Music Therapy and Sensory Processing Disorder in Individuals with Autism Spectrum Disorder: A Systematic Review

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MUSIC THERAPY AND SENSORY PROCESSING DISORDER IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER:
A SYSTEMATIC REVIEW

By

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ABSTRACT

Individuals with Autism Spectrum Disorder (ASD) often experience atypical patterns of sensory processing. Sensory Processing Disorder (SPD) occurs when sensory information is interpreted incorrectly or not filtered appropriately. This often results in atypical behavioral responses that may impact an individual’s ability to sustain attention, communicate, and participate in social activities. Music therapy has been shown to enhance social, communication, and cognitive skills through a variety of interventions designed and adapted to each individual’s needs. The purpose of this systematic review is to analyze and describe the evidence about how SPD impacts ASD and how music therapy can be used to address challenges that arise from SPD.

A systematic literature review was conducted using 22 articles from an electronic database that met specific inclusion criteria. Results were summarized to describe participants, setting, research design, goal/objective, intervention(s), and generalizations. Overall, the results showed a need for more extensive research on the prevalence of SPD in individuals diagnosed with ASD and the effectiveness of music therapy to address SPD. To support board-certified music therapists who work with individuals with ASD, it is imperative that future research be conducted in order to establish best-practice goals and interventions.
CHAPTER 1

INTRODUCTION

Music therapy is an evidenced-based health profession that dates back seven decades. Over that period, research has shown the benefits of using music interventions with various populations (American Music Therapy Association [AMTA], 2015). Specifically, music therapy has been described to benefit individuals with Autism Spectrum Disorder (ASD) (AMTA, 2015). Today, there is a high prevalence of individuals with ASD, which leads to an increased need for board-certified music therapists working with these populations (Groene, 2003). Individuals with ASD often have sensory systems that do not properly filter and organize incoming stimuli (Kalas, 2012). It is estimated that 40% to 88% of individuals with ASD and other disabilities experience dysfunction of the sensory systems (Ahn et al., 2004). The multi-sensory aspects of music therapy interventions can be used to address communication, social, and cognitive skills that may be affected by sensory processing difficulties (Walworth, 2007). This systematic review was conducted to examine the existing literature regarding the use of music therapy to address sensory processing in individuals with ASD.

Sensory Processing

Sensory processing is the way in which the brain receives, filters, organizes, and interprets sensory input received from the seven sensory systems (Berger, 2002; O’Donnell et al., 2012). Sensory processing disorder (SPD) is the diagnostic term used when sensory information is interpreted incorrectly or not filtered appropriately, and atypical behavioral responses result (Berger, 2002). Jean Ayres first identified SPD in 1972 while studying children with learning disabilities (Armstrong et al., 2013; Davies & Tucker, 2010). According to Watling and Dietz
Ayres established her theory of sensory integration based on her understanding of the disruption of purposeful behaviors caused by interferences in the integration of sensory information. The disruption of purposeful behaviors can lead to functional impairments that result in difficulty performing activities of daily living as well as challenges associated with coping, social, and play skills (Cosbey et al., 2010). Parham and Mailloux (2001) identified five specific functional impairments associated with SPD including decreased social skills, decreased adaptive response, impaired self-confidence, deficient adaptive skills, and diminished fine-, gross-, and sensory-motor skill development. Various behavioral challenges such as irritability, lethargy, and stereotypic behaviors can also result from difficulties with sensory processing (O’Donnell et al., 2012). These functional impairments and behavioral challenges may result from overstimulation and decreased attention skills.

Individuals with SPD have difficulty attending to specific stimuli while ignoring irrelevant sensory information, which can negatively impact the child’s ability to sustain engagement in play, social, and academic activities and lead to decreased exploration of the environment (LaGasse et al., 2019; O’Donnell et al., 2012). Overstimulation, or sensory overload, can also affect the individual’s ability to sustain attention and engage in activities of daily living. Individuals can experience hyper-reactivity to sensory input as well as hypo-reactivity. A hyper-reactive response means the individual is avoiding sensory input while a hypo-reactive response means the individual is seeking sensory input. According to Wakeford (2012), children often present with mixed patterns of hyper- and hypo-reactivity, which means the child may be hyper-responsive to some sensory input (e.g. touch and taste) and hypo-responsive to other sensory input (i.e. smell). The combination of sensory seeking and avoiding behaviors can result in sensory overload because the brain is unable to properly filter and
organize incoming stimuli (Kalas, 2012). The results of atypical sensory processing can have negative impacts on a child’s ability to learn and grow, so it is important to understand how children with SPD respond to different types of sensory information in order to identify areas of strengths and challenges.

**Autism Spectrum Disorder (ASD)**

Autism Spectrum Disorder (ASD) is a neurological disorder characterized by persistent deficits in social communication and social interaction as well as restricted and repetitive patterns of behavior, interests, or activities (Centers for Disease Control and Prevention [CDC], 2019). It is estimated that 1 in 59 children in the United States are diagnosed with ASD regardless of racial, ethnic, or socioeconomic groups (CDC, 2019). Individuals diagnosed with ASD often process sensory stimuli differently. The DSM V includes hyper- or hypo-reactivity to sensory input as one diagnostic criterion for ASD under the category of restricted, repetitive patterns of behavior, interests or activities (CDC, 2019; LaGasse et al., 2019). ASD is a spectrum disorder, and individual differences are explained by severity level. Severity of diagnosis is determined by social communication impairments and restricted, repetitive patterns of behavior (CDC, 2019). Individuals with a more severe ASD diagnosis may experience more sensory processing dysfunction.

One result of sensory processing dysfunction is sensory overload, which has been likened to a state similar to fight-or-flight (Berger, 2002). Sensory gating is the ability to selectively attend to sensory stimuli while ignoring irregular stimuli, and it is impacted by sensory overload (LaGasse et al., 2019). These individuals may have difficulty sustaining attention and may also display learning difficulties and behavioral challenges due to inefficient processing of sensory stimuli (LaGasse et al., 2019; Pasiali et al., 2014). Symptoms of ASD may cause significant
impairment social and occupational functioning (CDC, 2019). Individuals with a comorbid
diagnosis of ASD and SPD are likely to experience more challenges related to social,
communication, and academic skills. It is important to understand the effects of sensory
processing on individuals with ASD in order to address challenges with attention, learning, and
behavior.

