The Effects of Music Therapy on Social Skills in Individuals with Autism: A Meta-Analysis

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Education in Special Education

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ABSTRACT

Over the past decades, the rate of autism has increased around the world (Ghasemtabar et al., 2015). A prolonged impairment in social skills and communication is a key feature of autism. According to Vaiouli and Schertz (2012) joint attention is an important developmental milestone for developing higher levels of social engagement. The delay or absence of joint attention is typically seen in individuals with autism (Vaiouli & Schertz, 2012). Given that there is no known treatment or cure for autism, the focus in supporting individuals with autism is aimed toward implementing an intervention strategy that targets the symptoms of autism (Yum et al., 2020). The current investigation conducted a meta-analysis on the effects of music therapy on social skills in individuals with autism. The analysis for this study was based on data from four research studies providing 20 effect size estimates. The sample within the four studies included data from 117 participants. The sample size for the effect size analysis was based on a sample size of n = 596. The four articles included in this meta-analysis produced an overall large positive significant effect size of d = 0.572 with a 95% confidence interval of 0.37 to 0.78. The mean effect size suggests a large significant effect from music therapy across all studies. All studies included in this current investigation published and reported overall positive results. The Q-statistic tests revealed significant heterogeneity across all studies, with variability across the mean effect size estimates, ranging from d = -0.14 to d = 1.28. Since the effect size estimates were all positive for the published studies, it is likely that publication bias existed in the studies used in this meta-analysis. According to Walker et al. (2008) high levels of heterogeneity can compromise the conclusion of a meta-analysis, therefore future research is also needed to help decrease the level of heterogeneity across studies.

PREFACE

This dissertation is an original, independent work that investigates the effects of music therapy on social skills in individuals with autism.

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DEDICATION

I would like to dedicate this dissertation to the brave men and women that were stationed upon the USS Cole DDG-67 on October 12, 2000. Your bravery and dedication will never be forgotten. Electronic Warfare Technician 1st Class, Kevin Shawn Rux, may you rest in peace knowing that you are loved.

I would also like to thank and dedicate this dissertation to my husband Matt. Throughout the years, you have always been my biggest supporter! Thank you for believing in me and always providing me with an abundance of love and encouragement. May you always know how much I love you, then, now, and forever.

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Chapter 1-Introduction

The Effects of Music Therapy on Social Skills in Individuals with Autism

Autism spectrum disorder (ASD) is a disorder characterized by a prolonged impairment in social interaction, communication, and restricted repetitive patterns of behavior across various conditions (Ghasemtabar et al., 2015). Impairments in social interaction may include lack of eye contact, lack of language, lack of joint attention, poor attention span, and limited peer relations (Volkmar & Pauls, 2003). Impairments in communication may include lack of pragmatic language, lack of verbal and non-verbal language, and lack of imaginative play (Volkmar & Pauls, 2003). Restricted repetitive patterns of behaviors may include abnormal preoccupations or interest, difficulties adjusting to change, and stereotypic behaviors (Volkmar & Pauls, 2003).

Over the past couple decades, the rate of diagnostics for ASD have increased (Ghasemtabar et al., 2015). According to Cardinal et al. (2020) over a span of seventeen years the rate of ASD in schools, within the U.S., has increased by 43% per year. According to Yum et al. (2020) the increase in the diagnostic rate of ASD, in recent years, may be due to the evolution of diagnostic criteria and public awareness. Given that there is no known effective treatment or cure for ASD, the focus in supporting individuals with ASD is aimed toward implementing an intervention strategy that targets the symptoms of ASD (Yum et al., 2020).

According to Yum et al. (2020) intervention strategies should be aimed toward improving impairments such as lack of human interaction, lack of response, lack of eye contact, lack of understanding sarcasm, and lack of emotional recognition. Although some individuals with ASD do not comprehend social interactions, they can imitate and follow rules of social behavior (Yum et al., 2020). Approximately 56% of children diagnosed with ASD test below average (IQ < 85) on assessments that determine intellectual ability (Yum et al., 2020). According to Yum et al.

(2020) intervention strategies may be less effective for individuals diagnosed with severe ASD, suggesting that an individual's level of severity may greatly affect the outcome of an intervention.

In the past few decades, the diagnostic rate of ASD has increased around the world (Ghasemtabar et al., 2015). According to Ghasemtabar et al. (2015) a prolonged impairment in social skills and communication is a key feature of ASD. Past research has indicated that individuals with ASD initiate fewer social interactions and show less empathy and/or interest in social communication (Vaiouli & Schertz, 2012). According to Vaiouli and Schertz (2012) joint attention is an important developmental milestone for developing higher levels of social engagement. The delay or absence of joint attention is typically seen in individuals diagnosed with ASD (Vaiouli & Schertz, 2012).

Joint attention refers to the ability to use signals and/or pre-symbolic communication to gain another person's attention or interest for the purpose of direct communication or sharing (Vaiouli & Schertz, 2012). According to Vaiouli and Schertz (2012) joint attention should become noticeable around nine months old and should be well developed around eighteen months. When a developmental milestone that creates a foundation for language and social development is absent or delayed, young children are deprived from learning new skills through reciprocal communication (Vaiouli & Schertz, 2012). Therefore, it is imperative to find an intervention that improves social skills in individuals diagnosed with ASD.

• Many intervention treatments have been used to improve social skills in individuals with ASD (LaGasse, 2017). According to LaGasse (2017) video modeling and peer-mediated interventions are considered "established" intervention practices for improving social skills in individuals with ASD. Although there have been several established intervention techniques that

directly and indirectly target social skills in individuals with ASD, there is no evidence to support that one method of intervention is more effective than another (LaGasse, 2017). This may be due to the individualized levels of severity in ASD. According to Vaiouli and Schertz (2012) past research has suggested that music can offer an individualized child-centered approach to intervention that promotes social development in individuals diagnosed with ASD.

Impairments in social interaction, communication, and restricted repetitive patterns of behavior are often seen in individuals with ASD (Eren, 2015). The cognitive pathology that affects individuals who have ASD may cause them to experience social difficulties (Eren, 2015). According to Eren (2015) music can temporarily bypass the cognitive process and target the social and emotional challenges that individuals with ASD experience. Eren (2015) also noted that a positive response to music is often seen in individuals who have ASD.

Koelsch (2009) suggested that music can automatically distract attention from stimuli that cause negative reactions. Past research has determined, using functional neuroimaging, music can stimulate activity in major limbic and paralimbic brain structures that help individuals initiate, generate, maintain, and regulate emotions (Keolsch, 2009). Eren (2015) also suggested that music can provide opportunities to overcome social and communication difficulties for individuals diagnosed with ASD.

Groß et al. (2010) suggested that music can also be used as a form of creative art therapy. In the past, it has been suggested that using music to express individualized social needs can actively support mental and psycho-physical recovery in various clinical and therapeutic environments (Groß et al., 2010). In addition to these environments, music therapy can be used to develop social impairments (Groß et al., 2010). According to Groß et al. (2010) several past studies have illustrated the use of music therapy in the development of social skills in young

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children with ASD. The delay in development of joint attention has been identified in past research as being a major characteristic of social deficits in individuals with ASD (Kim et al., 2008).

