

Sensory Processing Disorder and the Presentation of Challenging Behaviors in the Classroom—
Teacher Strategies Derived from Established Sensory-Based Interventions

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Sensory Processing Disorder and the Presentation Challenging Behaviors in the Classroom—Teacher Strategies Derived from Established Sensory-Based Interventions

Every individual is constantly processing and managing sensory messages. There are five familiar senses sight, sound, touch, taste, smell, as well as two less familiar, proprioceptive and vestibular (DiMatties & Sammons, 2003). The five common sensations we receive give us information about the environment surrounding us. While the two less familiar, are present to detail events that occur internally, providing information on body position and movement. “Most are born with the ability to receive sensory messages and organize them effortlessly in the “right” behavioral and physiological response,” (Miller & Fuller, 2007, p. 5). This means that for the majority of individuals sensations can be automatically translated into the proper behavioral and physiological response. Sensory Processing Disorder (SPD) is the current name for the condition that affects the sensory abilities of at least one in twenty children through a complex neurological dysfunction (Miller & Fuller, 2007). Sensory Processing Disorder exists when sensory signals do not get organized into the appropriate response. For individuals with SPD it is not that they do not receive any sensory information, instead, the sensory information is sensed normally, but perceived abnormally (Roley, Bissel, & Clark, 2008). As a result, a child’s daily routines and activities are disrupted and generally cause distress or confusion (Miller & Fuller, 2007). Consistent failure in one area of sensory processing is often linked to difficulties with sensory information in other activities. “If a child routinely fails to organize similar messages, chances are he will have problems in other areas that rely on that same sensory and motor foundations” (Miller & Fuller, 2007, p. 5). Since children with Sensory Processing Disorder do not process sensory information the way typically developing children do, they may not behave

the same way either. “Some feel sensations more intensely, others feel them less intensely, and some just don’t get sensory information ‘right’” (Miller & Fuller, 2007, p. X).

The condition increasingly now known as Sensory Processing Disorder was originally termed sensory integration disorder. Dr. A. Jean Ayres coined the term sensory integration when she first recognized and pioneered the study of the disorder in the mid-1900’s (Ayres, 1972 as cited in Miller & Fuller, 2007). Ayres’ work was prompted by her clinical observations of children with learning disabilities; believing that learning is a function of the brain and that learning disabilities reflect deviation in this functioning (Schaaf & Miller, 2005). Dr. Ayres is well known for her exploration of the association between sensory processing and the behavior of children with disabilities. “She theorized that when sensory processing is impaired in a child—when there is a ‘sensory integrative dysfunction’—social, emotional, motor, and/or functional problems can result” (Ayres, 1972 as cited in Miller & Fuller, 2007, p. 6). The body of research that was produced by Dr. Ayres now serves as a cornerstone of study into Sensory Processing Disorder. A significant portion of Ayres’ work hinged on the connection between sensory processing and resulting behavior. Though it would be more simplistic if Sensory Processing Disorder produced only one or two patterns of unusual behavior, SPD produces a multitude of processing patterns that are unique to each different individual. “SPD produces three classic symptom clusters that may occur independently or in combination with one another and that can range in severity from mild to severe” (Miller & Fuller, 2007, p. 11-12). The three patterns of SPD recognized are Sensory Modulation Disorder (SMD), Sensory-Based Motor Disorder, and Sensory Discrimination Disorder. Furthermore, within these three major patterns there exist multiple subtypes that all fit under the umbrella of Sensory Processing Disorder (Miller & Fuller, 2007).

The degree of difference between children with Sensory Processing Disorder and typically developing children varies, as it would with any other condition. Some children are affected in only one sensory system while others are affected in multiple systems (Miller & Fuller, 2007). Additionally, children within the same subtype patterns may exhibit symptoms at different severity levels. “Symptoms of the same subtype may be severe enough to raise parents’ alarm from birth or so mild that it takes years to recognize that something about their child’s functioning isn’t quite right” (Miller & Fuller, p. 13). No matter where the child’s symptoms fall on the continuum of severity, Sensory Processing Disorder needs to be identified as early as possible. When symptoms are not visible or do not immediately affect those around individuals with SPD, the issues can be overlooked. No matter how obvious, Sensory Processing Disorder always deprives children of important sensory information and experience that they require in order to learn and develop (Miller & Fuller, 2007). Regardless of severity the social, emotional, motor, and academic development is hindered unless timely help in overcoming and adapting to the disorder is received.

The symptoms an individual displays are the by-product of many factors, which extend beyond the pattern and severity of Sensory Processing Disorder that they possess. Examples of these factors would be “the time of day, the setting, the child’s level of stress or fatigue, and the specific sensation involved” (Miller & Fuller, 2007). All of these factors are intertwined within the context of a situation that has its own standards and expectations. Each of us functions most efficiently when there is a “just right” fit between our context and our innate personal characteristics (Miller & Fuller, 2007). Children with typical sensory processing skills possess the ability to make necessary adaptations to achieve a good fit in situations they do not like. In contrast, children with Sensory Processing Disorder are not able to process sensory information

naturally and efficiently, making it harder for them to achieve the appropriate fit between their characteristics and the context (Miller & Fuller, 2007). Overall, context can place a child's sensory difficulties into perspective for parents and others. "Context explains why the same child may be totally competent in one setting or at certain times of day and utterly lost in other ones" (Miller & Fuller, 2007, p. 16). Placing children with SPD into their individual contexts allows professionals to develop new techniques that better serve the child's sensory needs.

Children who experience significant difficulty processing sensory information, those with SPD symptomology, receive intervention through sensory-based strategies. These are strategies based upon work done by Ayres (1972), the influential individual in the discovery of Sensory Processing Disorder. Ayres', an occupational therapist, originally designed what she coined Sensory Integration Therapy, a strategy that explores the potential relationships between the neural process of receiving, modulating, and integrating sensory input and the resulting output: adaptive behavior (Schaaf & Miller, 2005). Adequate processing is crucial to the production of adaptive behavior. "The goals of treatment are to improve sensory modulation related to behavior and attention and to increase abilities for social interactions, academic skills, and independence through better SI [Sensory Integration]" (Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson 2011, p. 77). With this goal in mind, occupational therapists create sensory-rich therapeutic environments that produce opportunities for meaningful sensational exploration and encourage the child's desire to play. In this playful environment, the therapist guides the child through challenging and fun activities designed to stimulate sensory systems and facilitate integration of sensory motor, cognitive, and perceptual skills (Schaaf & Miller, 2005). By way of these playful activities, the therapist creates a treatment that provides the child with controlled sensory experiences to elicit an adaptive response (Pfeiffer et al., 2011). Ultimately, this

therapeutic intervention results in future adaptive responses that allow the child with sensory processing difficulties to gain independence in their daily routines.

For children with Sensory Processing Disorder early diagnosis is key because it leads to early intervention. Early intervention increases the chance of successful outcomes through treatment. The immature brains of young children are more “plastic”, which enables them to be more flexible and change more easily (Miller & Fuller, 2007). As a result, intervention is more effective. This is not to say that older children cannot benefit. Older children still benefit from intervention, however “...the benefits may take longer to achieve and may be based on cultivating coping skills rather than modifying the brain, as early intervention is believed to do” (Miller & Fuller, 2007, p. 45). When Sensory Processing Disorder is identified it provides the correct diagnosis for the unusual behavior exhibited. Due to the fact that their behavior is atypical, children with SPD often attract negative labels from peers and adults. “With intervention these behaviors get labeled for what they really are—symptoms of an underlying neurological disorder (Miller & Fuller, 2007, p. 46). In this manner, undesirable stereotyping and punishment can be avoided for children with SPD. Diagnosis of Sensory Processing Disorder often begins with screening, where professionals search for markers and indicators to determine if differences in development exist and are sufficient to warrant a more comprehensive assessment (Sensory Processing Disorder Foundation, 2014). Screening can take place in many different settings, which may be a school, physicians office, or a private practice clinic. If there exist substantial differences to warrant further assessment, the next step is evaluation. “An evaluation for SPD involves standardized testing, detailed clinical observation, and parent-report measures” (Sensory Processing Disorder Foundation, 2014). Once an evaluation is completed, a diagnosis may be made and intervention can then begin.

Occupational therapists generally are the professionals who work with children who have sensory processing disorders and then consult with caregivers and classroom teachers. After performing an assessment, occupational therapists can determine the nature of the child's sensory processing needs. Taking this information into account, the occupational therapists implement strategies and design activities specifically to develop skills and help with adaptation. There are many different methods that occupational therapists can implement and tailor to the needs of the child. Since children with sensory processing disorder are a heterogeneous group, this individualization of intervention is vitally important to the effectiveness of treatment programs.

Unfortunately, when the *Diagnostic Statistical Manual of Mental Disorders-Fifth Edition* (*DSM-5*) was created in 2013, Sensory Processing Disorder was denied inclusion into the text. While Sensory Processing Disorder is not included in the *DSM-5* as a separate, diagnosable condition some characteristic aspects of the disorder are still recognized as a symptom or behavior of other disorders, specifically Autism Spectrum Disorder. Autism Spectrum Disorder is characterized by social communication impairments and restricted repetitive patterns of behavior, interests, or activities. Restricted, repetitive patterns can be manifested through the appearance of fascinations and routines in children as related to apparent hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (*DSM-5*; American Psychiatric Association, 2013). Children with Autism Spectrum Disorder commonly exhibit extreme reactions or rituals that involve taste, smell, sound, touch and texture. Examples of this behavior include “extreme responses to specific sounds or texture, excessive smelling or touching of objects, fascination with lights or spinning objects, and sometimes apparent indifference to pain, heat, or cold” (*DSM-5*; American Psychiatric Association, 2013).

Literature has established that a relationship exists between the appearance of Autism Spectrum Disorder and sensory processing abnormalities in young children. Studies have demonstrated that children with ASD routinely display more abnormal responses to sensory input specifically in areas of tactile sensitivity, auditory filtering, and taste/smell aversion (Tomchek & Dunn, 2007; Wiggins, Robins, Bakeman, & Adamson, 2009). Similar to Sensory Processing Disorder, sensory abnormalities that appear in children with ASD are considered as red flags to be considered when seeking a diagnosis and are significant for early identification efforts (Wiggins et al., 2009). Due to the fact that aspects of Sensory Processing Disorder are considered to be part of the criterion for diagnosis of Autism Spectrum Disorder it is an applicable means of examining treatment effectiveness of sensory-based strategies.