**Music Therapy to Address Sensory Processing**

Music therapy has the unique ability to address sensory processing because of the multi-
sensory characteristics of music. Musical elements including rhythm, melody, dynamics, tempo,
and form can be manipulated to stimulate and organize an individual’s sensory system (Berger,
2002). Music therapy interventions can also include instruments, manipulatives (i.e. scarves,
puppets, stretchy bands, etc.), and movements that incorporate tactile, auditory, proprioceptive,
and vestibular stimulation. In addition, music activates all main regions of the brain (Miranda &
Overy, 2009) that are involved in sensory, cognitive, and communicative functions (de l’Etoile &
LaGasse, 2013). Music can serve as a calming stimulus by providing consistent patterns of
rhythm and melody that allow the brain to overcome the sense of fight-or-flight and begin to
appropriately filter, process, and interpret sensory input (Berger, 2002). Music therapy
interventions can be designed or adapted to specifically target goals related to SPD.

According to AMTA (2015), music therapy interventions that focus on enhancing
social/emotional, communication, sensory-motor, and cognitive skills are effective in addressing
areas of functioning affected by SPD. Wakeford (2012) encourages analyzing instruments and
music experiences from a sensory perspective, which entails considering the variety of sounds,
colors, textures, and movements associated with each instrument and activity. The intervention
design may remain the same, but the instruments used may change based on the individual
child’s hypo- or hyper-response to sensory stimuli. When designing and adapting interventions, it is important for the music therapist to identify and interpret responses to elements of music in order to develop a more comprehensive understanding of the individual’s strengths and areas of difficulty (Martin et al., 2012). Researching how music therapy is being used to address sensory processing in individuals with ASD is crucial to understanding how to more effectively create and adapt interventions that target deficits in related areas. The goal of interventions addressing sensory processing differences is to support the individual’s successful participation in everyday life through developmentally appropriate learning opportunities that are designed to enhance social, motor, communication, and cognitive skills (Humpal & Kern, 2012; Wakeford, 2012).

**Operational Definitions**

For the purpose of this review, the author used the following operational definitions.

*Sensory processing*: the way in which the brain takes in, filters, and organizes sensory input (Berger, 2002).

*Autism Spectrum Disorder (ASD)*: a neurologic disorder characterized by deficits in social communication and social interaction as well as restricted and repetitive patterns of behavior, interests, or activities (CDC, 2019).

*Music therapy*: an evidence-based practice of using music interventions to accomplish individualized goals designed and implemented by a board-certified music therapist (AMTA, n.d.).
CHAPTER 2
REVIEW OF LITERATURE

Sensory Processing

Individuals with SPD may experience dysfunction in filtering sensory stimuli, which can impact the child’s ability to sustain engagement in play, social, and academic activities (LaGasse et al., 2019). The inability to sustain attention can lead to limited participation in sensory experiences, which negatively impacts a child’s exploration of the environment (O’Donnell et al., 2012). It is important to establish data that express the prevalence of SPD in the population in order to have participants with which to conduct further studies on effectiveness of interventions for SPD. In a study by Ahn and colleagues (2004), parents of kindergarten children were surveyed to assess their perception of children’s behavioral responses to sensation in order to estimate the rates of SPD. Using the results from this study, the researchers estimate that over 220,000 kindergarten students in the United States may suffer from SPD (Ahn et al., 2004). The findings support the need for more epidemiological studies of SPD in the general population.

After prevalence data is obtained, research can shift in focus to the effects of SPD on functioning. Armstrong et al. (2013) conducted a study to examine differences in function that exist among children with SPD, physical disabilities, and typically developing (TD) children. The results revealed that children with SPD demonstrated significant differences in function particularly in the self-care domain from TD children. Children with SPD also showed differences in social function, specifically in the areas of peer play and safety (Armstrong et al., 2013). Overall, the results showed the importance of assessing the effect of sensory impairments on the child in order to design appropriate interventions to target affected goal areas such as play, social participation, and stereotyped movements.
Atypical sensory processing may affect many areas of a child’s life, including play. Bundy and colleagues (2007) studied SPD and the effect of intervention on playfulness. During this study, children with SPD attended twenty individual sessions in which interventions were designed to address sensory integration by providing enhanced sensation during challenging activities (Bundy et al., 2007). Results showed that group scores of the test of playfulness differed significantly, but the scores did not increase post-intervention. Correlation results provide evidence that sensory modulation has an effect on playfulness. The interventions used in this study did not result in increased playfulness; however, more research is needed in this area because the results did support the idea that SPD affects play (Bundy et al., 2007).

Another area of functioning that may be affected by SPD is social participation. A child’s ability to participate in social activities is crucial in the development of social and cognitive skills (Cosbey et al., 2010). Little is known about how SPD affects social participation, so Coseby and colleagues (2010) designed a study to examine the social patterns of children with SPD and TD children. Children with SPD were found to enjoy quiet table-top activities (i.e. crafts, drawing, and coloring) whereas activities with clear expectations and rules were the least enjoyed. It is possible that the visual-processing and sequencing skills involved in these activities are affected by SPD and may increase levels of frustration. Participation in social activities differed as children with SPD reported engaging in these activities primarily with family or alone unlike TD peers. Although this study provided preliminary results, the overall finding was that more research needs to be conducted to determine the impact of SPD on social participation and to determine effective interventions strategies (Coseby et al., 2010).

