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Systematic Review of Sensory Integrations with Autism Spectrum Disorder

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Systematic Review of Sensory Integrations with Autism Spectrum Disorder

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Abstract

Autism Spectrum Disorder is a developmental disorder that can affect communication and behavior. In children a sensory diet is utilized in order to address these issues. Research has been completed over the years looking into the effects of different sensory integrations on classroom behavior and participation. This is a comparison study of various integrations including, but not limited to, vestibular swinging, therapy balls, and therapy cushions. It is often up to an Occupational Therapist to create a sensory diet for each student on a caseload. The purpose of this study was to discover if there is one treatment that can be utilized as a generalized integration for all students suffering with classroom behavior and/or on the Autism Spectrum. This would then allow for a baseline sensory diet for therapists to utilize while developing a rapport with the students. This would especially be helpful when maintaining a larger case load or when appointments are short. It would allow for sensory integrations to begin prior to testing and observations in order to aid in correcting classroom behaviors earlier, limiting missed content throughout the school year.

Keywords: Autism Spectrum Disorder, sensory integration, sensory diet, attention difficulties, behavior problems

Introduction

Autism Spectrum Disorder (ASD) is a prevalent neurodevelopmental disability in the United States. It is often diagnosed in childhood due to difficulties in social contexts, restricted or repetitive behaviors, or issues with attention and other executive functions. In the school setting, a deficit in attention due to a focus on repetitive behaviors or a lack of interest in the social context can be very detrimental to the learning process. When children are seen having difficulties by teachers and other staff, therapists in the district or the parents are notified to pursue further testing and observations. This begins a long process of observations in the natural setting and in the therapy setting, many different tests, and a trial and error process of what interventions work and which ones do not. Typically, no interventions are introduced or utilized until the observations and testing are completed. With this protocol, students are waiting weeks and possibly a month or two before they are able to receive a complete sensory diet to assist them in re-engaging them in the classroom.

This paper analyzes six peer-reviewed research articles studying different sensory interventions, including proprioceptive interventions such as therapy cushions and therapy balls, tactile interventions such as weighted blankets and weighted vests, and vestibular interventions such as the platform swing. The end goal is to investigate if there is an intervention that treats attention related issues in children with ASD that can be prescribed individually while a child awaits extensive observation and testing to be designed a comprehensive sensory diet. After extensive research, to date there is no single intervention that can aid in that way for a child. However, there does seem to be a link between the type of attention deficit and type of intervention that works best for each child.

Literature Review

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is diagnosed in 1 in 68 children in the United States, 1 in 38 children in Korea, 1 in 63 children in the United Kingdom, 1 in 588 children in Venezuela, and 1 in 10,000 in Oman (Brodzeller, 2017). Children on the Autism Spectrum tend to showcase a variety of different symptoms and impairments. According to the *Diagnostic and Statistical Manual of Mental Disorders-Version 5 (DSM-5)* written by the American Psychiatric Association (APA), Autism must be “marked by delays in communication and social interactions, and restricted and repetitive behavior, interests, and activities” (Mash, 2019 pg 158). From there, symptoms can differ, falling into a variety of different categories. Those include somatosensory disturbances, atypical developmental patterns, mood disturbances and issues with attention or personal safety (Pfeiffer, 2011). Children on the spectrum also tend to have difficulties when it comes to processing, integrating, and responding to various stimuli in their surrounding environment. Between 45-90% (depending on the study) of children have demonstrated these sensory difficulties (Schaaf, 2014). This lack of ability to properly work with sensory stimuli is thought to be the reason why many ASD children participate in self-stimulating behaviors.

Self-stimulating Behavior

Self-stimulating behaviors, also known as stimming, is defined as “movements that serve no perceptible purpose in the environment” and are often displayed as “stereotypic motor movements, aimless running, aggression, and self-injurious behaviors” (Pfeiffer, 2011). Often times this will be hand or arm flapping, vocal outbursts, leg shaking, head hitting, or even skin picking. All of these behaviors interfere with children’s ability to complete day to day tasks and limits their abilities variably, depending on the intensity and how often the behaviors occur.