Various studies have brought forth the need for further research that address early diagnosis, intervention, and future outcomes of language and social development (Kim et al., 2008). According to Kim et al. (2008) music therapy enhances spontaneous self-expression, and emotional and social development in individuals with ASD. Delayed speech development is often associated with developmental delays (Groß et al., 2010). Groß et al. (2010) suggested that speech development is a predictor of future learning difficulties in reading, writing, and spelling. A developmental delay in speech is a risk factor for other cognitive and social-emotional problems (Groß et al., 2010). Groß et al. (2010) suggests that music therapy may help enhance speech development and communication skills in individuals with ASD.

The use of music therapy as an intervention to enhance social skills in individuals with ASD is a common practice (Yum et al., 2020). The examination of music therapy as a social skills intervention has been inspired by significant evidence on the potential use of music as an intervention technique to improve social skills in individuals across various severities of ASD (Yum et al., 2020). Yum et al. (2020) suggests that passive music can be used to improve familiarity and relaxation, whereas active music promotes teacher/student engagement, thereby providing an opportunity to promote learning through non-verbal language. Music therapy has been comprehensively examined as a medium to increase social skill in individuals diagnosed with low-functioning ASD (Yum et al., 2020).

Yum et al. (2020) defined music therapy as a systematic process of intervention that promotes joint attention. Children with ASD are often highly passive in social situations (Yum et

al., 2020). According to Yum et al. (2020) the low verbal ability that many individuals with ASD demonstrate is limited when social interactions involve verbal exchanges. However, Yum et al. (2020) suggested that music can become a sluice for individuals whose social interactions are impaired. Furthermore, group music therapy can be used as an intervention strategy to help individuals with ASD learn how to interact in social situations (Yum et al., 2020).

LaGasse (2017) noted that music therapy sessions should be individualized to each person's needs and abilities. Past research has suggested that the use of music therapy can be used on individuals with various socioeconomic backgrounds, cultures, and ages and can be implemented at home or in school by combining music therapy with evidence-based strategies such as prompting and reinforcement (LaGasse, 2017). According to LaGasse (2017) music therapy is typically provided by a professional music therapist that holds a bachelor's degree in music therapy. Professional music therapists develop music-based interventions that promote '' social communication in individuals with ASD (LaGasse, 2017).

Music therapy has been an effective intervention strategy to improve social-emotional reciprocity and verbal and nonverbal interactions among individuals with ASD (Yum et al., 2020). Yum et al. (2020) noted that individuals with ASD can display various symptoms and abilities depending on their developmental speeds and interests. Some individuals may have a deficit in restricted interests or repetitive behaviors, and also be accepting of social situations (Yum et al., 2020). In past studies, music therapy has been known to improve attention and peer interaction in play-based settings (LaGasse, 2014). According to LaGasse (2014) music therapy has also improved academic learning.

Music alone does not improve social behaviors, it is the presence of music within other interventions, such as a preferred activity, that encourages positive behavioral change (LaGasse,

2014). Therefore, the willingness to participate in social interactions may build a bridge to social skills development for individuals who have difficulty interacting in social situations (Yum et al., 2020).

The purpose of this study is to measure the effects of music therapy on social skills in individuals with autism. It is hypothesized that the quantitative analysis of studies that have researched the effects of music therapy on social skills in individuals with autism will reveal a significant positive effect of music therapy on social skills in individuals with autism.

A meta-analysis will be conducted on the effects of music therapy on social skills in individuals with ASD to investigate the following research questions:

- 1. What is music therapy's impact on students identified with autism?
- 2. What is the effect of music therapy on social skills in experimental group research design studies?

3. What are the potential moderators of the impact of music therapy?

Autism

Autism spectrum disorder (ASD) is defined as a developmental impairment characterized by specific deficiencies in social communication, and restricted and repetitive patterns of behavior (Yum et al., 2020). According to Azbell and Laking (2006) the abnormal social and behavioral development seen in individuals with ASD is the result of a dysfunctional central nervous system. Volkmar and Pauls (2003) suggest that some social skills develop over time but, even high-functioning individuals continue to display difficulties in social communication. Volkmar and Pauls (2003) noted that a high rate of seizures is associated with ASD and therefore brain involvement is strongly suggested. According to Azbell and Laking (2006), the input stimuli received by individuals with ASD is more complex and therefore affects them differently than individuals without ASD.

Brain Mechanisms. The high rate of epilepsy and persistent neurological signs strongly suggest brain involvement in ASD (Volkmar & Pauls, 2003). In postmortem studies, a range of abnormalities have been reported, including neuron depletion and reduced dendritic arborization in the limbic system (Volkmar & Pauls, 2003). These findings are of particular interest because of the nature of social difficulties found in individuals with ASD (Volkmar & Pauls, 2003). Volkmar and Pauls (2003) noted that monkeys who have lesions in their amygdala and hippocampus have behavior similarities comparable to those seen in individuals with ASD. Past research has suggested that social processing differs between individuals with ASD in prefrontal cortical regions (Volkmar & Pauls, 2003).

A decrease in Purkinje and granule cells has been observed in the cerebellar cortex of individuals with ASD (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) the

overall brain size is 2-10% greater in individuals with ASD than it is in individuals without ASD. It is still unclear whether the increase in brain size is generalized across the entire brain or in specific areas (Valkmar & Pauls, 2003). Volkmar and Pauls (2003) speculated on the possibilities related to the decline of neural pruning, but the reasoning behind the increase remains unclear.

Social processes have also been an area of focus in ASD. During activities that involve perception of faces, Volkmar and Pauls (2003) determined that the fusiform gyrus is not activated in individuals with high-functioning autism (Asperger's Syndrome). According to Volkmar and Pauls (2003) social deficits are not caused by the inability to process facial information. Individuals with high-functioning autism often have a difficult time applying social meaning to visual stimuli (Volkmar & Pauls, 2003). In past studies, research has shown that individuals with ASD exhibit highly unusual patterns of visual searching when exposed to intense social situations (Volkmar & Pauls, 2003).

The specific processes on the human neural system have become a focus of interest in the understanding of social communication and facial recognition in individuals with ASD (Volkmar & Pauls, 2003). Different neurotransmitter systems have been researched in studies that focused on neurochemistry (Volkmar & Pauls, 2003). Past research has indicated that a high concentration of serotonin has been observed in individuals with ASD (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) there are a variety of reported abnormalities with brain involvement associated with ASD, but no unified theory or explanation has been reported in studies that focus on the neurotransmitter systems in individuals with ASD.

Environmental Components. Over the past decade, genetic research has revealed that neuronal junction is particularly vulnerable to genetic and environmental factors (Grabrucker, 2013). According to Grabrucker (2013) "understanding how genetic and environmental risk

factors in autism converge at synapses might provide a valuable starting point for future work towards uncovering the patho-mechanism of autism" (p. 1). ASD is a developmental disorder that is usually diagnosed between 14-36 months old (Grabrucker, 2013). However, past research has indicated that ASD might be present at birth, thus raising considerable interest in prenatal environmental factors (Grabrucker, 2013).