In addition to play and social participation, stereotyped movements (SM) may be related to atypical sensory processing. SM are a defining characteristic of ASD, but they are also present
in children with other sensory and developmental disorders (Gal et al., 2010). The purpose of a study by Gal et al. (2010) was to examine the relationship between SPD and SM in children with and without developmental or sensory disorders. Results showed that intellectual disability interacts with sensory impairments and ASD to increase the prevalence of SM. These findings are consistent with the idea that SM are an adaptive behavior that individuals with SPD use to cope with sensory over- and underresponsivity (Gal et al., 2010). Although SM may serve an adaptive function for individuals with SPD, they are often not considered socially acceptable (Pfeiffer et al., 2011). Future research is needed to test interventions that address manifestations of sensory differences (i.e. SM) while also adapting the sensory environment to provide the most effective treatment options (Gal et al., 2010).

These studies provide preliminary evidence that sensory processing affects various areas of functioning in daily life including play, social participation, and stereotyped movements. There is still very little known about the prevalence of SPD (Ahn et al., 2004) and effective interventions to address impacted areas of functioning (Armstrong et al., 2013; Bundy et al., 2007; Cosbey et al., 2010; Gal et al., 2010). Overall, research shows that atypical patterns of sensory processing disrupt purposeful behaviors and may lead to functional impairments (Cosbey et al., 2010). Taken together, these studies emphasize the importance of conducting future research to understand the potential effects of SPD on daily functioning and to design interventions to encourage a child’s ability to develop and learn.

**Autism Spectrum Disorder (ASD)**

ASD is a neurodevelopmental disorder characterized by impairments in social interaction and communication, and many individuals diagnosed with ASD also have SPD (Tomchek & Dunn, 2007). Tomchek and Dunn (2007) conducted a study to investigate the differences in
sensory processing between children with ASD and TD children. The results showed that children with ASD were often reported as having sensory impairments, and TD were not. Sections of the Short Sensory Profile (SSP) that showed the greatest differences between groups included underresponsive/seeks sensation, auditory filtering, and tactile sensitivity. Overall, the findings show that children with ASD experience atypical patterns of sensory processing, which can impair the child’s ability to sustain engagement with people and activities (Tomchek & Dunn, 2007).

The difficulty sustaining attention and engagement may lead to challenges with problem behaviors and cognitive outcomes in the classroom setting for children with ASD. Ashburner et al. (2008) conducted a study to explore the associations between the patterns of sensory processing experienced by children with ASD and TD children and the effect on classroom experiences. The SSP was also used to measure sensory processing, and the results confirmed previous findings that patterns of sensory processing differ in children with ASD. The following findings were consistent with the study conducted by Tomchek and Dunn (2007). Scores in the underresponsive/seeks sensation and auditory filtering sections of the SSP were significantly negatively associated with attention to cognitive tasks, and tactile sensitivity was associated with various attention difficulties (Ashburner et al., 2008).

A similar study by O’Donnell et al. (2012) explored sensory processing characteristics in preschool-aged children with ASD and the impacts of SPD on various aspects of classroom behavior. Results showed a consistent association between higher levels of sensory processing difficulties and higher levels of behavior challenges. Overall, a majority of the children in the study experienced sensory processing challenges. All of the children were found to have challenges in adaptive behavior; however, there was no correlation between sensory impairments
and level of cognitive ability. The findings suggest the importance of comprehensive evaluation to identify each child’s unique sensory processing characteristics and how these characteristics may influence behavior (O’Donnell et al., 2012).

Once a comprehensive evaluation has been conducted, the therapist can begin to design interventions to address the individual’s unique sensory processing differences. Pfeiffer and colleagues (2011) conducted a pilot study to research the effectiveness of sensory integration (SI) interventions in children with ASD. Sensory integration treatment interventions were based on the individual needs of each child but included strategies such as providing environmental accommodations and sensory opportunities, fostering adaptive responses, and promoting the therapist-child relationship. Results showed children in the SI group demonstrated significantly fewer mannerisms (i.e. stereotyped or self-stimulatory behaviors) associated with ASD after the interventions. These behaviors may serve regulatory functions for individuals with ASD, but they are often perceived as socially inappropriate and may contribute to communication barriers (Pfeiffer et al., 2011). The findings encourage the use of individualized measures to determine client progress on individualized goals.

These studies provide evidence that individuals with ASD experience different patterns of sensory processing than do TD peers. SPD is not a diagnostic criterion of ASD, but various studies have documented sensory processing differences in children with ASD (Ashburner et al., 2008; O’Donnell et al., 2012; Tomchek & Dunn, 2007). Problem behaviors, deficits in motor skills, and impairments in attention can interfere with the child’s participation in the school setting (Tomcheck & Dunn, 2007; Ashburner et al., 2008; Armstrong et al., 2013). In addition, classrooms are typically complex sensory environments, and specific sensory processing difficulties may contribute to academic underachievement (Ashburner et al., 2008). It is
important for therapists working with these individuals to conduct comprehensive evaluations, determine goals based on the unique sensory characteristics, and design appropriate interventions to target those goals strengths and challenges.

**Music Therapy to Address Sensory Processing**

Music therapy is uniquely able to address challenges that arise from sensory processing disorder. SPD can affect some or all of the sensory systems (Ahn et al., 2004), and elements of music can be adapted accordingly. Tempo, rhythm, dynamics, and form are among the many musical elements that can be altered within music therapy interventions to address and individual’s sensory processing needs (Berger, 2002; Lantigua, 2019). Specifically, a steady beat in music has been shown to promote attention and learning by encouraging engagement behaviors in children (Geist & Geist, 2012). Children often present with mixed patterns of sensory processing in which they are hyper-sensitive to some forms of sensory input and hypo-sensitive to others (Wakeford, 2012). Stegemöller (2014) found that music is associated with dopamine release, which can impact motivation, behavior, and working memory. Due to the variability in SPD, it is important that music therapists assess each individual’s sensory needs and adapt interventions appropriately.

The first step to effectively designing and adapting music therapy interventions is understanding what music research has been done with individuals with a variety of disabilities including ASD. Brown and Jellison (2012) conducted a systematic review of music research with children and youth with disabilities and typically developing peers. In this review, the authors found that many of the studies were conducted with children with ASD. The reasoning for this could be due to the fact that ASD is becoming a more common and accurate diagnosis (Brown & Jellison, 2012). In contrast, it was discovered that there is a low percentage of music research
conducted with children with learning disabilities. It is possible that this lack of research is the result of children with learning disabilities often being served in inclusive classrooms, while music therapists are most often working with children in pull-out classrooms and facilities (Brown & Jellison, 2012). Interestingly, the predominant research method found in this review was experimental designs. Overall, this study found low rates of music research with children with disabilities, and of these studies, children with ASD was the most commonly studied.