When it comes to participating in the day-to-day classroom, their stimming behaviors often affects their ability to engage in learning, interact with others, and pay attention. Sensory disorders tend to be categorized in three ways: sensory over responsivity, sensory under responsivity, and sensory seeking or craving (Murdock, 2014). These different sensory disorders have also been linked to a child's ability to pay attention and actively engage in the classroom setting and beyond. Due to these disorders affecting their day-to-day interactions and causing significant impairment in more than one aspect of their lives, intervention is needed.

Sensory Integration Theory

When it comes to intervention with ASD children, it often focuses on what impairments are the most influential to their lives. Common skills intervention will focus on limiting stereotypical stimming behaviors, social skills such as communicating, motor movements (fine and gross), cognitive performance, classroom performance, attention, and emotional regulation (Sorensen, 2014). Occupational therapists (OT) are commonly used to work on various therapeutic strategies with the children. One of the common interventions was originally developed by A. Jean Ayers, PhD, OTR, called Sensory Integration. Sensory integration helps children “register, modulate, and discriminate sensations received through the sensory systems to produce purposeful, adaptive behaviors in response to the environment” (Bodison, 2008). Research over the years has focused on the effects of sensory intervention and if it truly is an evidence-based practice. Over multiple research studies, sensory interventions have been found to be beneficial.

In an article written by Schaaf, et al. (2012), an intensive study with one particular child on the Autism Spectrum was completed. This particular student had difficulties with fine motor skills, participation and attention in social settings, keeping safety in mind with daily tasks,

difficulties with activities of daily living (ADL) such as dressing independently, and struggled with different routines. After participating in sensory interventions for 10 weeks, 3 sessions a week, this student made great strides toward correcting the limiting behaviors. The student was able to participate in writing and other fine motor activities. He was able to assist with dressing tasks, interact with others recognizing when they were upset, pay attention in the classroom, and showed an overall decrease in activity and impulsive behaviors. The child even was able to change up his nightly routine without throwing a fit.

Sensory Diets

Sensory integrations are typically integrated into something called a sensory diet. This is a comprehensive sensory intervention plan incorporating tactile, proprioceptive, and vestibular activities (Pfeiffer, 2008). These are highly individualized, taking into account the child's skills, goals, and interests. It also keeps in mind the abilities and wants of the parents or families, as well as the teachers when utilized in a school context. In order to build a diet for the individual student, significant time is required to properly design and prescribe interventions. The evaluation assesses the child's problem areas by first observing the child in the natural setting, whether that is at home, in the classroom, or interacting with others in a day-to-day context. From there, the OT will do interviews with the parents as well as the child's teacher (if in the school context) to see what they are like on a typical day, aside from the observation. After that, the OT will begin performing various standardized tests and various clinical observations in order to get a more comprehensive view of the child (Bodison, 2008). This also allows therapists to really understand what the child enjoys and start building a sense of rapport.

Despite the benefits that having a highly individualized program provides, the process often takes a lot of time. In the school setting, there is typically a single OT that provides

services for the entire district, if not multiple districts. The time that they are available to help the students is often minimal due to the amount of students that require services. Throughout the years, the prevalence of Autism Spectrum Disorder along with many other disabilities has increased. This is thought to be from a variety of different factors such as the descriptiveness of symptoms and the reduced overall stigma associated with disabilities. In an article written by Bagatell, et al. (2010), it was found that in the year 2000 more than “79,000 children with ASD received services” and later in 2006, “the number increased to more than 224,000”. The combination of limited resources mixed with increasing need makes the evaluation process even longer, increasing wait times for students to be evaluated which impacts the child’s ability to function (Bremer, 2016).