It has continually been shown in research that children with Autism Spectrum Disorder exhibit atypical behavioral responses to sensory input. These differentiated responses to sensory input affect the way in which children with ASD act in the classroom, generally teachers notice behavioral and emotional problems, sensory over-reactivity, and anxiety (Ashburner, Rodger, Ziviani, & Hinder, 2008). Eaves & Ho (1997) determined that the “educational progress of children with ASD can be affected by their limited capacity to self-regulate their emotional and behavioral responses and remain on task (as cited in Ashburner et al., 2008, p. 564). Classrooms are typically complex sensory environments and this is important to consider when working with children with ASD. It is their maladaptive responses to these complex sensory environments that are believed to underlie most of the negative behaviors that teachers have observed. Research has shown that individuals with ASD are slower in reorienting their attention between visual and auditory stimuli and between visual stimuli in different spatial locations (Ashburner et al., 2008). For example, the classroom is a typically noisy place and with all of the background noise

around the child with ASD it is hard for them to focus in on one object or one person's voice, namely the teacher's (Grandin, 1992). This atypical slowness in reorienting attentions leads to a preference for static, repetitive, and predictable stimuli. "They may therefore either seek predictable, repetitive sensory input as a means of screening out complex sensory input that is overwhelming or difficult to process or indulge in their preference for predictable, repetitive sensory input when understimulated" (Ashburner et al., 2008, p. 565).

The goal of this study seeks to connect sensory-based strategies, derived from sensory-based theory and occupational therapy practices, to the classroom for any children displaying SPD symptomology regardless of a diagnosis of ASD or other disorders. A child's inability to modulate, discriminate, coordinate or organize sensations negatively affects their ability to function and participate within the classroom. Without these important abilities often children with Sensory Processing Disorder fall behind in school and other childhood accomplishments. When these children attempt to gain the input from the environment that they require for success often their behavior is negatively labeled, causing them to be viewed by the teacher as behavior problems. For this reason, it is important that teachers become more knowledgeable about Sensory Processing Disorder. As they become more familiar with the concept, they can impact the children they work with by providing them with intervention resources. Due to the fact that Sensory Processing Disorder is not a recognized condition within the DSM-5, it is not as prevalent in the literature to be studied for this research, however, it is a distinct concept within the diagnosis of Autism Spectrum Disorder. Therefore, this study plans to research sensory-based intervention strategies that have been established for the treatment of sensory processing abnormalities present in children with Autism Spectrum Disorder. Taking this knowledge, the study will demonstrate ways in which the strategies discussed within previously performed

research can be translated and implemented within the general education classroom for any child who struggles with a Sensory Processing Disorder. It is important to understand that many different children may present with Sensory Processing Disorder and that there is comorbidity between SPD and other common childhood disorders (Sensory Processing Disorder Foundation, 2014). For this reason the research found in this study will be synthesized so that it can have relevance to any child in a classroom who presents with sensory needs. By providing teachers with this knowledge, this study hopes to prepare teacher's to provide sensory-based strategies for children in their classroom. Using this knowledge, teachers will be able to deliver important assistance within their classrooms to enhance the learning capabilities of all students regardless of their diagnosis.

Literature Review

Children with Autism Spectrum Disorders (ASD) could present with co-occurring sensory processing disorders and either hyper- or hypo-reactivity to sensory input or an unusual interest in sensory aspects of the environment are now a diagnostic criteria for ASD in the *Diagnostic Statistical Manual of Mental Disorders—Fifth Edition (DSM-5; American Psychiatric Association, 2013)*. Sensory processing problems in children with ASD are believed to be an underlying factor associated with behavioral or functional performance problems (Case-Smith, Weaver, & Fristad, 2014). Ornitz (1974) believed that sensory modulation problems are related to stereotypic or repetitive behaviors, such as behaviors now shown by children with ASD, and that the stereotypic behaviors demonstrate the child's attempt to lower arousal (self-calm) or increase arousal (sensory-seeking) (as cited in Case-Smith et al., 2012, p. 2). The understanding that sensory processing problems can influence the behavior of children with ASD has affected the focus of intervention. "When sensory processing problems are believed to influence a child's behavior, interventions that use sensory modalities to support self-regulation, promote optimal arousal, improve behavioral organization, and lower over-reactivity are often recommended" (Case-Smith et al., 2014, p. 2).

An important study was performed in 2014 by Case-Smith, Weaver, & Fristad that sought to systematically review the research evidence of two forms of sensory interventions that have been used for children with Autism Spectrum Disorder. Researchers believed that although "wide recognition of sensory processing problems and their effects on life participation for individuals with ASD, sensory interventions have been inconsistently defined and refer to widely varied practice" (Case-Smith et al., 2014, p. 2). When sensory interventions are among the services most requested for children with ASD, this lack of consensus has resulted in great

confusion for parents and practitioners. This study seeks to examine and assess the evidence of different types of sensory processing interventions to determine which would be most beneficial for teachers to implement in the classroom with children who have sensory issues. The two forms of intervention that this study will focus on are sensory integration therapy and sensory-based intervention for children with autism spectrum disorders and concurrent sensory processing problems (Case-Smith et al., 2014).

Sensory Integration Therapy (SIT)

One form of sensory intervention frequently recommended for children with Autism Spectrum Disorder is sensory integration therapy (SIT). “SIT is a clinic-based intervention that uses play activities and sensory-enhanced interaction to elicit the child’s adaptive responses” (Case-Smith et al., 2014, p. 3). By organizing activities that engage the child’s participation, occupational therapists challenge the child’s sensory processing and motor planning skills (Case-Smith et al., 2014). Using gross motor activities that stimulate the vestibular and somatosensory systems the goal of SIT is to increase the individual’s ability to integrate sensory information (Mailloux & Roley, 2010 as cited in Case-Smith et al., 2014, p. 3). The vestibular and somatosensory are two systems that can be negatively affected by sensory processing disorders. The vestibular system refers to the awareness of sensory input coming from the inner ear, a sense that provides an individual awareness of their body’s movements through space (Cox, Gast, Luscre, and Ayres, 2009). The somatosensory system encompasses the body’s tactile and proprioceptive senses; providing the individual with important feedback on touch and pressure within mechanoreceptors of the skin and joints (Cascio, 2010). The ability to accurately receive tactile and proprioceptive sensation is critical for the development of motor skills during childhood (Cascio, 2010). By challenging the child’s ability to integrate sensory information,

occupational therapists promote more organized and adaptive behaviors. “Traditional SIT is provided in a clinic with specially designed equipment (e.g. swings, therapy balls, inner tubes, trampolines, and climbing walls) that can provide vestibular and proprioceptive challenges embedded in playful, goal-directed activities” (Case-Smith et al., 2014, p. 3). Each element of SIT is individualized to the child and targets specific objectives to help the child maintain self-regulation and alertness (Case-Smith et al., 2014). Part of SIT is also to reframe the child’s behavior using a sensory processing perspective. “Explaining the possible links between sensory processing and challenging behaviors, then recommending strategies that target the child’s hyper- or hypo-reactivity, can help caregivers and other treatment providers develop different approaches to accommodate the child’s needs” (Case-Smith et al., 2014). Making modifications to the child’s environment or routine supports their ability to self-regulate and participate in everyday activities. For the purposes of this research seven studies were examined that sought to determine the effects of sensory integration therapy. Across all studies participants were diagnosed with Autism Spectrum Disorder, presented with a sensory processing disorder, and were applied a manualized SIT intervention based on the original work of Ayres (Case-Smith et al., 2014). Together these studies represent an overview of the effectiveness of sensory integration therapy (SIT) when used with children who have been diagnosed with ASD.

In a study by Pfeiffer et al. (2011) children ages six to twelve with ASD were randomly assigned to either an SI or fine-motor treatment group; parents and researchers were blinded to group assignment for the entirety of the study. Treatment, designed by researchers who were occupational therapists, consisted of 18 intervention sessions of forty-five minutes each over the course of a six-week period (Pfeiffer et al., 2011). Both groups would receive the same amount of intervention. Before beginning the treatment phase researchers collaborated with parents and

caregivers to determine measurable goals for each child that focused on sensory processing/regulation, functional fine motor skills, and social-emotional skills (Pfeiffer et al., 2011). Interventions were then created based upon each child's specific goals and measured for growth at the end of treatment. "The results of the study were mixed yet demonstrated significant changes in the autistic mannerisms (a component of social responsiveness) and significant progress toward individualized goals in the areas of sensory processing and regulation, social-emotional function, and FM skills" (Pfeiffer et al., 2011). These findings imply that the children with ASD who received SI intervention were able to regulate and process sensory stimuli in their environment without reaching sensory overload and becoming overstimulated. They could process sensory stimuli without the need for regulatory strategies that are often perceived as socially inappropriate (Pfeiffer et al., 2011).

Similar to this study is another randomized control trial performed by Schaaf, Benevides, Mailloux, Faller, Hunt, van Hooydonk, Freeman, Leiby, & Kelly (2013), in which children with ASD between the ages of four and eight were randomly selected to receive either an SI treatment or continue on with their usual care. In this instance only evaluators were blinded to each child's allocation. Following an initial assessment of the child, researchers, met with parents to identify five goals that would be addressed during the study period (Schaaf et al., 2013). Those "participant children randomly allocated to the treatment group" received the SIT intervention "three times per week in 1-hour sessions for 10 weeks" (Schaaf et al., 2013, p. 4). At the end of the intervention phase another assessment took place to examine any significant differences that could have arisen due to receiving the SIT treatment. Researchers, who were trained occupational therapists, were specifically interested in the effects of intervention on sensory behaviors, functional and adaptive behaviors, as well as individual goal attainment (Schaaf et al.,

2013). A significant finding of the study was that children with ASD who received treatment scored higher than controls on goal attainment (Schaaf et al., 2013). These results, however, must be interpreted with caution due to the fact that parents were not kept blind to their child's treatment allocation. Furthermore, children who received the SI treatment showed significant improvement in functional behaviors than those children in the control group. This was important because the children demonstrated "decreased need for caregiver assistance on self-care and social activities" (Schaaf et al., 2013, p. 11). Ultimately, those children with ASD who received SI intervention displayed a trend toward increased independence.