Many of the following music therapy studies were conducted with individuals with ASD, which emphasizes the finding by Brown and Jellison (2012) that much of the music research was with children with ASD. Kern at al. (2013), conducted a study to evaluate the status of music therapy services for serving individuals with ASD. Professional members of AMTA who were identified as working with this population were asked to complete a survey designed to learn more about components of evidence-based practice with clients with ASD. The results showed that music therapists have a strong use of assessment, yet there are not many ASD-specific or validated assessment tools available (Kern et al., 2013). The authors found that the most frequently indicated goal areas address were communication and social skills, which are two core diagnostic characteristics of ASD. The surveyed music therapists identified several areas of training needs including implementation of evidence-based practices, recent research related to ASD and music therapy, and behavioral, sensory, and neurologic approaches to ASD (Kern at al., 2013). While there are several areas of training that can be improved, this study suggests that professional music therapists are using assessments to determine appropriate goals and evidence-based interventions in music therapy sessions.

Kern et al. (2013) found that there are not many assessment tools available that are specific to working with individuals with ASD, but the SCERTS model was listed as an
emerging tool. In 2009, Walworth et al. conducted a video analysis study to determine if the SCERTS model is an effective assessment tool for identifying music therapy goals for individuals with ASD. The Social Communication, Emotional Regulation, and Transactional Support (SCERTS) model is a “comprehensive curriculum designed to assess and identify treatment goals and objectives within a multidisciplinary team of clinicians and educators for children” with ASD (Prizant et al., 2003). The videotaped sessions were coded to identify SCERTS goals and objectives being addressed during music therapy treatment (Walworth et al., 2009). The results of the descriptive analysis found that all three domain areas were addressed in music therapy sessions; however, music therapists appeared to be unaware of the transactional support goals being addressed. By understanding the SCERTS model, music therapists are able to more clearly articulate what goal each intervention is specifically addressing. Also, the SCERTS model is designed to be used by an interdisciplinary team, which can allow for more effective communication of goals and objectives between therapists of all disciplines.

The two most frequently addressed goal areas in the study by Kern et al. (2013) were communication and social skills, which fall into two of the three broad domains identified in the SCERTS model. A previous study by Kaplan and Steele (2005) analyzed music therapy goals and outcomes for clients with ASD and found that the top two primary goal areas were language/communication and behavioral/psychosocial. These goals are in line with the diagnostic criteria for ASD, and the results of these three studies emphasize the importance of addressing the goals. Kaplan and Steele (2005) used a computerized program to collect and organize data to analyze various outcomes including frequently used interventions and goal areas. The two most common goal areas seem to suggest that behavioral/psychosocial and
communication needs must be addressed before areas such as motor skills and cognition (Kaplan & Steele, 2005).

Difficulties with processing sensory information and deficits in attention skills may impact communication skills, social and academic functioning (LaGasse et al., 2019). In a study by LaGasse et al. (2019), children with ASD were compared with typically developing peers to gather evidence of the effect of music therapy interventions on sensory gating and attention outcomes. The children with ASD participated in a 35-minute individual music therapy attention protocol over five weeks. The brain and behavior measures indicated that children with ASD have less sensory gating capabilities, which may negatively impact early attention processes. Results showed that children with ASD had significant improvements in selective and sustained attention following music therapy intervention (LaGasse et al., 2019). Results from this feasibility study suggest that music therapy may be an effective treatment option for addressing attentional difficulties.

**Attention**

Atypical sensory processing can affect a child’s ability to attend to a task and sustain engagement in activities involving joint, sustained, selective, or alternating attention (Kalas, 2012; LaGasse et al., 2019; Pasiali et al., 2014; Walworth, 2007). Interventions to address attention may use music as a cue for alternating instruments, requesting instruments, or stopping and starting based on musical patterns (LaGasse et al., 2019; Walworth, 2007). Lantigua (2019) conducted a study in which a music-based selective attention training (MSAT) program was developed to improve selective attention in toddlers with developmental disabilities. Over time, it was determined that the selective attention therapeutic music experience (TME) was most effective when placed between two sustained attention tasks (Lantingua, 2019). The researcher
discovered the importance of using developmentally appropriate auditory and visual distractors that can be cognitively processed and recognized by the toddlers. The results of this study also showed that participation sensory-based activities that include multi-sensory materials such as scarves and cabasa focused on developing sustained attention led to more successful completion of TMEs addressing selective attention (Lantingua, 2019).

Children with SPD may also experience difficulty with joint attention, which involves engaging another person’s attention to share an experience. Joint attention involves both attention skills and social skills making it a behavior to learn for individuals with ASD in particular. Kalas (2012) conducted a study to determine the effects of simple versus complex music on joint attention in children with ASD. The results of the study showed a significant interaction between the music condition and functioning level. Children diagnosed with a higher severity of ASD elicited more responses to joint attention during the simple music condition, and the complex music condition was more effective for children with mild/moderate ASD (Kalas, 2012). The researcher observed signs of overstimulation in individuals with more severe ASD during the complex music condition. This observation is supported by previous research findings that children with ASD often have difficulties with sensory processing (Berger, 2002; Kalas, 2012). In contrast, the more predictable structure in the simple music condition may have been inadequate for maintaining the attention of children with mild/moderate ASD. This study demonstrates the importance of assessing the individual strengths and areas of difficulty for each client and adapting interventions respectively.