Attention Deficits

Children who have attention problems due to the nature of their disability often require intervention in order to successfully learn information within the classroom. Attention deficits, as briefly discussed previously, can become a major issue for kids on the Autism Spectrum. Attention issues stem from a variety of different problems such as their self-stimulating behaviors distracting them, their lack of social awareness keeping them from being on-task, or an overall deficit in self-awareness and proprioception. While students are waiting to be evaluated properly to have a sensory diet, they are continually losing more and more classroom content until the OT can get around to their waitlist. This poses a serious issue impairing the child’s ability to successfully master material in their grade level. The findings in this study are interesting, raising awareness on how to best serve students who are placed on that waiting list in order for them to not miss important class content.

Research Questions

The purpose of this paper was to review currently published research regarding best practices for OT care with ASD. Specific questions that will be addressed are:

1. Among the various interventions that would make a comprehensive sensory diet, is there a specific intervention that holds external validity with all children on the Autism Spectrum that would allow them to increase their participation, attention, and on-task behaviors?
2. Could a single intervention help enough to get the student in the right direction in order to limit missed content while waiting, or is a comprehensive diet the only way sensory interventions work? Are there multiple interventions that show promise in assisting children on the Autism Spectrum when utilized on their own?

Methods

This study was comprised of six peer-reviewed research articles pertaining to common sensory interventions that are used within a sensory diet. These sensory interventions fall into three major categories: proprioceptive, tactile, and vestibular interventions. Proprioception is the sum of neuronal impulses that come from the muscles, skin, ligaments, tendons and joints and allow for an individual to understand where their body is located in space (Blanche, 2012). Activities in proprioception help to correct issues that a child may have with posture, motor planning or control, decreased organization of space, or behavior regulation. Tactile interventions refer to stimulating the sense of touch or feel. Often times children on the spectrum may have tactile defensiveness where they are hypersensitive to external stimuli from touch or texture. Sometimes this is seen as an extreme sensitivity to tags on clothing, clothing in general, or receiving hugs. They may stray away from activities that would require them to get their hands dirty, especially if they are working with different textures. Due to their tactile defensiveness, they may have difficulties with self-regulation, modulation, and anxiety (Srivastava, 2019). The vestibular system relates to a person's sense of balance and stability created by a fluid found within the ear canal. Vestibular interventions therefore act to re-stabilize and balance a child on the spectrum, allowing them to regain coordination and remain safe in daily activities.

This study searched for resources from January 1st, 2008 through February 2019 to provide a comprehensive review of the most recent data available. Utilizing research databases, this study found peer-reviewed articles from the American Journal of Occupational Therapy, Behavioral Disorders, Focus on Autism and Other Developmental Disabilities, Autism, and other various journals to provide factual information. To find these articles, the key words "Autism

Spectrum Disorder”, “Autism”, “Attention”, “Sensory Interventions”, and “Occupational Therapy” were utilized. In order to reach conclusions, the data from the results section of each article were analyzed. Taking into consideration the sample size, intervention, characteristics of the participants (i.e. tactile defensive, attention problems, behavior regulation, etc.), and the validity of each study, this paper will assess the effectiveness of the overall interventions. With the determined effectiveness, it is the goal to determine which intervention works the best and is able to be generalized the most to all children on the Autism Spectrum.

Table 1

Category	Title	Author (year)	Size (n)	Description
Proprioceptive	Effectiveness of Disc ‘O’ Sit Cushions on Attention to Task in Second-Grade Students With Attention Difficulties	Pfeiffer, Henry, Miller, and Witherell (2008)	63	Researchers wanted to look into the effects of the Disc ‘O’ Sit therapy cushion in improving the attention of second-grade students. 31 were assigned to the treatment group while 32 were assigned to the control group. Teachers allowed the discs to be used for 2 hours of each school day for 2 weeks. They then rated students using the Behavior Rating Inventory of Executive Function before and after the use of the therapy disc. An analysis of variance was completed on the results to determine if there was evidence of a change in attention. The results provided evidence that there may be an improvement.