Prenatal influenza, rubella, and viral infections have been linked to a higher risk of ASD due to exposure during fetal development (Grabrucker, 2013). According to Grabrucker (2013) maternal infections could affect the fetal immune system and brain because the placenta is a source of hematopoietic stem cells that provide nutrients to the fetus during pregnancy. Zinc deficiencies, abnormal melatonin synthesis, gestational diabetes, and other toxins have also been linked to a higher risk of ASD (Grabrucker, 2013). Zinc is a structural component of proteins that regulates enzymatic processes (Grabrucker, 2013, p. 7). A Zinc deficiency can compromise the immune system and increase the possibility of infection (Grabrucker, 2013).

According to Grabrucker (2013) two major environmental factors contribute to the development of ASD at the synapse level. The first factor is the structural composition of synapses, which results in changes in receptor number (Grabrucker, 2013). Thus, "influencing NMDAR, AMPAR, and mGluR and affecting signaling components within the PSD" (Grabrucker, 2013, p. 10). The second major environmental factor is the "p38 MAPK (mitogen-activated protein kinase) and ERK pathway" (Grabrucker, 2013, p. 10). According to Grabrucker (2013) ERK regulates the synaptic delivery of AMPAR and dendritic spine modifications.

ERK kinases are heavily affected by the level of Zinc within the human body (Grabrucker, 2013). In a past study, remarkable anomalies in social behavior, which resemble ASD similarities have been observed in a "ERK2 knock-out mice exhibit" (Grabrucker, 2013, p. 10). Moreover, Zinc deficiency via GPR39 changes structural components and a disturbance in signaling by kinases leading to a disruption in LTP formation and plasticity at synapses may converge (Grabrucker, 2013). Finally, environmental factors such as immune system abnormalities or Zinc deficiencies can cause an imbalance of inhibition and excitation and therefore increase the risk factor for ASD (Grabrucker, 2013).

Genetic Components. Angelman and Prader-Willi syndromes have drawn attention to the genetic disposition of parental imprinting in brain development and how mutations can lead to neurodevelopmental disorders (LaSalle, 2013). According to LaSalle (2013) artificial reproductive technology has played a significant role in the discovery of Dup15q syndrome (duplications of 15q11-q13) observed in individuals with ASD. A laboratory managed by LaSalle (2013) has observed a significant association with PCB-95 levels in the brain and Dup15q syndrome, which led to the suggestion that genes and environmental factors play an important intertwined role in the development of ASD.

Many cases of ASD with cytogenetic duplications or deletions have been researched (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) a linkage disequilibrium in GABRB3 (a marker in the gamma-aminobutyric acid receptor subunit gene), or UBE3A (Angleman syndrome gene) is often observed in individuals with ASD. Tuberous sclerosis, fragile X syndrome, and neurofibromatosis have also been associated with ASD (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) researchers have identified chromosomes 16 and 17 as a gene closely associated with the mutation of tuberous sclerosis (chromosome 16) and neurofibromatosis (chromosome 17). Volkmar and Pauls (2003) also noted a possible association between HLA-DRB1 alleles and ASD. Finding genes that are directly linked to ASD is similar to that of complex diseases (Volkmar & Pauls, 2003). Most diseases that have been linked directly to gene mutations are much clearer than those of ASD (Volkmar & Pauls, 2003). Volkmar and Pauls (2003) noted that if ASD was a Mendelian disorder, the genes would be localized. The absence of consistent significant findings suggests the possibility of multiple gene involvement in ASD (Volkmar & Pauls, 2003). "Either many genes with strong alleles of low frequency or common variants in genes with weak alleles" (Volkmar & Pauls, 2003, p. 1137).

Course and Prognosis of ASD. ASD is a life-long disability with several favorable treatment options that play a major role in the lives of individuals with ASD (Volkmar & Pauls, 2003). Past research has indicated that outcomes of ASD have improved over the years due to case detection and intervention strategies (Volkmar & Pauls, 2003). In some cases, individuals with ASD may be able to achieve self-sufficiency in adulthood, with and without periodic support (Volkmar & Pauls, 2003). Volkmar, Pauls, (2003) noted that the symptoms of ASD may change with age so therefore, independence and self-help skills should be a major focus in the treatment of ASD. The overall cognitive ability of an individual with ASD is a factor in predicting social outcomes (Volkmar & Pauls, 2003).

The difficulties in social interactions have been known to persist throughout childhood (Volkmar & Pauls, 2003). Volkmar and Pauls (2003) noted that social skills taught in childhood provide substantial social gains in adolescence. If an individual's behavior declines in adolescence hormonal changes may be to blame (Rapin, 1997). Therefore, greater behavioral skills are needed during these years to sustain the social and emotional demands of adolescence (Rapin, 1997). Rapin (1997) suggests that most individuals will remain partially dependent into adulthood, however those with adequate social skills are more likely to become self-supporting. Rapin (1997) noted that some individuals make substantial gains and others decline due to behavioral factors.

Standard Treatments of ASD. Over the past few decades, various methods used to treat the symptoms of ASD have been published (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) methods typically include medications, special education services, and behavioral therapy. In general, treatment goals should focus on reducing problem behaviors, and attaining growth in communication, cognition, and self-help skills (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) a highly structured comprehensive systematic approach is needed to treat the symptoms of ASD. Volkmar and Pauls (2003) noted that treatment goals can vary from person to person depending on functionality.

Lower-functioning individuals may be able to develop basic learning skills that foster communication, as more skills are acquired a shift toward conceptual learning could be possible (Volkmar & Pauls, 2003). Children who have not developed spoken language skills can be more communicative through nonverbal communication means (Volkmar & Pauls, 2003). Rapin (1997) suggests that the use of psychotropic drugs may help treat additional symptoms of ASD. According to past research, medication such as methylphenidate has been known to rapidly improve attention capacity in short periods of time (Rapin, 1997). Serotonergic antidepressants are also prescribed to alter stereotypic behaviors seen in ASD (Rapin, 1997).

The Importance of Interpersonal and Intrapersonal Synchrony in ASD

• Interpersonal Synchrony. Interpersonal synchrony is "the tendency for social partners to temporally coordinate their behavior when interacting" (Bowsher-Murray et al., 2022, p. 1). According to Bowsher-Murray et al. (2022) interpersonal synchrony is a common characteristic of social interactions which can be in the form of a spontaneous response, a conscious effort

(e.g., shaking hands, high five, dance), rhythmic properties (e.g., nodding, walking), and behavioral processes (gestures, gazing, facial expression, speech). Social behaviors usually develop shortly after birth and become more complex during infancy (Bowsher-Murray et al., 2022). Bowsher-Murray et al. (2022) suggested that interpersonal synchrony can positively influence the development of self-regulation, and empathy, which in turn may promote cognitive, social, and emotional development.