Musical Attention Control Training (MACT) is a specific music therapy intervention that can be used to address joint sustained, selective, and alternating attention that may be impacted by the inability to filter out irrelevant sensory stimuli (Kalas, 2012; LaGasse et al., 2019; Pasiali
et al., 2014). Pasiali et al. (2014) conducted a feasibility study to determine the effectiveness of using MACT interventions to improve attention skills in adolescents with ASD. A variety of music-based experiences were used including structured and improvised instrument play designed to address different types of attention skills. Overall, the results showed positive trends in outcomes related to selective and alternating attention (Pasiali et al., 2014). This study provides preliminary evidence in support of the effectiveness of MACT interventions to address attention if the music is developmentally appropriate and the type of attention being addressed complies with the individual client’s needs.

Communication

In addition to difficulty with attention, individuals with ASD and SPD may also experience deficits in communication, which can involve both spoken and written language. Register (2001) conducted a study to evaluate the effects of music therapy session curriculum on the prereading and writing skills of children in early intervention and exceptional education programs. Results of this study provide evidence that music is able to enhance print concepts and prewriting skills. It was discovered that music therapy sessions designed to address specific academic measures were more effective than sessions that addressed all developmental skills. The researcher concluded that there is a need for music therapists to develop a therapeutic plan focused on a specific skill area (Register, 2001).

The study by Register (2001) focused on written forms of communication (i.e. reading and writing). Lim (2010) conducted a study on spoken language using the Developmental Speech and Language Training through Music technique to encourage speech production in children with ASD. The researcher composed six songs that included a total 36 target words strategically placed within the lyrics. Results showed significant differences in pretest and
posttest scores for the group who received music therapy and the speech therapy group. The findings provide evidence for the idea that children with ASD perceive and produce linguistic information from music and speech similarly (Lim, 2010). Children with ASD were able to attend and respond to the musical stimuli while perceiving the linguistic information organized within the musical patterns. In particular, the findings show that the inherent structure of music stimuli enhances speech production and attention in children with a more severe ASD diagnosis (Lim, 2010).

Social Skills

Individuals who experience difficulty sustaining attention due to atypical sensory processing may also experience challenges with sustaining attention in social interactions. Music therapy is a unique treatment modality that is able to promote attention and communication as well as encourage the development of social skills through non-threatening musical activities that allow all participants to be successful (Gooding, 2011). Schwartzberg and Silverman (2013) conducted a study targeting social skills using music-based social stories as the intervention during music therapy sessions with children with ASD. The researchers obtained mixed results from the study, but anecdotal evidence from camp staff supported the use of music-based social stories as a way of providing a new and enjoyable way of learning social skills (Schwartzberg & Silverman, 2013). An individual’s ability to store and recall information is important, because it may lead to improved comprehension and generalization. Based on the results, the researchers suggested pairing social stories with music may facilitate comprehension, generalization, and on-task behaviors, which lead to improved social competence (Schwartzberg & Silverman, 2013).

Various music therapy interventions can be used to address social skills including social stories. LaGasse (2014) conducted a study to examine the effects of music therapy group
intervention on social skills. The participants in the study were children with ASD who attended either a music therapy group or a non-music social skills group. Results showed increased occurrences of joint attention and eye gaze with peers specifically after completion of the music group sessions. Similar to the study by Schwartzberg and Silverman (2013), this study provided evidence that musical structure is effective in maintaining children’s attention, and these musical experiences can be designed to provide support to encourage children to interact with one another (LaGasse, 2014).

Gooding (2011) also studied the effects of a music-based social skills intervention program. The participants in this study were children with a variety of diagnoses who also displayed language and attention difficulties (Gooding, 2011). Active music interventions and cognitive behavioral techniques were used to improve social competence. Results showed significant improvements in social functioning as measured by self-ratings, research ratings, and behavioral observations. These findings suggest that music therapy interventions addressing social skill deficits may be effective when a variety of activities are incorporated and designed to be developmentally and age appropriate (Gooding, 2011). The results of these three studies emphasize the idea that music is a fundamentally social activity that allows for successful participation of individuals at varying ability levels (Gooding, 2011).

These studies all provide evidence that music therapy is an effective treatment for sensory processing when designed with the individual clients in mind. Interventions can be adapted based on the individual’s needs to provide needed sensory input through fun and engaging activities that promote learning (Geist & Geist, 2012). In addition to attention, communication, and social skills, motor patterns can also be affected by sensory processing particularly in response to vestibular and proprioceptive needs (Farnan, 2007). Interventions to
address motor difficulties can include pairing rhythmic stimuli with specific movements (Farnan, 2007), allowing a child to jump on a trampoline while receiving auditory input (Berger, 2002), and using drumming to work on bilateral coordination (Berger 2002, Reschke-Hernandez 2011). Reschke-Hernandez (2011) organized a list of music therapy interventions and adaptations to address sensory needs including instrument exploration for tactile sensitivities and adding pressure and resistance during movement for vestibular and proprioceptive sensitivities (Thaut, 1984). Orff instruments and large gathering drums can also be used to provide vibrotactile input (Warwick, 1984; Farmer, 1985). The Premack Principle can also be integrated into music therapy sessions to encourage the individual to remain engaged by providing a preferred item or activity after less preferred tasks have been completed (American Psychological Association [APA], 2018). This comprehensive understanding of research, interventions, and adaptations will enable the music therapist to create opportunities for the individual to work on sensory, motor, cognitive, communication, and social skills to enhance functioning in everyday life.

**Purpose of Study**

The purpose of this systematic review was to identify and discuss research regarding SPD, ASD, and the use of music therapy to address sensory processing in individuals with ASD. The intention of this literature review was to reach a more comprehensive understanding of the existing research conducted on sensory processing and music therapy to address SPD. More specifically, the following research questions were explored:

1. What are the characteristics of the participants?
2. What goals and objectives related to sensory processing are being addressed?
3. What interventions are being used?
4. What generalizations can be made between studies?
CHAPTER 3

METHODS

The systematic search was conducted using keywords to identify articles from electronic databases. Keywords used in the electronic search included sensory processing, sensory processing disorder, Autism Spectrum Disorder, music, and music therapy. The keywords were entered into the search box on Google Scholar. Identified articles were screened to determine if each met the specified inclusion criteria.