Proprioceptive	Effects of Therapy Cushions on Classroom Behaviors of Children With Autism Spectrum Disorder	Umeda and Deitz (2011)	2	Researchers focused on the on-task and in-seat behaviors of a 5 and 6 year old utilizing an A-B-A-B-C design over a 2-3 week span. A chair was baseline, the cushions were the treatment and the final stage of the study they allowed the child to choose their preferred seating method. At the end of the study, there were no clinically relevant changes on behaviors with the implementation of the cushions.
Proprioceptive	Effectiveness of Therapy Ball Chairs on Classroom Participation in Children With Autism Spectrum Disorders	Bagatell, Mirigliani, Patterson, Reyes, and Test (2010)	6	Researchers worked to assess the effectiveness of therapy ball chairs on participation and attention with six boys on the Autism Spectrum. They looked at in-seat behavior and engagement in the lessons during circle time. They found that the reaction and in-seat behaviors depended on the child's needs. They found that those with posture issues did worse with the therapy ball compared to those with proprioceptive needs.
Tactile	The Effects of Deep Pressure Therapies and Antecedent Exercise on Stereotypical Behaviors of Students With	Losinski, Cook, Hirsch, and Sanders (2017)	3	Researchers alternated treatments of antecedent exercise, weighted blankets, and weighted vests to see how each treatment affected the child's stereotypical

	Autism Spectrum Disorders			behaviors such as self-stimulating behaviors. They utilized three elementary school children and treated them for four weeks and found that while deep pressure didn't seem to decrease behaviors, antecedent behavior had a mixed effect, decreasing behaviors in two of the three children.
Tactile	Pilot Study of the Effectiveness of Weighted Vests	Collins and Dworkin (2011)	10	Researchers focused on the effects of a weighted vests on the attention of second-grade students. They utilized an ABA design over a three to six week span. Participants, teachers, and research assistants coding the data were all blind to who was a control and who was a part of the treatment group. A repeated measures analysis found no significant differences between the groups indicating no effect of weighted vests on attention.
Vestibular	The Effect of a Platform Swing on the Independent Work Behaviors of Children With Autism Spectrum Disorders	Murdock, Dantzer, Walker, and Wood (2014)	30	Researchers utilized a randomized pretest-posttest to look into the effect of a platform swing on independent work behavior on preschool children with Autism or Pervasive Development Disorder. The participants engaged in two five-minute intervals of work and were then

				given intervention of either platform swinging or watched a video, depending on if they were the treatment or control. No significant differences in independent work, in-seat behavior, stereotyped stimulating behaviors, on-task behavior, or engagement was seen.
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Results

The following findings were taken from each of the articles that were analyzed during the research process. Six peer-reviewed research articles were analyzed within three categories of interventions: proprioceptive, tactile, and vestibular. These three categories tend to work hand in hand with one another and most interventions are a combination of two or all three. For the purpose of this study, the interventions have been divided into the category it most strongly represents, even though it may incorporate more than one. Interventions that were analyzed included therapy cushions, therapy balls, weighted vests, deep pressure therapy, and platform swings. Other interventions were searched for but no other peer-reviewed journals were found utilizing the search criteria determined at the beginning of the study. The lack of research on interventions in the past ten years is touched on later in the discussion. Each study lacked generalizability due to their small sample sizes and inconsistent, opposing findings.

Proprioceptive Interventions

As discussed in the methods section, proprioceptive interventions include activities that work to improve the child's ability to understand the space that their body takes up. The two interventions that were discovered as proprioceptive interventions for this study included therapy cushions, or the Disc 'O' Sit Cushion, and therapy balls. Both are utilized in the classroom and therapy settings in order to improve "balance, postural control, attention, and sensory seeking behaviors of the..proprioceptive sense" in children (Bagatell, 2010). Engaging their core in order to maintain an upright seated position allows the nervous system to recognize that they are in fact still utilizing the space around them. These interventions recognize that "the body experiences less proprioceptive and kinesthetic feedback when it does not move" and therefore may contribute to decreased attention in children on the spectrum simply because they are being

under stimulated (Pfeiffer, 2008). This study will review three articles, two of which pertain to the therapy disc and one pertaining to therapy balls.