Difficulties in social interaction, communication, and building relationships are all common characteristics of ASD (Bowsher-Murray et al., 2022). In past studies, there has been a particular interest in how individuals with ASD engage in interpersonal synchrony (Bowsher-Murray et al., 2022). Evidence has indicated that individuals with ASD initiate fewer social interactions in both spontaneous and intentional conditions (Bowsher-Murray et al., 2022). Past studies have found a significant correlation between low-functioning ASD and lower levels of interpersonal synchrony (Bowsher-Murray et al., 2022). The social significance of interpersonal synchrony may also be decreased in individuals with ASD (Bowsher-Murray et al., 2022).

Individuals with ASD experience significant difficulties in social participation, interacting with others, and problem solving (Vlachou & Stavroussi, 2016). Developing interpersonal relationships can help individuals with ASD effectively engage in and successfully understand how to manage social situations that involve complex communication (Vlachou & Stavroussi, 2016). Understanding how the underlying process of interpersonal synchrony correlates is important in understanding why interpersonal synchrony develops differently in individuals with ASD (Bowsher-Murray et al., 2022). Past research has indicated that interpersonal development is decreased in individuals with ASD (Bowsher-Murray et al., 2022).

Experimental tasks such as pendulum swinging, chair rocking, movement improvisation, and gazing have been observed in individuals with low levels of interpersonal development (Bowsher-Murray et al., 2022). According to Bowsher-Murray et al. (2022) similar behaviors have been observed in studies involving naturalistic environments.

A decrease in interpersonal development has been observed in conversations between couples in which one individual had an ASD diagnosis (Bowsher-Murray et al., 2022). High levels of reduced spontaneous motor synchrony was also observed in adults during a partner walk and talk task (Bowsher-Murray et al., 2022). According to Bowsher-Murray et al. (2022) there is undoubting evidence that suggests ASD is associated with reduced interpersonal development. In studies that investigated intentional vs. spontaneous synchrony tasks, lower interpersonal coherence scores were observed in groups that included at least one individual with ASD (Bloch et al., 2019).

Interpersonal synchrony increases empathy and enables successful interaction and reciprocal bonding (Bloch et al., 2019). To successfully communicate with others, Bloch et al. (2019) suggest developing intrapersonal skills prior to interpersonal synchrony. Intrapersonal development is an important factor in developing interpersonal skills and therefore, atypical synchrony of intrapersonal skills may also affect the development of interpersonal skills in individuals with ASD (Bloch et al., 2019). From an individual perspective, non-verbal communication such as gazing and gestures need to be coordinated with verbal output to communicate effectively (Bloch et al., 2019).

Intrapersonal Synchrony. Intrapersonal synchrony is defined by Bloch et al. (2019) as "the temporal coordination of communication signals in a socially informative manner" (p. 2). According to Bloch et al. (2019) the processing of sensory input evolves differently in individuals with ASD. In a past study that investigated perceptual stimulation, researchers discovered that "individuals with ASD judged the presentation of two visual stimuli to be temporally asynchronous for smaller stimulus onset asynchronies compared to typically developed control participants" (Bloch et al., 2019, p. 2).

Further evidence has also shown an advanced temporal understanding of auditory and visual events (Bloch et al., 2019). According to Bloch et al. (2019) individuals with ASD produce a significantly lower achievement rate for distinguishing the differences between auditory signals, exceptional judgment, and replicating durations. A broader multisensory temporal binding window for simultaneous discernment is also seen in individuals with ASD compared to typically developed participants (Bloch et al., 2019). Bloch et al. (2019) suggest that these findings support the belief that individuals with ASD demonstrate exceptional temporal temporal temporal temporal temporal binding with a "detail-focused, less holistic cognitive style" (p. 3).

Exceptional temporal processing is also displayed in higher level processes (Bloch et al., 2019). Stereotypical behavioral patterns and routines compensate for the exceptional timing functions presented in individuals with ASD (Bloch et al., 2019). According to Bloch et al. (2019) individuals with ASD have a high disposition to "rely on self-structured routines and repetitive behavior to control bottom-up perceptual input, thereby generating experiences of timelessness" (p. 3). Therefore, it is possible that exceptional temporal processing is likely to influence stereotypical behaviors seen in individuals with ASD (Bloch et al., 2019).

• Exceptional motor timing has also been seen in individuals with ASD (Bloch et al., 2019). According to Bloch et al. (2019) "clumsiness" is a major motor production often presented in individuals with ASD. Bloch et al. (2019) suggest that exceptional motor patterns should be investigated across the autism spectrum as they may present as a possible diagnostic

marker for ASD. In a past study designed to observe motor production variables which involved gaming tasks and touch screens, researchers observed significantly faster movement patterns and pressures in individuals with ASD compared to typically developed participants (Bloch et al., 2019).

Bloch et al. (2019) noted that other researchers have observed a significantly weaker motor performance in individuals with ASD compared to typically developed participants. Jerky limb movements, exceptional walking patterns, increased postural sway, and atypical motor output have been observed in individuals with ASD (Block et al., 2019). In past studies that focused on the motor abilities of individuals with ASD, a deficit in sensory input for motor planning and an increased variance in motor output has been observed (Bloch et al., 2019). Therefore, increasing evidence suggests that exceptional movement patterns influence the development of interpersonal synchrony because social communication signals, as motor acts,

The Autism Diagnostic Observation Schedule (ADOS) is a tool used by researchers to measure the development of communication skills in individuals with ASD (Bloch et al., 2019). In past studies, researchers investigated various types of gestures and their usage. During a narrative task researchers found no differences between frequency and type of gesture used, however, exceptional timing of gestures correlated to speech led researchers to conclude that a reduction in the quality of communication is a hallmark symptom of ASD (Bloch et al., 2019). Bloch et al. (2019) determined that "these results indicate that it is not the quantity of communicative signals that leads to the known communication difficulties but the quality of signals and how they fit in the interactional flow" (p. 4).

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In the social aspect Bloch et al. (2019) mentions that communication difficulties that encompass the use of gestures and social replication have been observed in relation to the advanced temporal understanding of sensory events in individuals with ASD. Likewise, according to Bloch et al. (2019) researchers also found a correlation between advanced temporal understanding and the severity of symptoms associated with social communication. Therefore, multisensory temporal binding windows coincide with interpersonal synchrony in participants who are classified as "typically developed" but not in participants with ASD (Bloch et al., 2019). According to Bloch et al. (2019) these findings indicate a distinct association in temporal processing and the reduction of interpersonal alignments seen in individuals with ASD.

The Developmental Importance of Social Skills in ASD

Social Skills can be defined as a complex interaction of skills used to skillfully perform social tasks (Ghasemtabar et al., 2015; Thompson et al., 2013). Rankin et al. (2016) noted that social skills are important for peer acceptance, social relationships, and academic success. White et al. (2007) suggested that a profound deficiency in social skills is a hallmark feature of ASD. Social deficits are a vital source of impairment for individuals with ASD (White et al., 2007). During development, social deficits become more complex during adolescence because individuals with social impairments become more aware of their social disability (White et al., 2007).

