices can help provide effective treatment interventions across these special populations, as single-subject design studies are particularly appropriate in Special Education due to the heterogenous populations such as Autism and ADHD (White et al., 1989, as cited Pustejovsky & Ferron, 2017). Even though the findings of this meta-analysis support the use of stability balls to improve In-Seat Behavior, there were limitations. The first limitation is the small sample size. Because of the heterogeneous characteristics of individuals diagnosed with Autism or ADHD, researchers are limited on selection of participants. All eight single subject design studies utilized in this meta-analysis had less than eight participants per study, which may not accurately represent the entire population for students diagnosed with Autism or ADHD. A second

limitation was the inability of this researcher to gather the raw data from two current studies completed on the effects of dynamic seating with students with Autism in Iran (Sadr et al., 2017) and the use of stability ball chairs with students with Autism (Sadr et al., 2015). The published studies contained zero graphs or data; therefore, this researcher made several attempts to phone, email, and reach out through social media. Unfortunately , this researcher was unable to access the raw data; therefore, the articles were excluded from this meta-analysis. Additionally, employing inclusionary criteria, the researcher had to restrict two additional articles that altered the sensory integration of the participants. Stanic et al. (2022) aimed to test the effectiveness of an active seat and task solving performance by placing seven accelerometers to measure movement, thermal imaging to measure skin temperature and an arm cuff to measure skin conductance on the participants. Likewise, Wu et al. (2022) used earlobe electrode and auditory beeping to measure reaction time by making the participants press a handheld trigger when they would hear beeping during an auditory task when on a chair or stability ball. This researcher considered that these additional behavior assessment methods may alter the participant's vestibular or sensory modulation; thus, interfering with the true effects of the stability ball on in-seat and on-task behavior. Lastly, the inconsistency in length of time, different assessment tools utilized, and the frequency varied greatly from study to study causing limitations since different practices and procedures were utilized in the studies. When Gochenour et al. (2017) conducted a systematic review to determine the effectiveness of alternative seating for students with attention difficulties, they were reluctant to attempt a meta-analysis due to the variance in the methodology. Despite the limitations, this is the first meta-analysis examining the effects of

stability balls with In-Seat and On-Task Behavior with students identified with Autism and ADHD. For In-Seat Behavior, frequency of two times a week demonstrated to be the most statistically significant, the quality of the studies was deemed adequate for strength of the evidence, and the measurement technique of whole interval design yielded the largest average Tau-U estimate. Although the results for On-Task Behavior were not statistically significant, the results of the interventions utilized were significant from baseline to intervention sessions.

Recommendations for Future Research

Sensory integration interventions continue to be trailed and utilized in the classroom by practitioners, occupational therapists, behavioral therapists, and educators to ensure that they offer accommodations and modifications for students with intellectual disabilities so that they can be successful in the classroom. Implementing the use of stability balls in the classroom to improve in-seat or on-task behavior is showing promise with students diagnosed with Autism or ADHD. Inclusively, future research needs to involve a much larger sample size that is representative of all ages diagnosed with Autism and ADHD. Operating with a larger sample size could demonstrate a stronger increase in effectiveness across these special populations and provide research that is stronger and more reliable because they lower standards of deviation and smaller margins of error. Along with the larger sample size, future research needs to implement experimental designs, such as randomized controlled trials, as that could provide the necessary support for practitioners and other professionals to validation the use of alternative seating.

Additionally, without more consistent practices across the board, it will be hard for researchers to replicate past studies for future research. Having a more unified assessment tool, length of time, and using the same sensory integration tool will provide the essential element to make strong quality evidence-based research for these heterogeneous diagnoses. Furthermore, even though in this meta-analysis frequency yielded statistically significant for in-seat behavior, the need for future research to support a specific more consistent frequency is evident for clinical significance. It is desired that this meta-analysis will assist future research to work towards filling the gap with the current literature to empower practitioners with the evidence-based research on the use of stability balls in the classroom to improve in-seat and on-task behavior with students diagnosed with Autism and ADHD.