In the case study completed by Schaaf et al. (2012) researchers, which were occupational therapists, describe the changes in a five-year-old boy with autism after participating in a ten-week program of intensive SIT. Before the treatment took place researchers interviewed the mother of the participant child (Schaaf et al., 2012). This was used as a means of determining the child's areas of strength and need as related to participation in home, school, and community activities. Along with the interview, a series of assessments were performed to establish whether difficulties were related to poor sensory processing and praxis (Schaaf et al., 2012). The assessments confirmed that the child's deficits in sensory processing and praxis were affecting his ability to participate in activities. After receiving ten-weeks of SIT, researchers saw significant improvements in the participant child's sensory processing capabilities. Specifically the report describes greater participation of the child in social, play, home, and community activities, as well as the ability to regulate and organize his responses to auditory, vestibular, tactile, and oral sensory input (Schaaf et al., 2012). Furthermore, there appeared notable decreases in ritualism and resistance to change or specific fears (Schaaf et al., 2012). This is important because specific fears include fear responses to sensory input within the environment.

Overall, these improvements indicate an improved ability in children with ASD to process and integrate sensory information for improved praxis (Schaaf et al., 2010).

Watling and Dietz (2007), two occupational therapists, carried out another study that examined the effectiveness of SIT. This single-subject study used an ABAB design to compare the immediate effect of SIT and a play scenario on undesired behaviors and task engagement of four young boys with Autism Spectrum Disorder (Watling and Dietz, 2007). This study design enabled researchers to examine the effect of the intervention for each participant after receiving treatment. Comparing the client's performance in the non-treatment condition, A phases, to that in the treatment condition, B phases, a clear picture of cause and effect can be created (Watling and Dietz, 2007). The study was comprised of three phases: familiarization, baseline, and treatment. Each phase of the study "included three 40 minute intervention sessions per week...followed by a 10-min tabletop activity segment that served as the data collection period" (Watling and Dietz, 2007, p. 577). Unfortunately, when effects were measured after intervention, short-term SIT did not have a substantially different effect from that of a play scenario (Watling and Dietz, 2007). While no objective improvement resulted, subjective data collected by researchers in intervention sessions and through parent reports suggested that changes did occur in participants' behaviors. Positive effects on "...transitions, socialization, compliance, and general behavior regulation" were evident during sessions and in the home environment (Watling and Dietz, 2007). However, these results should be viewed cautiously because of the possibility of bias.

A study performed by Fazlioglu and Baran (2008) sought to examine the effect of a SIT program on the sensory problems of children with ASD who attended the Trakya University Training and Research Center for Mentally and Physically Handicapped Children in Turkey. It is

significant to mention that in this specific study researchers were not certified occupational therapists and an occupational therapist was not involved in the design or implementation of the SIT intervention. Researchers sought to create a sensory integration therapy program that could later be used to assess and treat children with autism. The study involved the participation of thirty “low functioning children with autism,” ranging from ages seven to eleven, the majority of which “could not use language to communicate and were part of the special education program at the center” (Fazlioglu and Baran, 2008, p. 416). For treatment the children were randomly split into two groups, an experimental and control group. Following an evaluation of the sensory needs present in the group the children then participated in a “...prescribed set of activities designed to meet the child’s sensory needs and integrated into the child’s daily routine” (Fazlioglu and Baran, 2008, p.418). Sessions were then carried out within a specially arranged room in the center where special materials were placed for required activities. “Each child attended the 45-min. sensory integration sessions two day a week for 24 sessions” (Fazlioglu and Baran, 2008). However, children in the control group attended their regularly scheduled special education classes at the center. Researchers found a significant difference between treated and control groups, as well as a reduction in sensory problems after the sensory integration treatment (Fazlioglu and Baran, 2008).

Researchers Devlin, Leader, and Healy (2009) sought to examine the effects of sensory integration therapy in comparison to behavioral intervention on rates of self-injurious behavior (SIB) in a nine-year-old with autism. The two interventions were compared within an alternating treatments design. At the onset of treatment a functional analysis was performed to identify the variables that maintained the participant child’s self-injurious behaviors of hand-mouthing and hand-biting that resulted in visible tissue damage (Devlin et al., 2009). “This analysis

demonstrated that SIB was maintained by negative reinforcement as a means of escaping or avoiding demand situations” (Devlin et al., 2009, p. 223). Next, to be able to compare the differential effects of sensory-integration therapy and the behavioral intervention an alternating treatment pattern was carried out through ten daily sessions (Devlin et al., 2009). All sessions were done within the participant’s regular classroom. For the sensory integration condition, “...the participant was provided with access to the sensory-integration equipment and activities that delivered proprioceptive and vestibular stimulation in the form of a ‘sensory diet’” (Devlin et al., 2009, p.228). The sensory integration technique, which was designed by an occupational therapist for each participant, was applied for a thirty-minute period every two hours until at least four sessions had been performed in a day. The specific sensory diet used for the participant “...consisted of a variety of motor activities, oral motor control, a brushing protocol, and joint compression” (Devlin et al., 2009, p. 228). On alternating days the behavioral intervention was performed which specifically targeted the negative reinforcement that perpetuated the participant’s self-injurious behavior. Data from the SIT portion of the study showed zero trends with high rates of variability over the course of the intervention phase (Devlin et al., 2009). “Generally the data pattern for the behavioral intervention indicates a gradually decreasing variable trend” (Devlin et al., 2009, p. 229). Therefore, results of this study suggest that the behavioral intervention was more effective than SIT in treating the self-injurious behavior of a child with autism.

A similar study was conducted a few years later by Devlin, Healy, Hughes, and Leader (2011) to again compare the effects of sensory-integration therapy and a behavioral intervention. This time, however, researchers targeted not only self-injurious behavior in children with autism, but expanded to include all challenging behavior. They described challenging behavior as those

that "...make it difficult to implement instructional programming, prohibit inclusion into less restrictive environments, and may also cause injury to the individual engaging in the behavior or others in their immediate environment" (Devlin et al., 2011, p. 1303). Participants of this study were four children diagnosed with ASD who were between the ages of six and eleven. The participants were chosen because each had a history of engaging in challenging behavior in the form of aggression and self-injury (Devlin et al., 2011). In the initial phase of their research Devlin et al. (2011) performed a functional assessment on all participants to determine the variables maintaining their challenging behaviors. Though this information had no impact on the form of sensory-integration therapy the participants received. Following the assessment, both SIT and the behavioral intervention were alternated across daily sessions conducted mostly within the participants regular classroom, with some performed in an OT room at the school (Devlin et al., 2011). The sequence the interventions occurred in was randomized for each child. The sensory-integration intervention required that a 'sensory diet' be created for each child by an occupational therapist familiar with the technique. Recommendations by the occupational therapist were based on "...techniques that would facilitate vestibular, proprioceptive, and tactile input along with Wilbarger's (1995) joint compression and brushing" (Devlin et al., 2011, p. 1310). A SIT session took place over the course of each child's six-hour school day. The child was provided access to each of the sensory-integration activities and equipment for 15 minutes prior to any desktop activities that took place in the classroom. On days where the child's "sensory diet" was not implemented a behavioral intervention was used in its place that sought to use reinforcement as a way to reduce self-injurious behavior. Results demonstrated that "...for each of the participants, relatively little change was observed in the rate of challenging behavior between the baseline condition and the SIT condition" (Devlin et al., 2011, p. 1317). Data from

the SIT condition was highly variable and led to the conclusion that sensory diet implemented was not an effective intervention when treating challenging behavior.

Sensory-Based Intervention (SBI)

Contrasting to sensory integration therapy, another form of intervention used to address children with ASD and concurrent sensory processing disorder is sensory-based intervention. “SBIs are adult-directed sensory modalities that are applied to the child to improve behaviors associated with modulation disorders” (Case-Smith et al., 2014). Unlike SIT, sensory-based interventions require less of the child’s engaged attention and are expected to fit directly into the child’s daily routines. Only SBIs that engage the somatosensory and vestibular systems and are believed to promote behavioral regulation are of interest. This includes, “for example, brushing, massage, swinging, bouncing on a therapy ball, or wearing a vest” (Case-Smith et al., 2014, p. 3). These interventions are formed around the idea that through the systematic application of sensation to alter arousal states a child’s ability to interpret and use sensory information can be altered (Case-Smith et al., 2014). The goal of influencing the child’s arousal state is a key feature of sensory-based interventions. SBIs are differentiated in that they are not generally applied within a clinical setting, but instead are implemented within the child’s natural environment and daily routine (Case-Smith et al., 2014). This allows the intervention to be used as needed according to the child’s arousal state and can be administered by any adult present.

Brushing. A form of sensory-based intervention commonly implemented is the Wilbarger Protocol, a brushing protocol designed to target restricted and stereotyped behaviors. Stereotyped behaviors are commonly referred to as self-stimulatory because they are interpreted as an attempt to seek visual, tactile, vestibular, or other desirable sensory stimuli and avoid aversive stimuli to achieve homeostasis (Davis, Durand, & Chan, 2010). The Wilbarger Protocol

involves firmly brushing an individual on the arms, hands, back, legs, and feet with a soft surgical brush followed by gentle joint compressions to the shoulders, elbows, wrists, hips, knees, ankles, fingers, and feet (Davis et al., 2010). Implementation generally occurs every ninety minutes and requires extensive hands-on training to master the technique (Davis et al., 2010). In the study performed by Davis et al. (2010) researchers sought to examine the effects of a brushing protocol on the stereotyped behavior of a young boy with autism.

The case study identified a four-year-old boy who had previously been diagnosed with Autism. The study began by identifying, through collaboration with the mother and direct collaboration, three specific stereotyped behaviors of the participant. These included hand flapping, finger, flicking, and body rocking (Davis et al., 2010). The brushing procedure was then implemented within the participant's home by his mother and one-to-one therapist (Davis et al., 2010). Before beginning intervention both mother and therapist received hand-on training in the protocol. "The level of the participant's stereotyped, self-stimulatory behavior was measured before, during, and after the implementation of the brushing treatment" (Davis et al., 2010, p. 1054). The intervention took place over a six-week period of time. During this phase the child "...was brushed with a soft surgical brush approximately seven times per day, evenly spaced among his waking hours" (Davis et al., 2010, p. 1056). An occupational therapist identified the brush as being the correct brush for the Wilbarger Protocol. He was systematically brushed using firm pressure and long strokes until the entire skin surface was brushed at least once, resulting in three to ten strokes per body part (Davis et al., 2010). The results of the study did not demonstrate any decrease in the participant child's self-stimulatory behaviors. "The participant's level of stereotypy did not decrease during the brushing phases of the study, and analysis

suggests that a slightly elevated level of challenging behavior occurred during the daily brushing phases” (Davis et al., 2010).