In past studies, researchers have discovered that children with ASD are less likely to initiate communication and show less sympathy and interest in those who have engaged in social communication with them (Ghasemtabar et al., 2016). Ghasemetabar et al. (2016) noted that social skill deficits make it difficult to establish meaningful relationships, and often result in social isolation. White et al. (2007) suggested that social deficits may cause individuals with

ASD to suffer direct and indirect consequences resulting in loneliness and poor social support. When combined with typical developing peers, children with ASD often experience an increase in peer rejection and social isolation (White et al., 2007). Research has shown that social skill deficits may also cause anxiety and mood disorders in adolescence (White et al., 2007).

The social impairments seen in individuals with ASD often involve speech, verbal communication, and interpersonal synchrony (While et al., 2007). Problem areas may include impairments in social pragmatics, dwelling on certain topics, difficulty in expressing emotions, and difficulty understanding sarcasm and metaphors (White et al., 2007). According to White et al. (2007) social deficits are not caused by a lack of social interest. A lack of social synchrony and the ability to determine when to apply the skill is the major cause of disability (White et al., 2007). Given that children with ASD lack appropriate social skills and have fewer opportunities to engage in positive peer interactions, group interventions may aid in the development of social skills in individuals with ASD (White et al., 2007).

Supporting individuals with ASD in their homes, schools, and communities involves addressing each core area of impairment (Bellini & Hopf, 2007). Bellini and Hopf (2007) noted that social skill deficits impact children with ASD at an early age and have the capacity to lead to social anxiety, depression, and isolation. Individuals with ASD may attempt to initiate an interaction to meet their needs or wants, however, since bilateral contribution is needed for social interaction, initiating attempts of social interaction cannot be considered socially credible (Eren, 2015): In past studies, researchers have discovered that integrated and less restricted environments provide unique social learning opportunities for individuals with ASD (Eren, 2015).

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Individuals who display admissible social skills are more likely to be socially accepted by peers, benefit from integrated school environments, live more independently, and work in a more integrated environment (Eren, 2015). Improving social outcomes for individuals with ASD requires a more structured intervention and carefully designed opportunities of social engagement with non-exceptional peers (Eren, 2015). Therefore, selecting an intervention designed to meet the needs of the integrated group is essential (Eren, 2015). According to Eren (2015) pre-existing strengths can be used to develop impaired areas. LaGasse (2017) suggested that social skills interventions should be the main focus when addressing social behaviors of individuals with ASD.

According to LaGasse (2017) many treatments and practices are available to address the social needs of individuals with ASD. Impairments in social skills is a hallmark trait of ASD (Rankin et al., 2016). Social skills are an important factor in the development of peer acceptance, relationship building, and academic success (Rankin et al., 2016). According to the National Autism Council's National Standards Report (2023) practices such as peer training, joint attention, and behavioral interventions are considered "established" intervention practices for teaching social skills to individuals with ASD. The direct and indirect effects of social intervention practices have been investigated in past studies. LaGasse (2017) noted that there is no decisive evidence to suggest that one intervention strategy is more effective than another. Intervention goals should be developed with a strong focus on social skills (Volkmar & Pauls, 2003).

In past studies, music therapy has been known to improve social developmental and behavioral skills in children with ASD (LaGasse, 2014). LaGasse (2014) suggested that music therapy interventions may help improve attention capacity in individuals with ASD, especially in a hands-on environment. The use of music therapy to develop social skills in individuals with ASD provides a directional pathway that promotes a more prominent alternative for treating the symptoms of ASD (LaGasse, 2017). LaGasse (2017) noted that past research has indicated that music therapy interventions have been known to promote positive social interactions in individuals with ASD. According to Eren (2015) substantial evidence from past research has shown that individuals with ASD have an inclination toward music. Therefore, music interventions may provide a suitable environment that enhances social skills in individuals with ASD (Eren, 2015).

Developmental Techniques to Measure Social Skills

(i) Vineland Social-Emotional Early Childhood Scales (VSEEC). This scale is an 88-item assessment tool that determines the level of social and emotional development in children from birth to five years old (Thompson et al., 2013).

(ii) The Social Responsiveness Scale Preschool Version for 3-Year-Olds (SRS-PS). This scale is a 65-item parent-rated diagnostic assessment that measures the social development of 3-year-old children in natural social environments (Thompson et al., 2013).

(iii) The MacArthur-Bates Communicative Development Inventories, Words and

Gestures (MBCDI-W&G). This scale is an assessment designed to measure early language skills such as vocabulary comprehension and production, and communicative gestures in children from birth to 18 months (Thompson et al., 2013). According to Thompson et al. (2013) this scale can also be used to assess the developmental language skills of individuals with severe language delays.

(iv) *The Parent-Child Relationship Inventory (PCRI)*. This scale is a 73-item standardized assessment scale that measures the parent's attitude toward parenting and their child

(Thompson et al., 2013). According to Thompson et al. (2013) this standardized measure allows for the qualitative evaluation of prescriptive comparisons of a domain.

(v) *The Social Skills Rating System Scale (SSRS)*. This scale is an assessment designed by Gresham and Elliot, to measure social behaviors such as cooperation, assertions, self-control, and responsibility (Ghasemtabar et al., 2015). According to Ghasemtabar et al. (2015) this assessment consists of three specific forms (parent, teacher, student) and is designed for three periods (preschool, elementary, and secondary).

(vi) The Autism Treatment Evaluation Checklist (ATEC). This scale is an assessment designed to measure the effectiveness of new treatments on communication, sociability, cognitive awareness, and behavior (LaGasse, 2014). According to LaGasse (2014) this assessment is effective for monitoring the progress of social skills in children with ASD who are undergoing interventions. Higher functioning is determined in accordance with lower ATEC

(vii) The TRIAD Special Skills Assessment (TSSA). This scale is a criterion-based assessment designed to measure social interactions of individuals with ASD (Bharathi et al., 2019). According to Bharathi et al. (2019) this assessment can be used to determine a pre-test and post-test measure.

(viii) Social Responsiveness Scale (SRS). This scale is a 65-item assessment designed to measure the level of social impairments in children ages 4-18 (LaGasse, 2014). According to LaGasse (2014) this scale has been used to evaluate the development of social skills in individuals with ASD.

(ix) The Music Therapy Diagnostic Assessment (MTDA). This scale is an assessment designed to measure a child's interpersonal development and social communication skills during music therapy sessions (Thompson et al., 2013).

Music Therapy

Music therapy has been defined as the "clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program" (LaGasse, 2017, p. 24). According to LaGasse (2017) music therapists must acquire a bachelor's degree in music therapy that focuses on the principles of musical and clinical foundations of music therapy. In addition, music therapists must also complete 1200 hours of clinical training that includes an internship in music therapy (LaGasse, 2017). According to LaGasse (2017) a Board-Certified Music Therapist must take a music therapist national board certification exam.

Music therapists develop music-based interventions that target communication, social, emotional, and cognitive skills (LaGasse, 2017). Music therapy sessions are designed based on individualized preferences and abilities (LaGasse, 2017). According to LaGasse (2017) music therapy sessions can be provided individually or in group sessions, and can occur in an at-home, school, therapeutic, or community environment. An individual's current level of functioning can be determined by using the Childhood Autism Rating Scale (CARS) assessment (LaGasse, 2017). LaGasse (2017) noted that this process involves developmentally appropriate music experiences.