In an article by Pfeiffer, Henry, Miller, and Witherell in 2008, they studied 61 second-grade participants from six elementary schools located in northern Pennsylvania. Their research goal was to determine if Disc 'O' Sit cushions helps to improve attention difficulties in the classroom. Utilizing a treatment group of 29 students and a control group of 32, they tested to see if using the cushion two hours a day for two weeks would improve a student's attention. This was judged by pre and posttests that were completed by the teachers of the classroom. They found that students that were using the cushions were able to self-regulate enough to increase their attention to their tasks (Pfeiffer, 2008). Despite these being positive results, their effect size was only small to medium in the categories they tested making this not generalizable. This could have either been due to the minimal dynamic nature of the cushions, or it could be due to the fact that they let the teachers rate the intervention and therefore they may have judged based off of their own expectations.

In another article by Umeda and Deitz (2011) that also studied therapy cushions, only two individuals both with a diagnosis of ASD were studied. The authors focused on in-seat and on-task behaviors in relation to attention. The first participant had more disruptive self-stimulating behaviors while the second participant fidgeted more and was noted to have difficulty maintaining an upright seated position prior to the intervention. This study utilized an A-B-A-B-C series design in order to see behaviors before and after intervention, as well as which they would choose, a regular seat or the therapy cushion, if given the decision. The full length of the study took about thirteen and a half weeks with a one week break within the data collection. They analyzed each participant separately but found that neither of them seemed to do better

when it came to in-seat or on-task behavior. There was a small increase in on-task behavior with participant one when the intervention was introduced for a second time (Umeda, 2011).

The teacher was also able to state their observations with each student and noted that they noticed that the participant with posture difficulties seemed to do better when seated on the therapy cushion. Participant one preferred sitting in a regular classroom chair while participant 2 preferred sitting on the therapy cushion. They believed that the cushions did not show a positive effect because compared to other dynamic seats, the cushion does not activate the core musculature as much as a therapy ball and therefore does not keep the student alert, active, and engaged (Umeda, 2011).

In a third article written by Bagatell, Mirigliani, Patterson, Reyes, and Test (2010), the effectiveness of therapy balls when it came to classroom participation of students on the spectrum were researched. They studied six boys with Autism Spectrum Disorder struggling with in-seat behavior and engagement in the classroom setting. They created a baseline, introduced the intervention, and then allowed the student to choose what they liked better toward the end of the study. Data was collected over a four week span, daily for sixteen minutes during their Circle Time. One of the participants showed a large improvement when it came to their in-seat behavior and he continually chose to remain on the therapy ball (Bagatell et al., 2010). Another participant did not improve with the therapy ball and when given the choice, preferred the regular chair. A third participant saw no improvement with the intervention, yet chose the therapy ball to use at the end of the study. With his choice his out-of-seat behavior improved slightly. The fourth and fifth participants had an initial improvement in out-of-seat behavior when the intervention was introduced but then resumed to his baseline. When given the choice,

they chose the regular chair and there was a slight decrease in their out of seat behavior. There was no data for the sixth participant for in-seat behavior.

When it came to engagement, the therapy balls had no effect for any of the participants. The teacher expressed that she did not see an improvement with the students when it came to using the therapy balls. Only two of the six children preferred the therapy balls over the regular chairs to sit in during Circle Time. The researchers concluded that the therapy balls do not seem to positively affect in-seat behavior or engagement and admitted that for some children it hurt more than helped. The researchers made an interesting point of different kinds of sensory processing levels being a possible reason why the different children reacted in different ways to the therapy balls. They expressed that therapy balls may be too difficult to maintain posture for some students and that interventions should be individualized by child.