Weighted vests. Another technique employed by occupational therapists to deal with the self-stimulatory behaviors presented by children with Autism Spectrum Disorder is the use of weighted vests. Weighted vests employ graded sensory inputs, especially tactile and proprioceptive, to enhance neurological function and decrease problems caused by difficulty modulating sensory input (Hodgetts, Magill-Evans, and Misiaszek, 2010). Using the clinically maintained pressure of weighted vests is recommended based on the assumption that it facilitates an increase in parasympathetic and relaxed tone (Leew, Stein, and Gibbard, 2010). This is observed as reduced anxiety and over-arousal and increased awareness and attending. Influence of the somato-sensory system is important because it is believed that the system “...has neurological links to the development of a person’s arousal state and may also contribute to cognitive functions” (Bates, 1999 as cited in Leew et al., 2010, p. 114). This alteration in arousal state facilitates participation in appropriate and function activities for the child with ASD, optimizing their learning opportunities (Leew et al., 2010).

A study performed by Hodgetts et al. (2010) sought to examine the effects of weighted vests on stereotyped behaviors in children with Autism Spectrum Disorder. For the purposes of their study, researchers defined repetitive stereotyped behaviors as those that appeared to show no adaptive function within the child’s environment. Participants were six children between the ages of four and ten who had been previously diagnosed with autism and demonstrated stereotyped behaviors that interfered with classroom participation based on teacher report (Hodgetts et al., 2010). The study was carried out within each child’s self-contained classroom specific to children with autism. For both to baseline and intervention conditions children wore a

weighted vest, placed on them by a classroom aide, that had two pockets for weights in front and two in the back (Hodgetts et al., 2010). During the baseline and withdrawal phase children wore vests that contained Styrofoam balls, but for the experimental portion the weighted vests “...were calibrated at 5% of the child’s body weight...” (Hodgetts et al., 2010, p. 808). The children wore the vests for a total of twenty minutes each day at school around approximately the same time each day for the study period. While weighted vests are thought to provide sensory input to modulate arousal and reduce stereotyped behavior there was no evidence of this in the study performed by Hodgetts et al. (2010). The researchers saw no “...decrease in motoric stereotyped behaviors in any participant when wearing a weighted vest...” (Hodgetts et al., 2010, p. 811).

A similar study was conducted by Leew et al. (2010), but they shifted their focus away from the impact of stereotyped behavior to the impact of weighted vests of attention and engagement. Subjects for the study were four two-year-olds who were diagnosed with Autism Spectrum Disorder. Researcher’s examined “the effect of weighted vests on competing behaviors and joint attention (a pivotal skill for development and a core deficit for toddlers with ASD) in semi-structured play with their mothers...” (Leew et al., 2010, p. 113). During the experiment children wearing the vests were not placed in restrictive seating, but were placed near a low table while their mother’s sat on the floor. The two played in a responsive way for twenty minutes while toddlers wore weighted vests that equaled five percent of their body weight (Leew et al., 2010). Unlike the previous study discussed, weights were evenly distributed along the hemline of the vests in the front and back near the child’s hips. The children wore the vests for a ten-minute warm up period before every session to limit the amount of distractibility when wearing them (Leew et al., 2010). At the end of the study researchers found no observable effect. There was no

decrease in the “rate of problem competing behaviors” or improvement in joint attention, “measured as functional, pre-linguistic social communication” (Leew et al., 2010, p. 122).

Another study performed to test the application of weighted vests as an approach to treat sensory issues in children with ASD was performed in 2004 by Kane, Luiselli, Dearborn, and Young. The study focused on the “...effects wearing a weighted vest on stereotypy and attention to task of four children who had autism/pervasive developmental disorder” (Kane et al., 2004, p. 19). The children ranged from ages eight to eleven and had all previously shown delays in the areas of communication, social, and cognitive skills. “All participants presented with stereotypic behaviors, defined as repetitive, invariant, and perseverative motor responses, which interfered with instruction and were targeted for behavior reduction in their individualized education programs” (Kane et al., 2004, p. 21). For the purpose of this study the treatment was carried out at the private school all four children attended regularly. The study was comprised of three evaluation phases: baseline (no vest worn), weighted vest, and vest with no weight (Kane et al., 2004). Throughout all phases, play objects were made available to participants for the duration of the ten-minute session. The children were already familiar with the objects and once the play object was chosen the child was given the same one for the duration of the study (Kane et al., 2004). “Sessions were observed in the participants’ classrooms while they sat at a table/desk in a location separate from other students” (Kane et al., 2004, p. 21). In each phase a therapist presented the child with a play object at the start of the session and followed up with a verbal direction. The therapist then moved away from the child and interacted no more with them for the duration of the session (Kane et al., 2004). The test phase was identical “...except that 1 minute before the session, the therapist placed a weighted vest on the participant” which was “...equal to 5% of her/his body weight” (Kane et al., 2004, p. 22). A control condition was

performed as well where the vest contained no weight. Unfortunately the results of the study do not support the use of weighted vests as an effective intervention. Observations of the participants "...revealed that on many occasions, they touched, tugged at, and seemed "distracted" by the vest" (Kane et al., 2004, p. 23). Meaning that weighted vests may interfere with attention to task and provoke stereotypy rather than diminish the behaviors.

A study carried out by Reichow, Barton, Sewell, Good, and Worley (2010) used a similar alternating treatment design to compare engagement of participants with ASD or developmental delays. Three participants between the ages of two and six were selected for the study. All of which had an educational or medical diagnosis, used a weighted vest during part of the school day, attended a university-affiliated, inclusive early childhood center, and teachers saw benefits from the use of a weighted vest (Reichow et al., 2010). For the purpose of this study treatment was integrated into the children's daily routine at their university-affiliated early childhood centers. "All sessions occurred during the daily morning table-time activity in the child's classroom" and "data were collected during the first 10 min of each activity" (Reichow et al., 2010, p. 5). The experiment consisted of three phases: a baseline with no vest, a vest with no weight to serve as a placebo, and a weighted vest. For the placebo phase imposter weights were used to "...make it unlikely for an observer to distinguish whether the participant was in the weighted-vest condition or the vest-with-no-weight condition" (Reichow et al., 2010, p. 5). The conditions were randomly assigned over five consecutive school days. The experimental period consisted of two sessions of the weighted-vest condition, two sessions of the unweighted-vest condition, and one session of the no-vest condition (Reichow et al., 2010). The observer took note of the child's engagement, stereotypic behavior, and problem behavior over the ten-minute session. For two of the participants wearing a weighted vest had no relation to change in the

child's engagement, stereotypic behavior, or problem behavior. "...[T]hey were just as likely to engage in the activity when wearing the weighted vest as they were when they wore the vest with no weights or did not wear a vest" (Reichow et al., 2010, p. 7). The third participant showed mixed results. The weighted vest made no difference in engagement and the child's amount of problem behavior were greatest when he was wearing the weighted vest (Reichow et al., 2010). However, for this specific child, "...the percentage of intervals coded as stereotypic behavior was lowest when the weighted vest was being worn" (Reichow et al., 2010, p. 7). While changes did occur during the experiment, interpretations must be made with caution because the condition was experienced for such a short period. Overall this study demonstrates that weighted vests are not an effective intervention to use for children with ASD or developmental delays.

Therapy balls and cushions. An alternative strategy to attain and maintain an optimal state of arousal in children with Autism Spectrum Disorder is to employ the use of therapy balls in the environment rather than normal furniture seating. "Therapy balls, because they are a type of dynamic seating, may provide children with ASD an opportunity to both actively move and maintain an optimal state of arousal level while maintaining a healthy, safe, and productive posture" (Schilling & Schwartz, 2004, p. 425). When children are in inflexible seating they frequently assume extreme postures in their attempts to move. Therapy ball chairs are a dynamic and relatively low cost seating alternative to provide children with a better solution. Specifically it works well for children with ASD who have "...issues regarding balance, postural control, attention, and sensory seeking behaviors of the vestibular and proprioceptive sensory" (Bagatell, Mirigliani, Patterson, Reyes, & Test, 2010, p. 896).

Schilling and Schwartz (2004) conducted a study using therapy balls for seating as an intervention to determine their effect when used on preschool children with ASD. The participant

children were identified by their teacher as having difficulty with in-seat behavior and maintaining engagement to task. Using a single-subject withdrawal design within the natural classroom setting Schilling and Swartz (2004) implemented their intervention over the course of two school weeks. Before beginning the intervention each participant was fitted for a therapy ball. “Therapy balls were individually fitted to a diameter that assured each child could sit comfortably with his feet flat on the floor with knees and hips flexed at 90°” (Schilling & Schwartz, 2004, p. 426). Furthermore, the therapy balls had molded feet that extended to allow the ball to sit still while not in use. Next, collaborating with classroom teachers, researchers determined the time of the day and activity in which each participant would use the ball for seating (Schilling & Schwartz, 2004). Each teacher was asked to identify which specific portion of the day the child had the most difficulty with in-seat behavior and engagement, however, because the “participants’ schedules and curriculum were not altered, the duration of the activity varied in length of time” (Schilling & Schwartz, 2004, p. 426). Staff members were then instructed to give no prompts to the child during the intervention unless behavior on the therapy ball was harmful to the child, his peers, or teachers. “Findings of this study indicated substantial improvements in in-seat behavior and engagement across all four participants when seated on therapy balls” (Schilling & Schwartz, 2004, p. 430). Moreover, the teachers and students both consistently reported a preference for therapy balls as compared to normal seating furniture.