After an individual completes the CARS assessment, the music therapist will design an appropriate treatment plan that is based on individual needs (LaGasse, 2017). Although music therapy can have many different approaches, a protocol that addresses individualized treatment

needs is the most appropriate way to design a treatment plan for an individual with ASD (LaGasse, 2017). Music therapy interventions combined with evidence-based strategies promote a highly individualized treatment that addresses the needs of individuals with different levels of ASD (LaGasse, 2017).

Active and Passive Music Therapy

Music therapy is used as a therapeutic approach to enhance an individual's social, physical, and emotional well-being (Bharathi et al., 2019). Bharathi et al. (2019) suggested that music therapy can be used as a form of communication to help improve difficulties in movement, sensing, and feeling. Throughout most of Europe and North America, music therapy has been used as a therapeutic practice for several years (Aldridge, 1994). Aldridge (1994) noted that active music therapy and passive music therapy are two principal ways of applying music therapy. Active music therapy techniques require the patient to play a musical instrument or sing, whereas passive music therapy techniques require the patient to listen to musical recordings (Aldridge, 1994). According to Marquez-Garcia et al. (2021), these methods include procedures that follow a particular technique and should be implemented accordingly.

In each approach, music is often chosen to suit the patient's individual likes or interests (Aldridge, 1994). The effectiveness of these techniques is not fully understood (Marquez-Garcia et al., 2021). Hillecke et al. (2005) noted that music therapy can be used as an effective tool when treating various illnesses. In past studies, music therapy has been shown to improve the emotional, behavioral, and social wellbeing of individuals with ASD (Marquez-Garcia et al., 2021). After World War II, hospitals across North America incorporated the use of passive music therapy to reduce stress and enhance the overall physical and emotional well-being of patients (Aldridge, 1994). In Europe, it has been suggested that using music therapy as a
psychotherapeutic approach can help individual's deal with intrapersonal conflicts by causing an awakening of their emotions (Aldridge, 1994).

The effect of music on the heart and blood pressure has also been a topic of interest throughout the years (Aldridge, 1994). In the medical journal Lancet, researchers discovered that music influenced blood pressure according to how much the participant appreciated music (Aldridge, 1994). Interest in music is an important factor that influences how a participant responds to music (Aldridge, 1994). In past studies, researchers discovered that heart rate increased or decreased, over a period of three minutes, when the participant was exposed to music at a precise time in the cardiac cycle (Aldridge, 1994). When the participant was exposed to music during times that was not within the cardiac cycle, no influence was observed (Aldridge, 1994).

The effects of perceived rhythm on the respiratory pattern were also explored, proposing that listening to music would influence the participants respiratory pattern (Aldridge, 1994). Aldridge (1994) noted that researchers observed no significant change in heart rate. However, in participants with tachycardia and/or cardiac arrhythmias research has shown a significant decrease in the participants ability to perceive music when compared to healthy individuals (Aldridge, 1994). The correlation between listening to music and changes in respiration have also been investigated (Aldridge, 1994). According to Aldridge (1994) listening to music seems to have paradoxical and anxiolytic effects. In the past, participants have reported music to be relaxing, however, their physiological reactions have suggested otherwise (Aldridge, 1994).

Listening to music and utilizing breathing techniques induce alternative states of consciousness which invoke calmness and inner peace (Aldridge, 1994). In hospitals, general anesthesia doctors have used passive music techniques to deliver a state of calmness and

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well-being in patients who undergo various surgical procedures (Aldridge, 1994). According to Aldridge (1994) music therapy appears to have a significant effect on the recovery process of neurological disorders. Patients who have experienced temporary aphasia, music therapy has played a significant role in the process of rehabilitation (Aldridge, 1994). Music therapy has fulfilled the rehabilitative role that involves repeated melody patterns and body movements (Aldridge, 1994). The singing of familiar songs has also been found to encourage articulation and language fluency (Aldridge, 1994). According to Aldridge (1994) the stimulation of singing motivates the patient to communicate and promotes the activation of verbal communication.

Patients who experience dysfluencies often have difficulties finding words. Aldridge (1994) suggests that music therapy can activate the emotional pitch of speech (e.g., tapping, humming, whistling). According to Aldridge (1994) music is a function that is distributed over both cerebral hemispheres of the brain. Recovery from aphasia is not a matter of learning new information in the non-dominant hemisphere, but a matter of the dominant hemisphere taking over the responsibility of language (Aldridge, 1994). The non-dominant hemisphere can be looked at as a reserve of functions in patients who experience regional failure indicating an overall neuroplasticity (Aldridge, 1994).

In cases of elderly stroke patients, researchers have discovered that music therapy in combination with speech therapy significantly improves aphasia (Aldridge, 1994). In cases of coma patients, creative music therapy has been shown to have an inverse effect on patients who are otherwise unresponsive (Aldridge, 1994). When the patient's breathing patterns are aligned with music, stimulated changes in consciousness were observed through a coma rating scale and clinical observations (Aldridge, 1994). Music therapy also appears to have an effective way of engaging individuals with special needs (Aldridge, 1994). Aldridge (1994) suggests that the

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functional properties of music exposure can arouse sensory processing in individuals with disabilities by enhancing memory recall and organizing the sequence of cognitive functioning.

In past studies, researchers have emphasized the importance of music in child development (Aldridge, 1994). In the case of a child with multiple disabilities, the need for stimulation increases by utilizing music that provides a sense of enjoyment (Aldridge, 1994). In the case of newborns and infants, music therapy has been used as a calming effect to induce sleep and relaxation (Aldridge, 1994). Music therapy has also been used to relieve fear and anxiety in children during the preoperative stages of surgery, and terminal illness (Aldridge, 1994).

Music therapy practices have been used since the early 1940's. In the early years of music therapy intervention, music education, singing groups, and folk dancing were used to improve socialization, self-expression, and psychological disorders (Marquez-Garcia et al., 2021). Physicians and therapists used music therapy in clinical settings to help children with ASD improve their individualized area of need (Marquez-Garcia et al., 2021). Active and passive music therapy have been examined in past studies as facilitators of verbalization (Aldridge, 1994). According to Aldridge (1994) music therapy can allow individuals without language to communicate and develop a significant improvement in the process of treatment for individuals with ASD.

Music Therapy for Individuals with ASD

• Behavioral and educational therapies have been known to support individuals with ASD, but no method has been proven to address the needs of all people with ASD (Marquez-Garcia et al., 2021). Given the diversity within the autism spectrum, assistive technology and therapies should be carefully selected to address the diverse needs of individuals with ASD

(Marquez-Garcia et al., 2021). Marquez-Garcia et al. (2021) suggests that music therapy employs various methods of support for individuals with ASD. According to Marquez-Garcia et al. (2021) there is a specific way each method should be executed or performed.

The history of music therapy dates back to 1940, with the first official publication in 1969 (Marquez-Garcia et al., 2021). In the earlier days of music, various activities involving music such as music education, singing groups, and folk dancing were used to achieve social goals (Marquez-Garcia et al., 2021). As the years passed, these achievements became recognized by clinicians as a way of improving social communication skills among those with ASD (Marquez-Garcia et al., 2021). Today, many clinicians around the world utilize music therapy activities and techniques to improve symptoms of ASD (Marquez-Garcia et al., 2021).