Inclusion Criteria

Inclusion criteria were formulated to determine a study’s relevance to the topic for this systematic review. Only studies published between 2000 and 2019 were included in the study. The participants must have had a diagnosis of SPD or ASD, or they must have been recruited for participation in music therapy services. Criteria for the music therapy specific studies included services being provided by a board-certified music therapist. The studies were used either a descriptive or experimental research design. No demographic characteristics, including sex, age, ethnicity, or setting of study were limited. Screening with these criteria resulted in 22 articles for analysis. The articles were grouped into the following categories: SPD, ASD, and music therapy (MT) based on diagnosis and the purpose of each study. Studies that researched the prevalence and effects of sensory processing were grouped into the SPD category. The ASD category included the studies in which the research was examining the effects of atypical sensory processing on individuals diagnosed with ASD. Finally, the studies in which research was conducted using music therapy as the treatment for atypical sensory processing were included in
the MT category. The articles within the MT category were further categorized into attention, communication, and social skills based on the targeted goal area in the respective studies.

In-Depth Analysis

A descriptive analysis was conducted by the researcher on each of the 22 articles that fit the inclusion criteria. To facilitate the analysis, the researcher collected data across eight categories: study, participants, age, setting, design, goal/objective, intervention(s), and generalization. The studies category was filled in with the authors of each article. Participants and age were found in the methods section where the authors listed the inclusion criteria and average age of participants in each study. Setting was included in the table to describe where the experimental research took place or where participants in descriptive studies were recruited from. The goal/objective being addressed in experimental studies and any specific interventions used to address the respective goals were included. Finally, the generalization statement obtained from the discussion section each of the 22 articles was included in the table to look for similarities between studies. The statement from each article summarized the results, made a generalization to individuals not included in the study if possible, or addressed implications of study for future research.
CHAPTER 4
RESULTS

After a comprehensive electronic database search, a total of 22 articles that fit the specific inclusion criteria were analyzed for this systematic review. These peer-reviewed articles were published in various journals between 2001 and 2019. Articles were found in the following journals: The American Journal of Occupational Therapy \( (n = 8) \), Pediatric Physical Therapy \( (n = 1) \), Journal of Music Therapy \( (n = 11) \), Music Therapy Perspectives \( (n = 1) \), and The Arts in Psychotherapy \( (n = 1) \). The categories used for analysis were studies, participants, age, setting, goal/objective, intervention(s), and generalization. A summary of the findings for SPD, ASD, and MT are found in Tables 1, 2, and 3, respectively.

**Sensory Processing Disorder (SPD)**

A full analysis of the five articles specifically addressing SPD is provided in Table 1. All of the studies included participants with different types of disabilities including SPD, ASD, hearing/visual impairments, intellectual disabilities, and physical disabilities. Four of the studies specifically included TD participants as control subjects. The mean age group ranged from 4 to 13 years old. Three of the studies included subjects recruited from schools, and two studies recruited participants from clinics. Only the study by Bundy et al. (2007) was an experimental research design that tested the effects of sensory integration interventions on play. The generalizations for all five of the studies followed a similar theme. Overall, the finding was that more research is needed in the area of SPD, specifically analyzing the effect that atypical sensory processing has on various areas of functioning in daily life. Once more is known about the impacts of SPD, specific interventions to address affected areas can be researched.
<table>
<thead>
<tr>
<th>Studies</th>
<th>Participants</th>
<th>Age</th>
<th>Setting</th>
<th>Design</th>
<th>Goal/Objective</th>
<th>Intervention(s)</th>
<th>Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahn et al. (2004)</td>
<td>Kindergarten students; ( N = 710 )</td>
<td>4 to 6 Y</td>
<td>School</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>Need for more rigorous epidemiological studies of SPD.</td>
</tr>
<tr>
<td>Bundy et al. (2007)</td>
<td>SPD (( n = 20 )), TD (( n = 20 )); ( N = 40 )</td>
<td>4 to 11 Y</td>
<td>Clinic</td>
<td>E</td>
<td>Play</td>
<td>Enhanced sensation during SI interventions</td>
<td>SPD has an effect on play, but more research is needed to test the effects of intervention on play.</td>
</tr>
<tr>
<td>Coseby et al. (2010)</td>
<td>SPD (( n = 12 )), TD (( n = 12 )); ( N = 24 )</td>
<td>6 to 9 Y</td>
<td>School</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>More research is needed to determine effect of SPD on social participation and effective interventions.</td>
</tr>
<tr>
<td>Gal et al. (2010)</td>
<td>TD (( n = 30 )), ID (( n = 29 )), VI (( n = 50 )), HI (( n = 56 )), ASD (( n = 56 )); ( N = 221 )</td>
<td>6 to 13 Y</td>
<td>School</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>More research is needed to test interventions that address sensory processing differences while adapting the sensory environment.</td>
</tr>
<tr>
<td>Armstrong et al.</td>
<td>SPD (( n = 27 )), PD (( n = 27 )); ( N = 81 )</td>
<td>1.3 to 7.3 Y</td>
<td>Clinic</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>Children with SPD demonstrate sensory impairments and deficits in social skills.</td>
</tr>
</tbody>
</table>

*Note.* Abbreviations for participants as follows: SPD = Sensory Processing Disorder, TD = Typically Developing, ID = Intellectual Disabilities, VI = Visual Impairments, HI = Hearing Impairments, ASD = Autism Spectrum Disorder, PD = Physical Disabilities. Abbreviations for age as follows: Y = Years. Abbreviations for research design as follows: D = Descriptive, E = Experimental; Abbreviations for Interventions as follows: SI = Sensory Integration
Autism Spectrum Disorder (ASD)

Table 2 provides a full analysis of the four articles specifically addressing research on sensory processing and ASD. Two of the articles compared groups of individuals with ASD to TD individuals, whereas two articles only included participants with ASD. The average age of participants ranged from 3 to 12 years old. Three of the studies were descriptive research designs in which survey and computer data were obtained and analyzed. Only the study by Pfeiffer et al. (2011) contained an experimental design that researched the effects of sensory integration interventions on sensory processing regulation. The overall generalization made from these articles is that children with ASD often demonstrated atypical sensory processing patterns that may be associated with deficits in academics and the presence of stereotyped behaviors. The results of the studies all emphasize the importance of conducting an assessment or evaluation of each client in order to determine each individual’s unique manifestations of SPD and the influence on behaviors in order to determine relevant goals and effective interventions.