Using the finding of the previous study mentioned, Bagatell et al. (2010) sought to extend and expand upon the effectiveness of therapy balls for seating with children diagnosed with Autism Spectrum Disorder. “The study is similar in that it uses a single-subject design to examine classroom participation—specifically, in-seat behavior and engagement and social validity” (Bagatell et al., 2010, p. 896). Conversely, Bagatell et al. (2010) expanded the concept

of social validity; seeking to include child preference and examine which specific types of sensory processing pattern seen in participating children responded best to the use of therapy ball chair. The intervention phase mirrored that described in the previous study in that all participating children were fitted for therapy ball chairs and then used for a two-week period (Bagatell et al., 2010; Schilling & Schwartz, 2004). Unlike the previous study, Bagatell et al. (2010) found mixed results on the effectiveness of therapy ball chairs for the three participating children. The children who showed the most positive effect when using the therapy ball chairs had demonstrated mild or definite sensory dysfunction on the SPM Body Awareness and Balance and Motion subtest, which measures proprioceptive and vestibular functioning (Bagatell et al., 2010). Those children who showed little improvement had indicated typical functioning on the same measure. “The results suggest that therapy ball chairs may be more appropriate for children who seek out vestibular-proprioceptive input rather than for children with other patterns of sensory processing” (Bagatell et al., 2010, p. 901). It is significant to note that researchers in the current study were trained occupational therapists, whereas the treatment designed and implemented in the previous study by Schilling and Schwartz (2004) was not performed by an occupational therapist.

Another form of alternative seating devices that has been implemented when working with children with ASD is therapy cushions which are inflatable discs that were originally designed for core strengthening and training. However, it is believed that these devices can function similarly to therapy balls, in that they provide “...students with a seating surface that offers more sensory feedback than a standard classroom chair” (Dietz and Umeda, 2007, p. 153). A study performed by Dietz and Umeda (2007) sought to determine the efficacy of using therapy cushions to promote in-seat and on-task behaviors for children with ASD. Their study examined

the effect of therapy cushions on two kindergarten students with ASD during whole-class math activities. During the baseline phase participants used standard classroom chairs during math activities, while in the intervention phase they used standard classroom chairs with therapy cushions (Dietz and Umeda, 2007). Each portion of the study was two to three weeks long with a one-week acclimation phase before the first intervention phase to allow the children to become familiar with the cushions. The final portion of the intervention was to assess the seating preferences of the child after they had experienced both the baseline and intervention seating options (Dietz and Umeda, 2007). For the first participant of the study the therapy cushion seemed to provide no affect on the child's in-seat and on-task behavior. The child "...verbally expressed resistance to cushion" and chose to sit on a standard chair over a chair with the therapy cushion (Dietz and Umeda, 2007, p. 157). The second participant presented with similar results in that no substantial differences were seen when comparing both phases of the study. However, what is interesting is that participant two showed no resistance to the cushion and actually preferred this seating option to a standard chair for five out of six days (Dietz and Umeda, 2007). Also, the classroom teacher reported that he or she felt the child's attention was better when using the therapy cushion. While attention was better for the second child when using the cushion, the teacher reported that for both children "...that sitting behavior and level of disruptiveness were generally comparable with either type of seating device (Dietz and Umeda, 2007, p. 157). Overall, no substantial change in function behavior was evident when using a therapy cushion.

Methodology

Scope of Literature Review

This research is a literature review of peer reviewed journal articles that explore the effectiveness of sensory-based strategies established for treatment of sensory processing abnormalities present in children with Autism Spectrum Disorder (ASD). By performing a survey of the literature, features of effective sensory-based techniques were explored and the outcomes of intervention on behavior of children with ASD who struggle with sensory processing were examined. In order to locate these journal articles, search engines such as Google Scholar, the UNC Library Homepage Search Engine, Academic OneFile, and Academic Search Complete were employed. Furthermore, the initial searches of this study specifically targeted research described within the American Journal of Occupational Therapy and the Journal of Autism and Developmental Disorders between the years of 2004 to 2014.

The following broad search terms were applied to research journal articles: “sensory integration and autism”, “occupational therapy and sensory integration”, “occupational therapy and autism”. Once this preliminary search was completed, additional search terms were employed to locate additional articles: “sensory integration therapy”, “sensory based intervention”, “brushing”, “Wilbarger Protocol”, “therapy balls”, “therapy cushions”, “alternative seating”, and “weighted vests”. Further investigation was then conducted by determining the references from each of the literature reviews and experimental studies. The research criteria was broadened to allow for studies performed outside of the United States to be included. Again, only journal articles published within the last ten years, from 2004 until 2014, were included in these subsequent searches for literature.

Criteria for Inclusion and Exclusion

After finding articles, inclusionary and exclusionary criteria were developed. First, as already noted it was determined that only articles that had been published within the last ten years would be included in the literature. This created a time frame between the years 2004 and 2014 for all articles reviewed. All research articles included in the literature review implemented a form of intervention based on the sensory integration theory originally developed by A. Jean Ayres (1972). This approach is "...based on the understanding that disruptions in neurological processing of sensory information interfere with the production of organized and purposeful behaviors that provide the foundation for learning and skill development" (Watling and Dietz, 2007, p. 575). This results in the use of strategies that support an individual's ability to function adaptively and meet the contextual demands of their daily living skills. Studies included in the current research employed strategies that were based upon intervention techniques that are typically used in the field of occupational therapy. Though the strategies employed in the current literature are derived from occupational therapy, the intervention cannot actually be considered an occupational therapy treatment if not designed and implemented by an occupational therapist. However, searching the literature for established sensory-based strategies.

For this research the participants' age within each study reviewed was restricted to a range from three to twelve years to focus on young children who could receive therapy within a school or childcare setting. Studies were included even if the study did not take place in a school setting, that is studies performed in specialized locations, such as a clinical setting or institution, were not excluded in this research review. Furthermore, for the purposes of this study only articles in which participants had received an official diagnosis of an autism spectrum disorder (ASD) and appeared to have sensory processing problems were examined and included in the

literature review. Many different types of studies were included within this research. Included were other literature reviews that systematically examined previously published sensory interventions already implemented with children with autism spectrum disorders. Experimental design studies were incorporated that examined effects of sensory-based intervention in many different methods. This included randomized control trials, multiple baseline, and comparative studies. Additionally, case studies were included that performed in-depth investigations into the effects of specific sensory strategies that could be used with children with ASD who had sensory processing problems. No research articles were excluded specifically due to their study design.

Data Analysis Plan

Examining the literature, this research sought to determine which features were significant when designing a sensory-based strategy for use with children diagnosed with ASD. Elements that were common across multiple studies were considered significant and included in the data analysis process. Once the significant criteria were determined a table was composed to display and organize the information acquired through the literature review of this study. This table lists each of the specific studies in the primary column. Across the top, each column is labeled with the features considered to be important: “Number of Participants”, “Age or Grade Level of Participant(s)”, “Setting”, “Parental Involvement”, “Targeted Sensory Processing”, “Targeted Engagement”, “Targeted Classroom Participation”, “Targeted Stereotypic Behavior”, “Treatment Designed by an OT”, “Intervention Implementer”, “Length of Study”, “Effective at the .05 Level”.

These categories were constructed in order to determine which features were most impactful or effective in designing a sensory-based strategy. From this table, suggestions can be made about which features of sensory-based interventions research has found most effective for

addressing the sensory needs of children with ASD. By establishing which features produce an effective sensory-based strategy it can be suggested which aspect of the intervention would be best translated into the classroom. Ultimately, the goal of this research is that teachers would be able to review the results of this study and determine which strategies are effective and work to bring these techniques into their classrooms and likely produce positive gains in their students with sensory needs.

Results

The purpose of this literature review was to determine which features of sensory-based strategy were effective when implemented with children diagnosed with Autism Spectrum Disorder. Fifteen studies were examined for specific attributes that create an effective intervention strategy. The discussion in the following paragraphs outlines sensory-based strategies that promote positive outcomes when applied with children with ASD.

Number of Participants

Each the fifteen studies examined within the literature review of this research chose to implement their sensory-based intervention on a different number of study participants. There were three studies in which the intervention technique was only applied to one participant child who had been diagnosed with ASD (Devlin et al., 2009; Davis et al., 2011; Schaaf et al., 2012). There was one study in which only two children participated (Dietz & Umeda, 2011), while another group of researchers used three participants for their sensory intervention (Reichow et al., 2009). Five studies included four participants were included within their study design (Devlin et al., 2011; Leew et al., 2010; Kane et al., 2004; Schilling & Schwartz, 2004; Watling & Dietz, 2007). Furthermore, there were two studies, in which six participants received the intervention (Bagatell et al., 2010; Hodgetts et al., 2011). Expanding the number of participants farther one study selected fifteen children for inclusion in their intervention (Fazlioğlu & Baran, 2008), another study included seventeen participants Schaaf et al., 2013), and the largest number of participants included in intervention were twenty children (Pfeiffer et al., 2011).

Age or Grade Level of Participant(s)

As with the number of participants, the group of fifteen studies reviewed used a variety of different age groups for their particular sensory interventions. There was one study that did not

report the specific ages of the children involved in their research, but did report that they were enrolled in an intensive program for children kindergarten to first grade age that had ASD (Bagatell et al., 2010). Each of the other fourteen articles reviewed specified the age of their participants. There were three case studies that each focused on the effects of sensory-based occupational therapy had on only one child. One such study examined the effects intervention had on a toddler, specifically a two-year-old child (Leew et al., 2010) The other two case studies focused on a five year old child and a nine-year-old child (Devlin et al., 2009; Schaaf et al., 2012).

The remaining eleven articles analyzed the impact of intervention on an age range of participants. Four studies were interested in the effects of intervention on narrowed range of children; more specifically only two different ages of children were included. Two studies had participants that were either three to four years old, one contained children who were four to five years old, and another consisted of children between the ages of five and six (Davis et al., 2011; Dietz & Umeda, 2011; Reichow et al., 2009; Schilling & Schwartz, 2004; Schaaf et al., 2012 Watling & Dietz, 2007). One article included participants within their study that ranged across four different ages, in the study children were eight, nine, ten, or eleven years old (Kane et al., 2004). Two studies considered the influence intervention had on children across five different ages. One of these studies had participants who were of early elementary school age, specifically four, five, six, seven, and eight (Schaaf et al., 2013).

Another was more interested in the impact of a sensory-based intervention on children who were seven, eight, nine, ten, and eleven (Fazlıoğlu & Baran, 2008). Three studies decided to extend the age range for their study much farther including children of either five to six different ages within their research. One such article included participants who were between four and ten

years old (Hodgetts et al., 2011). Within another study the age of participants was across a range of six to eleven years old (Devlin et al., 2011). Though the current research wanted to focus specifically on the effect of sensory-based intervention on young children one study was included with a portion of participants that were of middle school age. This specific study consisted of children as young as six years old, but ranged all the way to twelve years of age (Pfeiffer et al., 2011).