Kossyvaki and Curran (2020) suggested that activities such as music making, listening to music, and responding to music can provide a pathway of communication for individuals with ASD, even when spoken language is not achievable. Everyone is "born with a propensity for music" (Kossyvaki & Curran, 2020, p. 119). According to Kossyvaki and Curran (2020) music is an essential human experience that everyone has engaged in before birth. During pregnancy, the mother's voice, footsteps, and heartbeat are heard as a rhythmic sound that enables the inclination for music at birth (Kossyvaki & Curran, 2020). Kossyvaki and Curran (2020) referred to music to coincide with time and space making music potentially transformative.

A structured and predictable environment is preferred by individuals with ASD (Kossyvaki & Curran, 2020). An interest in music is often encouraged by musical activities and it often provides an environment that is structured and predictable (Kossyvaki & Curran, 2020). Music has been known as a way of connecting with the world (Kossyvaki & Curran, 2020). Kossyvaki and Curran (2020) noted that people with ASD tend to respond to music. Social difficulties are common in individuals with ASD, regardless of their level of functioning. According to Kossyvaki and Curran (2020) past studies have discovered that children with ASD have difficulty initiating communication, when communication is initiated, it is usually for behavior regulating purposes.

Music therapy has been used for many years as an intervention strategy for children with ASD (Thompson et al., 2013). According to LaGasse (2014) ASD affects 1 in 88 children in the United States. The cause of ASD has been theorized, but no definite cause has been discovered. Researchers are also yet to find a cure for ASD, leaving many individuals with a lifetime of learning and social difficulties (LaGasse, 2014). Due to the life-long impact of ASD, it is imperative to conduct a meta-analysis to investigate evidence-based treatment methods that have a positive effect on social skills in individuals with ASD (LaGasse, 2014).

ASD is a developmental impairment characterized by specific deficiencies in social communication, and restricted and repetitive patterns of behavior (Yum et al., 2020). According to LaGasse (2014) social skills are a required ability for relationships and independence. An inability to acquire such skills could have a lifetime effect on social outcomes for individuals with ASD (LaGasse, 2014). Furthermore, social skill deficits do not resolve in individuals with ASD, without an effective treatment method (LaGasse, 2014). In fact, LaGasse (2014) noted that social skills may show less improvement than other deficits in individuals with ASD.

Over the years, many treatments have been used to address the social needs of individuals with ASD (LaGasse, 2014). Intervention methods such as structured teaching, social skills training, and behavioral therapies have been used as a treatment for social skill deficits (LaGasse, 2014). Past research has identified several interventions that target social skills in individuals with ASD (LaGasse, 2014). LaGasse (2014) noted that research has not shown conclusive evidence to support one method of treatment over another. Most researchers agree that social skill deficits are a hallmark sign of ASD, past research has indicated a continual need for substantial evidence that supports effective treatments (LaGasse, 2014).

Neurological needs, identified in individuals with ASD, should be researched further (LaGasse, 2014). Individuals with ASD experience an overload of sensory input due to neural organizational differences (LaGasse, 2014). Some researchers suggest that individuals with ASD choose not to interact within their environment, however, LaGasse (2014) noted that it is not a matter of not wanting to interact, it's a matter of not being able to follow through or tolerate social interaction. Social skills involve perceiving several sources of sensory input, contextual understanding of social intentions, and successfully responding during a social interaction (LaGasse, 2014). LaGasse (2014) suggests that deficits in neural organization could affect one or more of these elements.

Researchers agree that ASD affects an individual's social and communication abilities with symptoms causing individuals to experience peer refusal and social seclusion (Bharathi et al., 2019). In past studies, social and communication deficits have been shown to affect academic performance, behavior, and cognitive abilities in individuals with ASD (Bharathi et al., 2019). Bharathi et al. (2019) noted that early intervention is crucial to counterbalance the symptoms that impact social and problem-solving proficiencies in individuals with ASD. Music therapy is a form of communication that has the potential to address sensory, emotional, and physical deficits (Bharathi et al., 2019).

Ghasemtabar et al. (2022) believe that music-based interventions may have a positive effect on individuals with ASD. In addition to reducing social impairments, music encourages the development of hidden musical talents in individuals with ASD (Ghasemtabar et al., 2022).

Despite the problems associated with the day-to-day processing of emotions, individuals with ASD can perceive emotions in music equal to those who are not exceptional (Ghasemtabar et al., 2022). Ghasemtabar et al. (2022) noted that music interventions are particularly effective for individuals with ASD mostly because (1) musical training may counteract impairments in joint attention, and social interaction, (2) musical activities may be more enjoyable due to an enhanced understanding of emotions in music, and (3) musical activities may be less intimidating when individuals can freely investigate different musical instruments.

Past research has shown that participation in music therapy sessions may teach individuals with ASD how to recognize social cues and transition between one activity and another (Ghasemtabar et al., 2022). Individuals with ASD often demonstrate sensory impairments which may directly affect opportunities for social interaction (LaGasse, 2014). Pater et al. (2021) noted that new social skills can be acquired by focusing on an intervention that addresses behavior and personal interests. Music therapy may provide an opportunity to participate in social activities through music (Pater et al., 2021). LaGasse (2014) suggested that movement patterns in response to music may provide an opportunity to explore external stimuli. According to LaGasse (2014) external cues that support engagement promote positive social behaviors in individuals with ASD.

Music therapy has been used for many years to help individuals with ASD achieve social goals (LaGasse, 2017). Music therapy is a unique intervention that encourages meaningful interactions (LaGasse, 2017). In past studies, a positive response to music has encouraged positive social engagement in individuals with ASD (LaGasse, 2017). LaGasse (2017) noted several reasons why music may help develop social skills in individuals with ASD. According to LaGasse (2017) music can activate the left inferior frontal gyrus and optimize targeted behaviors.

"Neurological reactions similar to those of a musician when involved in music" have been observed in past studies (LaGasse, 2017, p.25).

LaGasse (2017) noted that this data indicates that music interventions may provide a strong foundation for developing social skills and possible generalization into nonmusical social environments. The rhythmic components of music provide neural organization and response cues that encourage individuals with ASD to appropriately respond to their environment (LaGasse, 2017). LaGasse (2017) suggests that a lack of neural organization may prevent an environmental response due to difficulties with "sensory overload, planning, initiation, and completing motor sequences" (p. 25). Music may also accommodate social deficits, as it has been shown to help with planning and motor sequences (LaGasse, 2017).

Music therapy sessions can be created to provide specific cues that help to initiate social interaction, and encourage a response (LaGasse, 2017). Cues can also be used to help control impulse response during social interaction (LaGasse, 2017). Using structured music as an outline for response time could create a musical experience that serves as a foundation for social interaction (LaGasse, 2017). Past studies have concluded that music therapy can provide a structured environment that encourages music exploration, which may help improve social deficits in individuals with ASD (LaGasse, 2017). LaGasse (2017) noted that social interaction is supported by the anticipation and timing of communication in music.