Music Therapy to Address Sensory Processing

Thirteen articles were analyzed in the music therapy group. Of these articles, three were group into attention, two addressing communication, and three for social skills. The other five articles were more general studies about MT research with individuals with ASD or using MT to address SPD. Full analysis of all thirteen articles is provided in Table 3. Eight of the thirteen articles included participants with ASD, and the study by Kern et al. (2013) involved AMTA members who worked with individuals with ASD. The overall age range was 0 to 49 years, but most of the studies focused either on early childhood (Kalas, 2012; LaGasse, 2014, LaGasse et al., 2019; Lantigua, 2019; Lim, 2010; Register, 2001) or adolescents (Goeding, 2011; Pasiali et al., 2014). A majority of the articles included experimental research designs. The following
goals/objectives were addressed: prereading/writing skills, verbal production, social skills, and attention (joint and selective). Various interventions were used to address these skills including music performance, movement, music-based social stories, and structured and improvised instrument play. Several common generalizations were found between studies including the following: (1) most commonly addressed goal areas fall within categories in the SCERTS model, (2) MT interventions have the potential to increase attention, speech production, and social skills, and (3) goals must be individualized and interventions must be designed to be developmentally and age appropriate in order to be most effective.
<table>
<thead>
<tr>
<th>Studies</th>
<th>Participants</th>
<th>Age</th>
<th>Setting</th>
<th>Design</th>
<th>Goal/Objective</th>
<th>Intervention(s)</th>
<th>Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomchek &amp; Dunn (2007)</td>
<td>ASD ((n = 281)), TD</td>
<td>51.58 Mo</td>
<td>Chart review and data entry</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>Children with ASD often demonstrate atypical sensory processing patterns.</td>
</tr>
<tr>
<td>Ashburner et al. (2008)</td>
<td>ASD ((n = 28)), TD ((n = 51)); N = 79</td>
<td>6 to 10 Y</td>
<td>Classroom</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>Atypical sensory processing in auditory filtering difficulties and underresponsiveness/seeks sensation was associated with academic underachievement in the children with ASD.</td>
</tr>
<tr>
<td>Pfeiffer et al. (2011)</td>
<td>ASD; N = 37</td>
<td>6 to 12 Y</td>
<td>Summer program</td>
<td>E</td>
<td>Sensory processing regulation and social-emotional function</td>
<td>SI interventions</td>
<td>SI interventions may be effective in addressing individualized goals and decreasing stereotyped behaviors.</td>
</tr>
<tr>
<td>O'Donnell et al. (2012)</td>
<td>ASD; N = 42</td>
<td>3 to 4 Y</td>
<td>Data from ASD center</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>A comprehensive evaluation to determine unique sensory processing characteristics and influence on behavior is important to treatment process.</td>
</tr>
</tbody>
</table>

*Note.* Abbreviations for participants as follows: ASD = Autism Spectrum Disorder, TD = Typically Developing. Abbreviations for age as follows: Y = Years, Mo = Months. Abbreviations for research design as follows: D = Descriptive, E = Experimental. Abbreviation for intervention(s) as follows: SI = Sensory Integration.
<table>
<thead>
<tr>
<th>Studies</th>
<th>Participants</th>
<th>Age</th>
<th>Setting</th>
<th>Design</th>
<th>Goal/Objective</th>
<th>Intervention(s)</th>
<th>Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register (2001)</td>
<td>EE, EI; N = 50</td>
<td>4 to 5 Y</td>
<td>Classroom</td>
<td>E</td>
<td>Prereading/writing</td>
<td>Variety of music activities</td>
<td>It is more effective to develop a therapeutic plan focused on one specific academic measure.</td>
</tr>
<tr>
<td>Kaplan &amp; Steele (2005)</td>
<td>ASD; N = 40</td>
<td>2 to 49 Y</td>
<td>Computerized measurement program</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>Most commonly addressed goal areas were communication and psychosocial.</td>
</tr>
<tr>
<td>Walworth et al. (2009)</td>
<td>ASD; N = 33</td>
<td>1.5 to 32 Y</td>
<td>Video-taped sessions</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>SCERTS models allows for identification of treatment goals and assessment of progress for individuals with ASD.</td>
</tr>
<tr>
<td>Lim (2010)</td>
<td>ASD; N = 50</td>
<td>3 to 5 Y</td>
<td>Clinic</td>
<td>E</td>
<td>Verbal production</td>
<td>DSLM</td>
<td>Music training resulted in improvement in speech production for children with ASD.</td>
</tr>
<tr>
<td>Gooding (2011)</td>
<td>Various diagnoses; N = 12</td>
<td>11 to 16 Y</td>
<td>School</td>
<td>E</td>
<td>Social skills</td>
<td>Music performance, movement, and improvisation</td>
<td>MT curriculum has potential for ameliorating social skill deficits.</td>
</tr>
<tr>
<td>Studies</td>
<td>Participants</td>
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<td>Setting</td>
<td>Design</td>
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<tr>
<td>Kalas (2012)</td>
<td>ASD; $N = 30$</td>
<td>4 to 6 Y</td>
<td>Clinic</td>
<td>E</td>
<td>Joint attention</td>
<td>Simple vs. complex melody</td>
<td>Careful manipulation of specific musical elements can help provide optimal conditions for facilitating joint attention with children with ASD.</td>
</tr>
<tr>
<td>Kern et al. (2013)</td>
<td>Members of AMTA working with ASD; $N = 328$</td>
<td>—</td>
<td>Online</td>
<td>D</td>
<td>—</td>
<td>—</td>
<td>Advanced training for implementing evidence-based practice is recommended.</td>
</tr>
<tr>
<td>Schwartzberg &amp; Silverman (2013)</td>
<td>ASD; $N = 30$</td>
<td>9 to 21 Y</td>
<td>Summer Camp</td>
<td>E</td>
<td>Social skills</td>
<td>Music-based social stories</td>
<td>Pairing social stories with music may facilitate comprehension, generalization, and on-task behaviors conducive to learning social competence.</td>
</tr>
<tr>
<td>LaGasse (2014)</td>
<td>ASD; $N = 17$</td>
<td>6 to 9 Y</td>
<td>Clinic</td>
<td>E</td>
<td>Social skills</td>
<td>Instrument play and movement</td>
<td>MT group sessions targeting social skills may improve joint attention and eye gaze.</td>
</tr>
<tr>
<td>Studies</td>
<td>Participants</td>
<td>Age</td>
<td>Setting</td>
<td>Design</td>
<td>Goal/Objective</td>
<td>Intervention(s)</td>
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<tr>
<td>Pasiali et al.</td>
<td>ASD; N = 9</td>
<td>13 to 20 Y</td>
<td>School</td>
<td>E</td>
<td>Attention</td>
<td>MACT</td>
<td>MACT interventions can be used to address attention which may positively impact cognitive functioning and learning.</td>
</tr>
<tr>
<td>(2014)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>LaGasse et al.</td>
<td>ASD; N = 7</td>
<td>5 to 12 Y</td>
<td>Music Therapy clinic</td>
<td>E</td>
<td>Attention</td>
<td>Structured instrument play</td>
<td>MT may be an effective intervention for addressing attentional difficulties that result from inefficient sensory gating.</td>
</tr>
<tr>
<td>(2019)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Lantingua</td>
<td>DD, TD (n = 60)</td>
<td>17 to 40 Mo</td>
<td>Early childhood educational facility</td>
<td>D</td>
<td>Selective attention</td>
<td>17 TMEs</td>
<td>MSAT program manual developed that includes music-based session plans for addressing selective attention in toddlers with developmental disabilities.</td>
</tr>
<tr>
<td>(2019)</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*Note.* Abbreviations for participants as follows: EE = Exceptional Education, EI = Early Intervention, ASD = Autism Spectrum Disorder, SLD = specific learning disorder, ADHD = Attention Deficit Hyperactivity Disorder, IDEA = Individuals with Disabilities Education Act, AMTA = American Music Therapy Association, DD = Developmental Disorders, TD = Typically Developing. Abbreviations for age as follows: Y = Years, Mo = Months. Abbreviations for research design as follows: E = Experimental, D = Descriptive. Abbreviations for intervention(s) as follows: DSLM = Developmental Speech and Language Training through Music, MACT = Musical Attention Control Training, TMEs = Therapeutic Music Experiences. Abbreviations for generalizations as follows: SCERTS = Social Communication Emotional Regulation and Transactional Support, MT = Music Therapy, MSAT = Music-Based Selective Attention Training.
CHAPTER 5
DISCUSSION