Setting

In each of the studies that examined particular sensory-based strategies indicated the setting in which the intervention was carried out. Out of the 15 articles reviewed five were carried out within a clinical setting (Fazlıoğlu & Baran, 2008; Pfeiffer et al, 2011; Schaaf et al., 2012; Schaaf et al., 2013; Watling & Dietz, 2007). Eight studies were performed within the participant's regular classroom (Bagatell et al., 2010; Dietz & Umeda, 2011; Devlin et al., 2009; Devlin et al., 2009; Hodgetts et al., 2011; Kane et al., 2004; Reichow et al., 2009; Schilling & Schwartz, 2004). The two remaining studies were implemented at the participant child's home (Davis et al., 2011; Leew et al., 2010).

Parental Involvement in Intervention

Of the 15 articles reviewed, six included parents or caregivers in the design and implementation phases of the sensory-based strategies implemented. Parent involvement in many cases consisted of researchers using parent or caregiver reports as a source of information to learn the unique behaviors of each participant child. By conducting in-depth interviews and having parents or caregivers complete sensory questionnaires researchers were able to use the information gathered to identify goals that would be addressed through implementation of an occupational therapy based strategy (Pfeiffer et al, 2011; Schaaf et al., 2012; Schaaf et al., 2013;

Watling & Dietz, 2007). Within two studies parents and caregivers were even further involved in the process by actually taking an action role within the intervention by either playing with or brushing the child so that researchers would later measure their change in behavior (Davis et al., 2011; Leew et al., 2010). Nine of the articles examined made no mention of the participant's parents or caregivers and never indicated that they had any involvement in the execution of the sensory intervention strategies used (Bagatell et al., 2010; Devlin et al., 2009; Devlin et al., 2011; Dietz & Umeda, 2011; Fazlioğlu & Baran, 2008; Hodgetts et al., 2011; Kane et al., 2004; Reichow et al., 2009; Schilling & Schwartz, 2004).

Targeted Sensory Processing

Seven of the fifteen articles reviewed for this study were interested in investigating the effect that sensory-based strategies had on sensory processing in children with ASD. However, sensory processing problems seen in children with ASD were defined in slightly different ways throughout the research examined. In one study, sensory processing problems were defined as the inability of the nervous system to modulate, organize, and integration information from the environment (Pfeiffer et al., 2011). Other studies defined sensory processing problems as the inability to engage in the physical and social environment and produce an adaptive response to sensations (Schaaf et al., 2012; Schaaf et al., 2013; Watling & Dietz, 2007). Furthermore, sensory processing problems were explained as deviations away from homeostatic and operant functions that create an inability to learn and participate in their daily lives (Fazlioğlu & Baran, 2008; Hodgetts et al., 2011). Sensory processing problems were similarly designated as the inability to provide input needed to maintain arousal states so that the individual can respond more effectively to environmental challenges (Bagatell et al., 2010). Though each study described sensory processing problems differently, all seven studies agree that efficient sensory

processing is essential for optimal functioning in children with ASD. The remaining eight studies did not focus on sensory processing problems seen in children with Autism and had no measures for changes in the child's ability to adaptively respond to sensations.

Targeted Engagement

Out of the 15 articles examined for this research, seven sought to determine the effect sensory-based interventions could have on the engagement of young children with ASD. Four of these studies defined engagement as purposeful manipulation of an object in the appropriate manner or orienting towards the appropriate material or speaker (Dietz & Umeda, 2011; Kane et al., 2004; Reichow et al., 2009; Schilling & Schwartz, 2004). Other researchers identified a child's engagement as an intentional, persistent, active, and focused interaction with the environment, including both people and objects (Bagatell et al., 2010; Watling & Dietz, 2007). An important clarification was made that engagement did not necessarily mean typical use of materials, but simply any interactions that held meaning for a specific child (Watling & Dietz, 2007). No matter how the individual studies defined engagement, the research as a whole agreed that engagement was a central component to participation and without it the participant's quality of life was compromised. The remaining eight articles did not measure the participant's engagement when applying a sensory-based strategy.

Targeted Classroom Participation

Out of the 15 articles reviewed, six focused on the effects sensory-based strategies had on the classroom participation of their participants. Within this group of studies the way in which researchers examined changes in class participation was slightly different. Three studies that analyzed classroom participation based on the child's in-seat behavior and task engagement. Accordingly researchers watched to see if the child's buttocks was in contact with the seat

portion of the chair and the legs were on the floor, as well as if they were purposefully engaging with materials and individuals in their environment (Bagatell et al., 2010; Dietz & Umeda, 2011; Schilling & Schwartz, 2004). Other articles considered stereotypic behavior as their measure for classroom participation. The thinking behind this was that stereotypic behavior observed in children with autism serves a homeostatic function, but interferes with the child's ability to learn and participate. Researchers used suppression of stereotypic behavior as an association of increased responding and participation in activities (Hodgetts et al., 2011; Kate et al., 2004; Reichow et al., 2009). Though these studies approached the issue in a different manner, all attempted to increase the class participation of children with ASD. The remaining nine studies did not seek to alter the class participation of their participant children.

Targeted Stereotypic Behavior

Seven of the fifteen articles that were reviewed discussed and targeted the effect of sensory-based strategies on stereotypic behaviors of children with ASD. Within each study stereotypic behaviors of participants were characterized in slightly different ways. Five studies designated stereotypic behaviors as those behaviors, which serve no apparent adaptive purpose in the environment and produce sensory stimulation that serves as reinforcement for the behavior (Davis et al., 2011; Hodgetts et al., 2011; Schaaf et al., 2012, Schaaf et al., 2013). Two studies described stereotypic behaviors as repetitive, invariant, preservative motor responses (Kane et al., 2004; Pfeiffer et al., 2011). Furthermore, researchers explained stereotypic behaviors as rigid interaction with the environment with an undifferentiated behavior that serves no adaptive purpose (Reichow et al., 2009). All studies that focused on stereotypic behavior agreed that these behaviors must be defined individually for each participant rather than generalized across the whole group. Furthermore, all saw that these behaviors were interfering with the child's ability to

behave appropriately and participate in the environment. There were eight studies that did not mention the stereotypic behavior in their participants with ASD.

Treatment Designed by an OT

A quality examined across the fifteen articles included within the literature review dealt with the designer of the sensory-based strategy applied to the participant. It is important to note that if the intervention was not designed by an occupational therapist it cannot be considered a sensory-based occupational therapy intervention. For the purpose of this research, it was determined whether or not the treatment technique implemented was designed by an occupational therapist specifically or if researchers had examined the literature to create their own sensory-based intervention. Occupational therapists trained in the sensory-based technique bring with them valuable knowledge and experience on the topic that cannot necessarily be gleaned from previously published research. Therefore, this aspect of the literature was reviewed to examine the effect of having the recommendations or ideas of an occupational therapist directly applied to the research. Eleven of the articles examined used an occupational therapist as a resource and guide in designing the intervention used for children with ASD (Bagatell et al., 2011; Davis et al., 2011; Devlin et al., 2009; Devlin et al., 2011; Dietz & Umeda, 2011; Kane et al., 2004; Leew et al., 2010; Reichow et al., 2009; Schaaf et al., 2012; Schaaf et al., 2013; Watling & Dietz, 2007). Of the fifteen articles that were reviewed there were six studies where the author, or researcher, of the study who designed the intervention was a trained occupational therapist (Bagatell et al., 2010; Dietz & Umeda, 2011, Hodgetts et al., 2011; Leew et al., 2010; Pfeiffer et al., 2011; Schaaf et al., 2012; Schaaf et al., 2013). The remaining two articles did not use an occupational therapist or their recommendations when designing their

study, but researchers relied on previously published protocols and journal articles to develop a sensory-based intervention (Fazlıoğlu & Baran, 2008; Schilling & Schwartz, 2004).

Intervention Implementer

In the fifteen studies reviewed for this research, sensory-based strategies were administered by either a researcher, a trained occupational therapist, or the child's parent. One study actually allowed the child's mother to administer part of the intervention after she received training on the brushing protocol that would be implemented by an occupational therapist (Davis et al., 2011). Four of the studies used researchers to administer the intervention to participant children (Devlin et al., 2009; Devlin et al., 2011; Fazlıoğlu & Baran, 2008; Schilling & Schwartz, 2004). Within these eight studies there were some cases in which researchers were aware of whether or not they were administering a sensory-based intervention or if it was a control phase. In some, researchers were blinded to whether or not the child was receiving the sensory-based intervention. There were ten studies in which a trained occupational therapist with specific experience in performing sensory-based strategies (Bagatell et al., 2010; Dietz & Umeda, 2011; Hodgetts et al., 2011; Kane et al., 2004; Leew et al.; Pfeiffer et al., 2011; Reichow et al., 2009; Schaaf et al., 2013; Schaaf et al., 2012; Watling & Dietz, 2007). It is important to understand that these are the only cases in which the intervention administered can be considered an occupational therapy treatment because they are implemented by a trained occupational therapist.

Length of Study

There was a diverse range of study duration and number of intervention sessions implemented throughout the fifteen research articles examined. It ranged from as few as three sessions with the participant, while others lasted weeks with up to sixty-seven sessions. To

explain the information found through this literature review, this research split up the duration of study into three distinct categories based upon how many sessions were performed with the participant. The first group is composed of those research articles whose intervention was applied for less than fifteen sessions with the child with ASD. Six articles examined fell into this category with three having only five sessions, one with ten sessions, one with 12 sessions, and finally another with fourteen sessions (Devlin et al., 2009; Devlin et al., 2011; Kane et al. 2004; Leew et al., 2010; Reichow et al., 2009; Schilling & Schwartz, 2004). Within this group only one study was found to create significant changes in the behavior of their participants and be considered effective (Schilling & Schwartz, 2004).