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APPENDIX A

INCLUSIONARY CRITERIA DATA SHEET

Article reviewed:

Date reviewed for inclusion criteria:

Inclusion Criteria	Yes	No	Comments
Research article is written in English			
The research article was written between the years 2001 and 2022			
The research article must have included stability balls as the independent variable			
The research article must have included in-seat and/or on-task behavior as the dependent variable.			
The research article must have included students diagnosed with autism spectrum disorder or attention deficit hyperactivity disorder			
The research article cannot add additional behavior assessment methods that may alter the students vestibular or sensory modulation			
The research must have included the effects stability balls with in-seat and on-task behavior with students with ASD or ADHD and expressed quantitatively and/or visually so that necessary data could be extracted, and effect sizes could be calculated.			

APPENDIX B:

EVALUATIVE METHOD SCORING RUBRIC

Quality Appraisal Evaluative Method Single Subject Scoring Rubric

Author(s):

Title of Article and Year:

Primary Quality Indicators	High Quality	Acceptable Quality	Unacceptable Quality
Participant Characteristics	1. Age and gender are provided for all participants. 2. All participants' diagnosis are operationalized including specific diagnosis. 3. If study utilized standardized test scores, the measures were indicated in the study 4. Information on the interventionist or secondary participants are provided in the study	Acceptable quality is granted if the study meets criteria for 1, 3 and 4	Unacceptable quality is awarded if the study does not meet all of the criteria in 1, 3, and 4.
Independent Variable	A high rating is awarded to a study that defines independent variables with replicable precision. If a manual is used, the study passes this criterion	An acceptable rating is awarded to a study that defined many elements of the independent variable but omits specific details.	Unacceptable rating is awarded to a study that does not sufficiently define the independent variables
Dependent Variable	A high rating is awarded to a study that meets the following criteria: 1.The variables are defined with operational precision.	An acceptable rating is awarded to a study that meets three of the of four	Unacceptable rating is awarded to a study that meets fewer criteria

	2.The details necessary to replicate the measures or provided. 3. The measures are linked to the dependent variables. 4. The measurement data is collected at appropriate times during the study.		
Baseline Condition	A high rating is awarded to a study in which 100% of baselines: encompass at least three measurement points, appear through visual analysis to be stable, have no trend or a counter therapeutic trend, and have conditions that are operationally defined with replicable precision	An acceptable rating is awarded to a study in which at least one of the criteria was not met in at least one, but not more than 50% of the baselines.	Unacceptable rating is awarded to a study in which two or more of the criteria were not met in at least one baseline or more than 50% of the baselines do not meet three of the criteria
Visual Analysis	A high rating is awarded to a study in which 100% of the graphs: have data that are stable, contain less than 25% overlap of data points between adjacent conditions, and unless behavior is at ceiling or floor levels in the previous condition.	An acceptable rating is awarded to a study in which two of the criteria were met on at least 66% of the graphs.	Unacceptable rating is awarded to a study in which two or fewer criteria were met on less than 66% of the graphs.
Experimental Control	A high rating is awarded to a study	An acceptable rating is awarded to a study	Unacceptable rating is awarded to a

	that contains at least three demonstrations of the experimental effect, occurring at three different points in time and changes in the dependent variables vary with the manipulation of the independent variable in all instances of replication. If there was a delay in change at the manipulation of the independent variable, the study is accepted as high quality if the delay was similar across different conditions or participants.	in which at least 50% of the demonstrations of the experimental effect meet the criteria, there are two demonstrations of the experimental effect at two different points in time and changes in the dependent variables vary with the manipulation of the independent variable.	study in which less than 50% of the demonstrations of the experimental effect meet the criteria, there are fewer than two demonstrations of the experimental effect occurring at two different points in which changes in the dependent variables vary with the manipulation of the independent variable.

Interobserver agreement	This indicator is positive if IOA is collected across all conditions, raters, and participants with reliability greater than 80%.	
Fidelity	This indicator is positive if treatment or procedural fidelity is continuously. assessed across participants, conditions, and implementers, and if applicable, has measurement statistics greater than 80%.	

Generalization	This indicator is positive if outcome measures or collected after the final data collection to assess generalization or maintenance.	
Social Validity	This indicator is positive if this study contains at least three of the following features: socially important dependent variables, time, and cost effective intervention, behavioral change that is large enough for practical value, consumers who are satisfied with the results, independent variable manipulation by people who typically come into contact with the participant, and a natural context.	

Overall, Strength of Research Report:

Strong	Adequate	Weak
Received high quality grades on all primary quality indicators and showed evidence of three or more secondary quality indicators.	Received high quality grades on four or more primary quality indicators with no unacceptable quality grades on any primary quality indicators, and showed evidence of at least two secondary quality indicators	Received fewer than four high quality grades on primary quality indicators or showed evidence of less than two secondary quality indicators.