The purpose of this study was to review the existing literature on sensory processing disorder, Autism Spectrum Disorder, and the use of music therapy to address the effects of sensory processing on individuals with ASD. Almost all of the studies on SPD and ASD were descriptive research designs and concluded with the need for more research. This could be due to many of these articles being preliminary or feasibility studies (Ahn et al., 2004; LaGasse et al., 2019; Pasiali et al., 2014; Pfeiffer et al., 2011). Across studies, shared problems included small samples sizes and the setting of the study. Another shared finding was lack of detail regarding specific interventions used to address goals. It is possible that this is due to the need to individualize design of interventions; however, it presents a challenge for replicating the studies. Robb et al. (2011) emphasize the importance of providing clear, detailed descriptions in the research as these are important for replicating music-based interventions in clinical practice and future studies. In contrast, the generalizations found across all of the articles were consistent. The SPD research emphasized the need for more research regarding how SPD impacts daily functioning. ASD research focused on the need for more research about the ways SPD affects the lives of individuals with ASD in order to determine effective interventions. Finally, the music therapy research identified common goal areas related to SPD that individuals with ASD may be working towards, but there was a need for more research about effective interventions to target these goals. Maintaining knowledge of current research and techniques is part of the AMTA Standards of Clinical Practice, and clients will not receive the highest quality therapy possible without this knowledge (Whitehead-Pleaux, 2015).
Limitations

There were several limitations in this systematic review. First, the researcher only included articles addressing SPD in individuals with ASD. SPD could affect individuals with other disabilities including specific learning disabilities, hearing impairments, visual impairments, and more. Of the MT articles retrieved based on the inclusion criteria, only one was published in a journal not distributed by AMTA. The researcher used Google Scholar to search for articles, and most of the articles retrieved by the search engine using music therapy keywords were published in the *Journal of Music Therapy* or *Music Therapy Perspectives*. It is possible that music therapy research published in other peer-reviewed journals was not retrieved by the electronic search engine, and therefore were not included in this study. Finally, only articles that were free domain or published in a journal the researcher had access to were included. These factors may have influenced the results of this study.

Future Research

As the rate of diagnosis of ASD increases, the need for music therapists working with this population also increases (Groene, 2003). In addition, many music therapists who work with individuals with ASD have sought outside training to expand their knowledge of evidence-based interventions (Kern et al., 2013). For these reasons, future research is needed to establish data on the effects SPD has on the lives of individuals with ASD. Research is also needed to determine the effectiveness of music therapy interventions designed to address SPD. Music therapy is an evidence-based practice, so it is important that the research be done in order to continue establishing the efficacy of the field in working with individuals with ASD (AMTA, n.d.).
Conclusion

The purpose of this review was to examine the existing literature to reach a more comprehensive understanding of the research on sensory processing and music therapy to address SPD in individuals with ASD. Results indicated that sensory processing affects functioning in individuals with ASD, specifically in the areas of attention, communication, and social participation. Music therapy may be an effective treatment option when interventions are designed to meet the individual’s unique sensory needs. The researcher also found an overall result that more research is needed in the areas of SPD, ASD, and MT. This review provides suggestions for future research that can be used to further the field of music therapy.
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