Next articles that fell into a second group in which participants received anywhere from sixteen to thirty intervention sessions were examined. Six studies fell into this category. One study implemented eighteen sessions (Pfeiffer et al., 2011), two performed twenty sessions (Bagatell et al., 2010; Hodgetts et al., 2011), one used twenty-four sessions (Fazlioğlu & Baran, 2008), and two applied thirty intervention sessions (Schaaf et al., 2012; Schaaf et al., 2013). Within this category five of the articles were found to be effective and significantly affect the behavior of children with ASD (Bagatell et al., 2010; Fazlioğlu & Baran, 2008; Pfeiffer et al., 2011; Schaaf et al., 2012; Schaaf et al., 2013).

The last category contained articles reviewed that chose to implement thirty-one intervention sessions or more. Only three articles fell within this group, one used thirty-three sessions (Watling & Dietz, 2007), another implemented thirty-five ((Davis et al, 2011), and with the most number sessions applied within a study was sixty-seven (Dietz & Umeda, 2011). However, none of the articles within this last grouping were found to be effective when applied.

Effectiveness

For the purposes of this research a study was determined to be effective if significant post intervention differences were seen in participant children with ASD. A study could be seen as effective if the differences seen in a participant child had a p-value of $\leq .05$. However, some case-studies did sampling over a specified time amount and compared results to baseline data collected at the outset of an intervention and averaged both sets of data to see if a positive statistical change occurred. Specifically, when considering effectiveness the interest is in the statistical significance that was charted within studies reviewed rather than considering subjective feedback from parents, caregivers, or teachers. The overall goal was to establish which studies were able to demonstrate functional changes on sensory issues of children with ASD. Of the fifteen studies that were evaluated only six were found to cause statistically significant transformations within the participant children (Bagatell et al., 2010; Fazlioglu & Baran, 2008; Pfeiffer et al., 2011; Schaaf et al., 2012; Schaaf et al., 2013; Schilling & Schwartz, 2004). The nine remaining studies reviewed were not considered effective because no statistically important differences could be ascertained from the data collected throughout the treatment phases (Davis et al., 2011; Devlin et al., 2009; Devlin et al., 2011; Dietz & Umeda, 2011; Hodgetts et al., 2011; Kane et al., 2004; Leew et al., 2010; Reichow et al., 2009; Watling & Dietz, 2007). Within the group of ineffective sensory-based strategies three of the studies actually found that the treatment technique applied actually made the child's sensory issues worse (Devlin et al., 2011; Kane et al., 2004; Reichow et al., 2009). For a majority of those research studies that were ineffective a major issue wasn't that no differences occurred between pre- and post intervention data. Positive changes were made, but that it wasn't enough to be seen as statistically significant. Also, it is important to remember that qualitative data was not

considered when determining intervention effectiveness so all parent, caregiver, and teacher opinions on the participant child's progress were not taken into consideration. Only quantitative data that could demonstrate significance was taken into consideration for which studies were determined as effective.

Studies Found to be Effective

Of the fifteen articles reviewed only six studies were found to be effective in altering the behavior of children with ASD ((Bagatell et al., 2010; Fazlioğlu & Baran, 2008; Schaaf et al., 2012; Pfeiffer et al., 2011; Schaaf et al., 2012; Schaaf et al., 2013; Schilling & Schwartz; 2004). Four of the six studies found to create a statistically significant difference in their participants were carried out within a clinical setting. The two other studies found to be effective were conducted within a classroom setting. No studies conducted within the participating child's home were found to be effective. Five of the six studies that were effective targeted the sensory problems of children with ASD and their ability to adapt to the environment. Only two studies that targeted engagement and classroom participation were successful in improving the participating children's behavior. Three out of six studies were able to positively impact the stereotypical behavior of their participant children with ASD. Furthermore, only four of the effective studies were actually designed and carried out by an occupational therapist. The number of participants involved in the effective studies ranged from only one child to twenty children participating. All of the nine articles found to be ineffective had included four participants or less in their studies. Five of the six effective studies had included children within their intervention over a range of ages, only one examined children of a specific age.

Discussion

Overview

The current study was designed to connect sensory-based strategies to the classroom by bringing intervention resources to teachers so they can better address the sensory needs of students in their class, regardless of diagnosis. This goal was achieved by researching literature that examined the effect of sensory-based strategies when applied to children with ASD. While the literature explored for the current study reviews sensory-based strategies applied to children with ASD, these are interventions that can be applied to any child within the classroom that exhibits sensory issues. It is important to clarify that it may not necessarily be solely children with ASD in the classroom that require strategies that address sensory needs. Since Sensory Processing Disorder has not been established within the DSM, this study chose to focus on research with children with ASD because a component of the diagnosis is that children can display unusual responses to sensory input in the environment. Research has established that children with ASD consistently exhibit atypical behavioral responses to sensory input, which has the potential to negatively affect their educational progress (Ashburner et al., 2014). Since research has established this difference, literature exists that details sensory-based strategies that have been applied to improve the sensory-related challenges experienced by children with ASD. This review of the literature highlighted common features across studies that had outcomes which were considered to be effective. Fifteen studies were included within this research to provide an overview of strategies established to determine which have supportive evidence and could be translated into the classroom. Overall, the finding of the present study provides teachers with a resource outlining the features of sensory-based strategies that create an effective study design and could be transitioned into the classroom to address the sensory needs of their students, regardless of a diagnosis.

Implications for Teachers

Setting. A significant finding of this research is that five out of the six studies that were considered effective occurred within a clinical setting whereas only one was performed in the participating child's classroom. It is critical to understand what is happening throughout studies taking place in a clinical setting that may make transferring the strategies to the child's classroom and home environment difficult. Clinical settings were specially arranged and within them were special materials to meet any challenges or needs that the child could have while in that environment. It served as a neutral setting and is designed to address any potential variable that could arise while the participant child was present. Children were not allowed to freely touch objects and materials within the environment, but specified individuals were required to arrange the materials that would be needed. It is understandable that these clinically engineered settings would produce results that are different from those performed within the child's natural environments.

In the literature reviewed there were five studies that were applied in clinical settings and were found to be effective, yet the two studies included that took place in the child's home were ineffective. Researchers reasoned that behaviors they were looking for might not be consistently or directly observable in a typical, unstructured environment (Leew et al., 2010). However, it is important to consider that the child's classroom and home make up their natural environment and provide them with a context, which impacts the sensory behaviors they display in that setting. For instance, classrooms are typically complex sensory environments with a high level of visual clutter, excessive noise, and—because of group seating—frequent, unpredictable tactile input; all of which can affect the attention and behavior of children with ASD in the setting (Ashburner et al., 2014). It is understandable that the child's classroom or home will produce much more

variability than a clinical setting and it is much more likely that unforeseen obstacles can occur, but it is important to consider the impact these settings have on the child overall. Therefore, to make an impact on the sensory difficulties young children with ASD experience it is important to determine how factors applied within a clinical setting could be successfully transferred into the child's natural environment. Current literature does not examine how factors that occur in a clinical setting could be transferred over to the child's natural environment and produce significant results.

Length of study. Another variable present across multiple studies that may be linked to effectiveness was the duration or length of intervention time of the study. Of the six studies which were effective each applied at least ten sessions, but no more than thirty. This suggests that less than ten sessions is insufficient for the participating children with ASD to acclimate to the intervention strategy being applied. Classroom teachers must keep this aspect in mind when they are attempting different sensory-based strategies for children with sensory needs in their classroom. Results of the intervention will not be observed instantaneously, likely because children need time to adjust and repeated exposure to the intervention, this finding speaks to the necessity that teachers be patient and persistent when testing out and implementing various sensory-based strategies. It is critical that teachers, while being patient and persistent in testing different interventions, document the child's progress to determine how effective the strategy is over time.

Research has established that children with ASD can present with difficulty in reorienting their attention and usually require more time when shifting their focus (Ashburner et al., 2014). Due to this atypical slowness in reorientation, children with ASD show a preference for static, predictable, and repetitive types of stimuli. With this narrow, over-focused attention and

hypersensitivity they have trouble with the introduction of new activities within their daily routines (Ashburner et al., 2014). Therefore, if researchers introduce a new intervention strategy into the routine that the child with ASD is not accustomed to, they must account for how overwhelming and distressing the new sensory input of the intervention can be for the participant. The participating children require a period of time to adjust and become familiar with the intervention strategy before it is acceptable to measure changes in their behavior. Research from the current study suggests that fewer than ten sessions cannot accurately establish that an intervention is ineffective due to a lack of change in the child's behavior. The child's potential to alter their behavior as a result of intervention can be misrepresented. By applying between ten and thirty sessions teachers can obtain a more realistic image of the child in their classroom with sensory needs and determine the impact of the strategy on their behavior.

Targeting sensory processing. In reviewing the literature another noteworthy aspect that appeared across effective studies was the importance of targeting the sensory processing abilities in an intervention strategy. Five of the six effective studies included in the current research targeted the specific sensory behaviors or needs of participating children. Research suggests that children diagnosed with ASD have difficulty processing sensory input required to maintain arousal states (Bagatell et al., 2010). Without this ability children with ASD are not able to respond effectively to environmental changes that are present within their daily routines. Furthermore, the sensory processing abilities of children with ASD not only differ from those without the diagnosis, but also there are significant differences within the population of children diagnosed with ASD (Pfeiffer et al., 2011). Due to heterogeneity in the study populations, it is important to note that some strategies may have been deemed ineffective because they were not appropriate for all of the study participants.

Those effective studies that targeted the sensory processing abilities of children with ASD used the unique profile of each participant to inform their creation of an individualized intervention strategy. It is clear that doing so ensured the intervention was appropriate and could make a more considerable impact on each child's adaptive behavior capacities. This is significant for teachers because it indicates the importance of considering the unique behaviors of the child with sensory needs in their classroom when choosing a sensory-based strategy to try. It is important that teachers do choose to target a sensory-based strategy to address the sensory needs of a child in their classroom. Establishing the need for a sensory-based strategy, teachers should choose an intervention that matches the unique needs of the child.