APPENDIX C

EVALUATION METHOD FOR STRENGTH OF SINGLE SUBJECT DESIGN STUDY

Author(s):

Title of Article and Year:

Primary Quality Indicators	High Quality	Acceptable Quality	Unacceptable Quality
Participant Characteristics			
Independent Variable			
Dependent Variable			
Baseline Condition			
Visual Analysis			
Experimental Control			

Secondary Quality Indicators	Evidence	No Evidence
Interobserver Agreement		
Fidelity		
Blind Raters		
Generalization		
Social Validity		

Overall, Strength of Research Report:

Strong	Adequate	Weak
Received high quality grades on all primary quality indicators and showed evidence for three or more secondary quality indicators.	Received high quality grades on four or more primary indicators with no unacceptable quality grades on any primary quality indicators, and showed evidence of at least two secondary quality indicators	Received fewer than four high quality grades on primary quality indicators or showed evidence of less than two secondary quality indicators.

Comments:

APPENDIX D: CODING PRIMARY AND PERIPHERAL MODERATORS

Peripheral Moderators		Participant characteristics			Independent Variables					Dependent Variables			
Areas of Expertise	Quality of Study Score	sex	age	Autism or ADHD	Stability ball	Location of the Study	Frequency	Length of time	Duration	In-seat behavior	On-task behavior	Behavior Assessment Methods	Behavior Measurement Techniques
1. Classroom Instructor	1. Strong	1. Male Only	1. 3-6 years old	1. Autism	1. Stability ball	1. General Education classroom	1. Days varied from 2-4	1. 1-10 minutes	1. 4 weeks	1.During circle time	1. One-on-one instruction	1. Direct Observation	1. Momentary time sampling
2. Pediatric therapist	2. Adequate	2. Female Only	2. 7-10 years old	2. ADHD	2. Therapy Ball	2. Special Education classroom	2. Two times a week	2. 11-20 minutes	2. 5 weeks	2. One-on-one instruction	2. Rotation between Mathematics, Social Studies and Language	2. Recorded	2. Whole interval design
3. Behavior Analysts	3. Weak		3. 11-14 years old		3. Therapy Ball Chair	3. Private Applied Behavior Analysis Clinic	3. Three times a week	3. 21-30 minutes	3. 6 weeks	3. Instructional activities	3. Independent seat work		3. Interrupted time design
4. Recorders/ Observers			999. Not listed		4. Stability ball chair	4. Home	4. Four times a week	4. 31-40 minutes	4. 8 weeks	4. Teacher selected activity based on individual	4. Academic blocks and independent work		
5. Graduate assistant/Graduate student							5. Five times a week		5. 15 sessions	5. Middle 40 minutes of Language			
6. Research assistants							999. Not noted		6. 12 weeks	6. Rotation between Mathematics, Social Studies and			
									7. 15-20 weeks	7. Math activity			
									999. Not listed	8. Academic blocaks and			

APPENDIX E: COMPLETED CODING PRIMARY AND PERIPHERAL MODERATORS

	Peripheral Moderators		Participant characteristics			Independent Variables					Dependent Variables			
Authors and year	Areas of Expertise	Quality of Study Score	sex	age	Autism or ADHD	Stability ball	Location of the Study	Frequency	Length of time	Duration	In-seat behavior	On-task behavior	Behavior Assessment Methods	Behavior Measurement Techniques
Bagatell et al. 2010 A-B-C design	5	2	1	1	1	3	2	5	2	1	1	999	2	1
Bagatell et al. 2010 A-B-C design	5	2	1	1	1	3	2	5	2	1	1	999	2	1
Bagatell et al. 2010 A-B-C design Omar	5	2	1	1	1	3	2	5	2	1	1	999	2	1
Bagatell et al. 2010 A-B-C design Ricardo	5	2	1	1	1	3	2	5	2	1	1	999	2	1
Bagatell et al. 2010 A-B-C design Roland	5	2	1	1	1	3	2	5	2	1	1	999	2	1
Bagatell et al. 2010 A-B-C design Samual	5	2	1	1	1	3	2	5	2	1	1	999	21	1
Brennan & Crosland 2021 Alternating Treatments	3	2	1	1	1	4	3	999	1	5	2	1	1	2
Brennan & Crosland 2021 Alternating Treatments	3	2	1	2	1	4	3	999	1	5	2	1	1	2
Brennan & Crosland 2021 Alternating Treatments	3	2	1	1	1	4	3	999	1	5	2	1	1	2
Boston 2017 A-B-A-B design Issac	1	2	1	2	2	2	2	4	3	1	7	999	1	3
Boston 2017 A-B-A-B design	1	2	1	2	2	2	2	4	3	1	7	999	1	3
Boston 2017 A-B-A-B design	1	2	1	2	2	2	2	4	3	1	7	999	1	3