Through three different articles, the effects of therapy cushions and therapy balls in relation to attention and classroom behaviors with children with ASD in the classroom setting were observed. These two different interventions did not prove to be beneficial or able to be generalized to the population of children with Autism Spectrum Disorder, or for those with attention difficulties. Despite these findings falling short of the goal, the different studies did bring up important points of the variability of children with ASD. It also pointed out the lack of research completed on that topic and the need for it to exist. In these studies as well as the ones to follow, boys tend to make up the majority of the sample population. This is because “males (are) 5 times more likely” to be diagnosed with ASD (Losinski Cook, Hirsch & Sanders, 2017).

Tactile Interventions

As referred to in the methods section, tactile interventions utilize the child’s sense of touch in order to overcome their difficulties with self-regulation, modulation, and anxiety. For

this study, articles were found discussing deep pressure therapy and weighted vests. Both are utilized in the classroom setting to help improve arousal in order to make improvements in attention and decrease disruptive behaviors (Losinski et al., 2017). Researchers believe that by adding pressure and stimulating the central nervous system by touch, it can reduce anxiety and give them a sense of calm.

The first article written by Loskinski, et al. (2017), examined the overall effects of deep pressure therapies in three children who were diagnosed with Autism Spectrum Disorder: Chad, Samuel, and Isaac. Researchers wanted to compare and contrast the effects of a weighted blanket, weighted compression vest, and an exercise bike. They were curious as to how the children would engage in stereotypical behaviors and maintain attention to tasks based on which intervention they were using. The study occurred over a period of four weeks where the students participated in no more than two sessions per day. They randomly alternated what intervention each student would receive until they reached 5 treatment cycles. The weighted blanket, when utilized, was worn for 10 minutes before they were to begin participating, but not during the actual observation. The compression vest was used 10 minutes before the observation and the 10 minutes during. The exercise bike was utilized 10 minutes prior to the observation for at least five minutes. The observation would then be done three to five minutes after that particular intervention.

For Chad, who originally had difficulties with disruptive behaviors, got distracted easily, and had co-occurring epilepsy and a stereotypical behavior of echolalia, the weighted blanket appeared to help. There were reductions in his stereotypical behavior but there were no increases in attention. Chad also chose to use the weighted blanket whenever he could. Samuel was nonverbal, struggling with attention problems and eye contact. He refused to use the weighted

blanket and there were only small decreases in stereotypical behaviors when he used the exercise bike. Nothing was able to increase his attention. Isaac was low verbal and had severe behavior problems, but was really good with attention when in a one on one setting. Exercise also seemed to be the most beneficial with decreasing stereotypical behaviors, but nothing affected his attention level. This study concluded that they proved that there was an “ineffectiveness of deep pressure therapies” (Losinski et al., 2017).

Research by Collins and Dworkin (2011), studied the effectiveness of weighted vests in relation to on-task behaviors and the ability of participants to remain in their seats. The study interacted with 10 different participants and randomly assigned them to wearing a weighted denim vest or a non-weighted vest. Each child was filmed for a total of 90 minutes in ten minute increments over a three to six week period during their scheduled seatwork time during the school day. Not all of the participants had an Individualized Education Plan (IEP) but struggled with remaining in their seats and paying attention to the task at hand. For the seven participants in the intervention group, the teacher observed behavior change in four of them when it came to their ability to remain in their seats and work on their tasks with focused attention. In terms of qualitative and quantitative data, there were no significant effects between the intervention and control groups, however two participants in the intervention group conformed to the hypothesized pattern of doing better with the intervention and worse when it was withdrawn. There were also six participants, two from the control and four from the intervention group that actually did worse with attention while wearing the vest proving it to be a distraction for some kids. This article concluded that weighted vests were not effective in increasing attention in students with a difficulty (Collins & Dworkin, 2011).

The studies both were inconclusive and showed that deep pressure therapy may not be as helpful as professionals have thought over the years. They expressed that “movement is an effective self-regulation” intervention that at that time was starting to show positive results in the field (Collins & Dworkin, 2011). Deep pressure therapy has always been thought to be experimentally supported since it is a tactile and proprioceptive intervention that was thought to alert the central nervous system. These articles question that assumption and they both call for additional research on bigger samples in order to generalize and ensure that there were no external reasons why their research was inconclusive.