Parental involvement. An additional feature of sensory-based intervention found to be important is the impact of parental involvement on the outcome of the intervention. Only six studies included parent and caregivers into the process of designing a sensory-based strategy for their child; three of these were effective when applied to children with ASD (Pfeiffer et al., 2011; Schaaf et al., 2012; Schaaf et al., 2013). Within these studies parents and caregivers served as a source of information about the participant child. Parents and caregivers completed sensory processing measures that would display for researchers specific sensory behaviors of the participant child and adaptive behaviors that they possessed before an intervention is applied. Parents completed the same measure after treatment. Parents were also involved in the creation of meaningful goals for their child, which determined what the child's target behaviors and which behaviors progress monitoring would focus on throughout the intervention. Parental involvement impacted the effectiveness of a sensory-based intervention by providing an individualized strategy and that created meaningful outcomes for the participant. Similar to the literature, teachers can rely on parents to add to the information they have on the child's sensory

behaviors. Combining all of this information, teachers can determine the most suitable intervention strategy for implementation in the classroom. Selecting an intervention in this manner allows for a more meaningful impact on the child's sensory behaviors. Teachers can use knowledge gained from collaboration with parents to inform the design and implementation of sensory strategies to improve the performance of children in their classroom.

Social validity. Building on the significance of parent or caregiver involvement in the design and implementation of sensory-based strategies, teachers need to consider multiple forms of evidence when determining the effectiveness of an intervention. In the current literature review only studies that could demonstrate statistical significance with a $p \leq .05$ were viewed as effective. The literature creates an objective interpretation of effectiveness without taking into consideration the social validity of their intervention. Social validity is the ability to demonstrate the social importance of treatment goals and outcomes (Callahan, Henson, & Cowan, 2008). The existing literature does not specifically take into account the opinion of the significant individual's involved or observe the participating children within their daily lives to determine effectiveness. In one study caregivers were interviewed who said the intervention had made a difference in their child with ASD's behavior, but these results were not analyzed (Watling & Dietz, 2007). Subjective reports made by the caregivers of participating children suggested that positive changes occurred in the child's behavior within their home environment. This suggests that caregivers perceived positive effects after the treatment even though researchers were unable to identify statistical significance in the study (Watling & Dietz, 2007). Demonstrating the need for teachers to consider sources of evidence that are impactful when exploring potential interventions to utilize in the classroom. Teachers should consider multiple sources of evidence, including statistical significance and caregiver perceptions of effectiveness, when selecting a

sensory strategy. If adults responsible for the care of the participant child deem the intervention as a helpful tool then that should be taken into consideration. There are instances where subjective data such as interviews that contain caregiver opinion can hold immense value when contemplating the relevance and feasibility of an intervention and may be more important than the objective data. Teachers should consider the social validity of a sensory strategy when choosing an intervention to employ in the classroom.

Professional development for teachers. The goal of the current study is to provide teachers with a resource that they can use to address the sensory challenges of students who enter their classroom. By bringing this information to teachers more children can be provided with the support that they require to thrive in a school setting. However, sensory processing disorder and the implementation of sensory-based strategies requires more than simply supplying teachers with basic knowledge. They need to be provided with this significant information in a manner that allows them to actually make functional changes within their classroom to support students with sensory challenges. For this reason, an implication of the current research is that teachers need to be provided with professional development by an occupational therapist that is skilled in the application of sensory-based strategies. The goal of professional development is for teachers to learn new skills that can be put into action within their classrooms. Teachers need the opportunity to spend time with an occupational therapist discussing these strategies in order to know which would be best for their classroom. Moreover, they not only need assistance learning the skill, but understanding what exactly a sensory-based strategy would look like when implemented in their classroom. A sensory-based strategy will have the best impact if the teacher is made fully knowledgeable of the intervention and the implantation process required. For this

reason it is extremely important that professional development by an occupational therapist be provided to teachers.

Change in policy. In the current literature few successful strategies were implemented in the classroom and teachers were not used as a valuable team member in the design and implementation process of a sensory-based strategy. However, it is acknowledged in the current study that interventions should be brought to children within their daily routines, which in most cases means the classroom. In order for teachers to make the most beneficial impact on their student with sensory difficulties they need to be fully supported by an occupational therapist. This can be very challenging if the child has no diagnosis and does not qualify for an Individualized Education Plan (IEP) or 504 plan. There is no general provision for students who are not under the special education umbrella to receive related services from occupational therapists. Yet, students with sensory challenges would benefit from collaborations between teachers and occupational therapists through a consultative model. Additionally, these strategies may benefit the entire classroom because these strategies can help improve attention and focus for students. This challenge calls for a change in education policy that allows for and promotes the consultation of occupational therapists with teachers to address sensory needs in the classroom. By changing the policy schools can allow occupational therapists to do more prevention of problems in the classroom through collaboration with teachers via a consultation model.

Strengths-based model. Current literature displays that young children with ASD show more sensory impairments when compared to children without the diagnosis and that sensory abnormalities are a distinguishing symptom of ASD (Wiggins et al., 2009). Most research is interested in establishing how the sensory impairments of children with not only ASD, but SPD

as well, are negatively affected by this difference between themselves and their typically developing peers. Looking at the child's sensory behavior as an impairment that needs to be altered, current literature seeks to determine sensory-based strategies that eliminate the child's current sensory processing pattern and replaces it with new adaptive behavior resembling those of individuals with typical sensory processing skills. There is little discussion in the literature about potential strengths associated with the atypical sensory processing of children with ASD and SPD. However, there are situations in which the acute perception of sensory information could be advantageous for the individual. Instead of only problematizing the way these children process sensory information, providers should consider ways in which their abilities and preferences may be positive additions to the classroom. With this alternative view, sensory-based strategies can be effectively designed to address challenges while also valuing each child's unique role in the classroom.

Limitations

A major limitation of the present research is that it was restricted to studies in which participating children must have had a diagnosis of Autism Spectrum Disorder to be considered for inclusion. However, sensory issues exist within a broader group than just children with a diagnosis of ASD. Research has shown that it is possible for sensory processing issues to be comorbid with other diagnosable disorders, such as Attention Deficit Hyperactivity Disorder (ADHD) or Fragile X Syndrome, as well as children who have received no diagnosis of a disorder (Miller, Nielsen, & Schoen, 2012; Miller, Reisman, McIntosh, & Simon, 2001). Moreover, within the DSM-5, the differential diagnosis of ASD has changed to include individuals formerly diagnosed with Asperger's. Asperger Syndrome was formerly a separate diagnosable disorder, but now is considered a "high functioning" form of ASD. These children

do not have significant delays in language or cognitive development and this ability impacts the way in which they will respond to a sensory-based strategy. Though technically on the spectrum, the abilities of children with Asperger's will affect any research measuring the capabilities of children with ASD. Furthermore, an age range of 4-12 was imposed in the current study in order to examine the effects of sensory-based strategies on young children that could possibly be applied within the typical classroom. Sensory issues can be present within individuals of any age and is not limited to this young age group. Research indicates the adults with ASD still display sensory processing difficulties that affect their abilities to participate in routines of their daily lives (Tavassoli, Miller, Schoen, Nielsen, & Baron-Cohen, 2014). An additional limitation of the current study is that only studies that were performed within the past ten years were included. If the literature review were expanded beyond the past ten years there would be more research studies examining the effects of sensory-based strategies on children with ASD. Another limitation is the lack of classroom setting studies that were found to be effective when applied. In the current research only one study performed in the classroom made a statistically significant impact on participants behavior. Not only were studies not as effective when demonstrated in the classroom, but also researchers did not utilize the teacher as a valuable team member when designing and implementing sensory-based strategies. Current literature lacked good collaboration with teachers that would have the potential to impact the effectiveness of interventions applied within the classroom.

Avenues for Future Research

Results of the literature review conducted for this study suggest the need for further research in implementing intervention strategies into the daily routines of children with ASD who present with sensory needs as well as children without this diagnosis. While multiple studies

conducted within a clinical setting were found to be effective (Fazlıoğlu & Baran, 2008; Pfeiffer et al., 2011; Schaaf et al., 2012; Schaaf et al., 2013), this was not translated into research that took place within the classroom setting. A characteristic of occupational therapy is to address the needs of individuals within their daily tasks (Watling & Dietz, 2007). For young school-aged children this implies that effective interventions must be brought to them within the classroom where they carry out the bulk of their daily activities.

Not only do intervention strategies need to be carried over into the child's daily routine, but also research in the future should strive to include the classroom teacher in treatment implementation. Besides parents and caregivers, the classroom teacher spends the most time with the child who needs support for sensory challenges. They have the ability to help meet the needs of the child within their daily routines, which is what interventions for children with sensory challenges should seek to target. In the literature reviewed, teachers were very limited in their involvement in the intervention process. Teachers were asked to fill out sensory measures on the behavior of the child in their classroom or give their opinion after a strategy was implemented. Yet none of this information was used to determine the effectiveness of an intervention strategy used in the classroom. Teachers were not utilized as a resource when researchers were applying sensory strategies in the classroom. In future research, teachers need to be more involved in the implementation process of strategy and need to be collaborating with occupational therapists to address the specific sensory needs of the target child. Teachers should be viewed as a valuable contributing team member in the design and implementation process of an intervention as well as an observer who can track the effects. Future research should focus on what role teachers should play in the implementation of sensory strategies within the classroom.

Another avenue for future research is the need to establish a sensory-based strategy that is consistent and valid when being applied to multiple children each with unique progress goals. Children diagnosed with ASD are a heterogeneous group, in that the number and types of symptoms can differ drastically and range from mild to severe (Pfeiffer et al., 2011). Since children with ASD who have sensory needs differ substantially from one another, future research should consider this heterogeneity in design and interpretation of studies. One possible way is to strive for a more homogenous group across at least one significant symptom factor. Ensuring that participants display very similar behavioral tendencies as a result of sensory processing may produce a more reliable and valid depiction of their behavior adaptations as a result of particular interventions. By targeting commonality among participant children, the effectiveness of an intervention strategy may be more easily detected and applied clinically.

Conclusion

The present study includes an examination of sensory-based strategies applied when working with children diagnosed with ASD. This study sought to present teachers with a resource of effective sensory-based strategies that can be used to address not only the sensory issues that children with ASD display, but sensory issues that any child in the classroom could have. The research examined specific features of sensory-based strategies established in literature and determined which features were common across strategies that were effective when applied to children with ASD. Teachers can use these findings as a resource for different intervention strategies that could be translated into their classrooms. Since the sensory needs of young children can be manifested as problem behaviors in the classroom (Ashburner et al., 2014), it is important that teachers are aware of Sensory Processing Disorder (SPD) and related symptomology as well as effective practices that can help students with sensory needs regardless

of a diagnosis. By employing the sensory-based strategies found to be effective in this literature review teachers could use this information as a resource to help all children with sensory needs succeed in the classroom.