17	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	1	999	2	1	1	3	3	6	6	2	1	1
18	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	1	999	2	1	1	3	3	6	6	2	1	1
19	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	1	999	2	1	1	3	3	6	6	2	1	1
20	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	1	999	2	1	1	3	3	6	6	2	1	1
21	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	1	999	2	1	1	3	3	6	6	2	1	1
22	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	1	999	2	1	1	3	3	6	6	2	1	1
23	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	2	999	2	1	1	3	3	6	6	2	1	1
24	Fedewa & Erwin 2011 A-B Continuous time-series	5	2	2	999	2	1	1	3	3	6	6	2	1	1
25	Krombach & Miltenberger 2019 ABC Design Alex	3	2	1	3	1	1	4	2		7	3	999	2	2
26	Krombach & Miltenberger 2019 ABC Design	3	2	1	1	1	1	4	2		7	3	999	2	2
27	Krombach & Miltenberger 2019 ABC Design Brandon	3	2	1	1	1	1	4	2		7	3	999	2	2
28	Krombach & Miltenberger 2019 ABC Design Carl	3	2	1	2	1	1	4	2		7	3	999	2	2
	Lemar 2012														

29	Lemar 2012 Multiple baseline wth reversal design Girl	4	3	2	2	2	4	2	1	1	3	8	4	1	1
30	Lemar 2012 Multiple baseline wth reversal design Boy	4	3	1	3	2	4	2	1	1	3	8	4	1	1
31	Schilling & Schwartz 2004 A-B-A-B design	4	2	1	1	1	2	2	3	1	4	4	999	1	1
32	Schilling & Schwartz 2004 A-B-A-B design	4	2	1	1	1	2	2	3	1	4	4	999	1	1
33	Schilling & Schwartz 2004 A-B-A-B design	4	2	1	1	1	2	1	3	1	4	4	999	1	1
34	Schilling & Schwartz 2004 A-B-A-B design	4	2	1	1	1	2	1	3	1	4	4	999	1	1
35	Schilling et al. 2003 A-B-A-B Interrupted time series	2	2	2	2	2	2	1	4	4	6	5	999	1	1
36	Schilling et al. 2003 A-B-A-B Interrupted time series	2	2	1	2	2	2	1	4	4	6	5	999	1	1
37	Schilling et al. 2003 A-B-A-B Interrupted time series	2	2	1	2	2	2	1	4	4	6	5	999	1	1
38	Taipalus et al. 2016 Alternating design Student 1	6	2	1	999	2	2	1	5	3	1	999	3	1	1
39	Taipalus et al. 2016 Alternating design Student 2	6	2	1	999	2	2	1	5	3	1	999	3	1	1
40	Taipalus et al. 2016 Alternating design Student 3	6	2	2	999	2	2	1	5	3	1	999	3	1	1
41	Taipalus et al. 2016 Alternating design Student 4	6	2	2	999	2	2	1	5	3	1	999	3	1	1

APPENDIX F
Institutional Review Board Approval

TO: Dr. Christopher Tarr
Special Education

FROM: _____
Michael Holmstrup, Ph.D., Chairperson Institutional Review Board (IRB)

DATE: March 20, 2023

RE: Protocol Approved

Protocol #: 2023-079-88-A
Protocol Title: The Effects of Stability Balls have on In-seat and On-task Behavior with Students with ASD and ADHD

The Institutional Review Board (IRB) of Slippery Rock University has conducted an administrative review of the above-referenced protocol under the "exempt" category.

You may begin your project as of March 20, 2023. Your protocol will automatically close on March 19, 2024 unless you request, in writing, to keep it open.

Please contact the IRB Office by phone at (724)738-4846 or via e-mail at irb@sru.edu should your protocol change in any way.