Vestibular Interventions

Vestibular interventions often involve dynamic movements of the body in order to move the liquid found within the ear canal that controls balance and coordination. The vestibula also aids us in having a sense of where we are in space directionally. Activities that work the vestibular system typically include rapid movement that can be jerky in nature, in many different directions or linearly, depending on the outcome wanted for the child (Ford-Lanza, 2017). The current most commonly researched vestibular intervention is the platform swing. It was also the only intervention that was studied based on the search criteria within the last ten years.

Murdock, Dantzler, Walker, and Wood (2014) researched whether a sensory break utilizing slow, linear movements on the platform swing allowed for a difference in on-task and engaged behaviors, as well as stereotypical movements in children on the spectrum. They studied 30 students who were randomly distributed into control or treatment groups. Both groups would engage in a five minute activity, receive a break either with a movie or sensory intervention, and then return to another five minute activity. The study collected 60 intervals of data in ten second segments. They found that there was really no significant increase in on-task or engaged

behaviors or decrease in stereotypical behavior with the intervention. Thirteen participants showed a 10% increase in at least one of the target behaviors, but only five of those were from the treatment group. The authors decided to group the participants in different levels of sensory patterns in order to see if there was a difference. They found that 66% of the participants that showed a 10% increase were sensory seeking and 14% were seeking or under responsive (Murdock et al., 2014). They compared this to known data which showed that the over responsive group experimentally tends to have better increases in on-task behavior with vestibular interventions. The findings from this study did not compare to the previous research. They therefore concluded that the platform swing was not an effective intervention and that they do not recommend it for therapy treatment at this time.

Among all of the different sensory interventions that could possibly be used with a sensory diet, there does not seem to be a current intervention that holds external validity among children on the Autism Spectrum. Utilizing all of this relevant research, there was no significant data to prove that there is an intervention that aids in limiting self-stimulating behaviors, increasing in-seat, on-task, and engaged classroom behavior, or increasing attention. With this data at this time it appears that utilizing a single intervention does not affect every single child in the same way. For some children, some interventions worked better than for others. However, at this time it looks like a comprehensive sensory diet is unfortunately the only way to truly assist a child in regaining attention deficits that are related to Autism Spectrum Disorder.

Discussion

This study critically looked at six different articles looking at three major categories of sensory interventions: proprioceptive, tactile, and vestibular. Overall, all of the interventions did not seem to have a substantial effect on the students that they studied. However, something that was apparent between all of the studies was the lack of sample size and therefore there was an inability to generalize the data to the entire population. It was also stressed by multiple studies that there is a general lack of research on the topic of sensory interventions, especially in relation to their effectiveness in real populations (Umeda, 2011). It is the job of an occupational therapist to “use..evidence-based interventions...(to) provide services under the Individuals with Disabilities Education Improvement Act of 2004 (IDEA)” (Pfeiffer, 2008).

This is extremely alarming as an individual entering a field where there is a lack of evidence-based interventions that we are stating have been studied. It is important as professionals in the field to continually give back to the field in order to continually progress it for years to come. Without evidence-based practice, we are no longer operating in a legal realm and makes this part of our field against the IDEA. There were several possibilities within the research to recommend why we are lacking findings in the research. For example, maybe when we learn about our participants, we are not learning enough information about their sensory needs. There are some studies where we are using therapy balls for children who score low in postural coordination and core strength (Bagatell et al., 2010). Using an intervention using a comorbid weakness is not going to be beneficial for them, nor are there going to be positive results that come from that intervention for that child, making it unable to be generalized.

For some participants, the intervention that is being utilized may be too structured for the individual (Losinski et al., 2017). Some children may need to have more of a choice in order to

feel like they are getting the most out of their intervention. Functional capacity may also play a large role in a child's ability to cope and therefore more calming sensory interventions may work better for getting them to increase their attention and on-task behaviors, while decreasing their stereotypical behaviors (Losinski et al., 2017). For example, in the Deep Pressure Therapy study by Losinski et al. (2017), Chad benefited more from the deep pressure calming intervention as opposed to the other two participants because his functional capacity was a lot higher. All of these reasons show the dynamic symptoms of Autism Spectrum Disorder and why there is such a need for a personalized sensory diet. However, these take time to provide and sometimes children will be waiting weeks to a month or two to have a diet that will allow them to stop losing class material due to inattention and disruptive behaviors.

Across the research studies, something became apparent that is important for the findings in this research study. Based on the child's sensory difficulties and their inattention style, there seems to be a correlation to their outcome to different sensory interventions. The article by Murdock et al. (2014) discussed the concept of different levels of sensory patterns: sensory over responsivity, sensory under responsivity, and sensory seeking/craving. Researchers discussed how this can relate to how children will react to different sensory interventions. Their particular research showed that the participants who were sensory over responsive did not have any improvement with vestibular intervention however, those who were seeking or under responsive did see small improvements. This could be something to complete additional research on in the future. Finding a relationship with this could make it easier to implement a single intervention without needing to do much interaction with the child until a comprehensive sensory diet can be completed with additional testing.

Attention Deficit Hyperactivity Disorder (ADHD) and Autism are often comorbidities because they are both neurodevelopmental diseases. There are three different types of attention problems: inattention, hyperactive, and impulsive (NIMH, 2016). Inattention relates to a child's inability to pay attention simply because they get really distracted by what is going on around them or internal thoughts. Hyperactive and impulsive tend to go together and are often shown by the child interrupting, being unable to wait their turn, and often cannot sit still when doing seat work. These similar symptoms show why there is a comorbidity between ADHD and ASD. Children also tend to get distracted by different factors associated to the different sensory patterns. Some children have difficulty paying attention because they are so sensory unresponsive that they cannot feel their own body and they lack proprioception. Other children are overly sensitive and are affected by internal thoughts or overstimulation by their clothing and other things related to themselves that they fail to pay attention. Some children get extremely distracted by the outside environment and outside stimuli that they suffer with attention deficits.

Combining these ideas together, more research needs to be done looking into how the different types of sensory pattern relate to the attention deficit they have. Sensory interventions may work differently depending on where they fall. For future research, I believe it is important to look into this connection; from these peer-reviewed research articles, those with over responsive tendencies like Chad, may benefit from tactile interventions, such as deep pressure therapies, because it may squeeze them and center them for a means of comfort to where they are not recognizing all of the small stimuli surrounding them. Those who are under responsive or seeking/craving may do better with vestibular or even proprioceptive interventions like the platform swing or the therapy ball/therapy cushions, like the participants who showed benefits in some categories linked to on-task behaviors in the article by Murdock, et al (2014).

Interventions that had no current data that should be researched in the near future would be additional tactile interventions including any kind of fidget material or oral material. Fidgets are gaining a lot of popularity and are being prescribed in diets as an evidence-based practice to increase attention and on-task behaviors. These could include fidget cubes, fidget spinners, therapy putty, and more. Oral motor materials were more popular in years earlier than 2008, but nothing has been done more currently. Oral motor materials like chew sticks, bracelets, and necklaces are also still being incorporated in diets but there is a lack of current research on the effectiveness. Overall, there needs to be additional research completed on all sensory interventions, especially in relation to those with ASD. Sensory interventions as a whole have been found to be productive, but when used individually they are being found to have little to no effect on different children with Autism Spectrum Disorder. In order to maintain the occupational therapy duty as described by IDEA, the field needs to increase their research and peer-reviewed journal prevalence in order to educate current and future professionals. In conclusion, there is not an individual sensory intervention that works better for a student with ASD to prevent them from losing content in the classroom due to inattention. Further research must be done on different and more prevalent or trendy intervention types and should look into different interventions working better for different sensory processing patterns and attention deficits.

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