Music therapy is appropriate to use with school-aged children who have no verbal language skills. According to LaGasse (2017) this method provides a way for individuals with ASD to engage in social interaction. Music therapy interventions have been known to have a positive effect on social skills in individuals with ASD (LaGasse, 2017). In past research a significant increase in social engagement, joint attention, peer interaction, and cognitive skills have been observed in individuals with ASD (LaGasse, 2017). These studies provide research-based evidence that music therapy can create positive social changes in individuals with ASD (LaGasse, 2017).

The Need for a Meta-Analysis

It has been hypothesized that music therapy interventions may improve social skills in individuals with ASD. In past studies, music therapy interventions have been known to improve emotional understanding and increase emotional engagement in individuals diagnosed with ASD (LaGasse, 2014). Music therapy interventions have also been known to decrease ASD related behaviors (LaGasse, 2014). LaGasse (2014) noted that music therapy can increase joint attention, social greetings, peer interaction, and cognitive social skills. Past studies have shown comparable evidence to suggest that music is a valuable tool that can be used to improve social behaviors in individuals with ASD (LaGasse, 2014).

Music therapy, within a group setting, has been known to improve social behaviors among children with ASD (LaGasse, 2014). In a play-based setting, music therapy has been known to improve attention, especially when musical instruments were involved (LaGasse, 2014). In an outdoor setting, music therapy has also been known to improve interaction in individuals with ASD (LaGasse, 2014). LaGasse (2014) noted that children with ASD engage better in academic group settings when music is involved. According to research, it is not music alone that influences the change of behavior, it is the music paired with structure, preferred activities, and visual support that influences the change (LaGasse, 2014).

Music therapy is a profession in which an individual uses music as an intervention to accomplish individual physical, emotional, and social goals (Ghasemtabar et al., 2022). Social skills are specific behaviors that are needed to competently complete a social task (Ghasemtabar

et al., 2022). According to Ghasemtabar et al. (2022) social skills are vitally important for successfully interacting in social situations. Most prominent, social skills' deficits may impede the ability to initiate and engage in social relationships, which may lead to social withdrawal and isolation among those diagnosed with ASD (Ghasemtabar et al., 2022). Past studies have suggested that music therapy is an effective method for improving social skills in individuals with ASD (Ghasemtabar et al., 2022).

Music therapy has brought about positive changes in social behavior (Ghasemtabar et al., 2022). Music intervention techniques have been known to harness musical talents and reduce social impairments in individuals with ASD (Ghasemtabar et al., 2022). Despite the problems in processing and controlling everyday emotions, individuals with ASD can discern emotions in music the same as non-exceptional peers (Ghasemtabar et al., 2022). In past research, evidence has shown that music therapy has helped individuals recognize social cues, cooperate in social groups, and transition between activities (Ghasemtabar et al., 2022). Although music therapy has many approaches, focusing on individualized needs is prominent when designing a treatment plan to address the social needs of individuals with ASD (LaGasse, 2017).

LaGasse (2017) noted that music therapy interventions are also a great way to address the social needs of individuals with different levels of ASD. Music therapy has been used as a therapeutic approach to enhance the physical, social, and emotional needs of individuals with ASD (Bharathi et al., 2019). Music therapy sessions provide an opportunity to socially interact with peers in an environment that is safe and non-judgmental (Eren, 2015). In past studies, real life experiences in the safety of a musical therapeutic setting have helped individuals with ASD to understand social interaction and communication cues (Eren, 2015). Therefore, it is prominent

to conduct a Meta-Analysis on the effects of music therapy on social skills in individuals with ASD.

Finally, a meta-analysis can provide information that may contribute to the development of an intervention that targets social deficits in individuals with ASD. Field and Gillet (2010) noted that a "meta-analysis is a statistical tool for estimating the mean and variance of underlying population effects from a collection of empirical studies addressing ostensibly the same research question" (p. 665). According to Field and Gillet (2010) a meta-analysis can provide valuable information about the mean and variance of an underlying population's effects, the variability in effects across studies, and information on moderator variables.

In this meta-analysis, the researcher will combine the treatment effect sizes of four research studies that involve music therapy as the independent variable and social skills in individuals with ASD as the dependent variable. The methodology of this meta-analysis is discussed further in chapter three.

Introduction

The present study conducted a meta-analysis to investigate the effects of music therapy on social skills in individuals with autism. The researcher obtained approval from the Slippery Rock University Institutional Review Board (IRB) for the present study (See APPENDIX A for IRB approval document). According to Field and Gillett (2010), a meta-analysis is a valuable tool that can provide information on the mean and variance of underlying population effects, the variability in effects across studies, and potential moderator variables. This meta-analysis research was conducted using a six-step procedure described by Field and Gillett (2010). The six-step procedure is as follows: (Step 1) Do a literature search, (Step 2) Decide on inclusion criteria, (Step 3) Calculate the effect sizes, (Step 4) Do the basic meta-analysis, (Step 5) Do some more advanced analysis, and (Step 6) Write it up (Field & Gillett, 2010).

The researcher conducted this meta-analysis on the effects of music therapy on social skills in individuals with autism to investigate the following research questions:

- 1. What is music therapy's impact on students identified with autism?
- 2. What is the effect of music therapy on social skills in experimental group research design studies?
- 3. What are the potential moderators of the impact of music therapy?

Inclusion Criteria

• The present study conducted a meta-analysis on the effects of music therapy on social skills in individuals with autism. This present study included research articles that met the following inclusion criteria: (1) The research must be written in English, (2) The research must be written between the years 2013 and 2023, (3) The research must include participants who

have been diagnosed with an Autism Spectrum Disorder who were between the ages of 1-12, (4) The research must include music therapy as the independent variable, (5) The research must include social skills as the dependent variable, (6) The research was conducted using an experimental group research design, (7) The research must quantitatively express the effects of music therapy on social skills so that the necessary data can be extracted and the effect size can be calculated.

Search Sources and Search Terms

The researcher searched for research articles that met the inclusion criteria through Google Scholar, and the Bailey Library at Slippery Rock University. The researcher conducted a Discovery Advanced Search (Databases A-Z) through the Bailey Library using various combinations of search terms. The researcher specifically searched through *The Journal of Music Therapy, The Journal of Child: Care, Health, and Development, The Journal of Advanced*

This comprehensive search provided access to articles that met the researcher's inclusion criteria. The present study used various combinations of the following search terms to locate articles that met the inclusion criteria: music therapy, passive music therapy, active music therapy, group intervention, social skills, social communication, social interaction, autism, autism spectrum disorder, Asperger Syndrome, intellectual disabilities. After this comprehensive search, the researcher used the Google Scholar search engine to locate additional research articles not previously found in the Bailey Library's Discovery Advanced Search (Databases A-Z).

The present study selected these search terms based on the current studies objective: This study focuses on the effects of music therapy on social skills in individuals with autism. Bharathi

et al., (2019) defined the term music therapy as a healthcare practice in which music is used as a therapeutic approach to improve social communication in an individual. The term autism is defined as a neurodevelopmental disorder that is characterized by a deficit in social and communication skills (LaGasse, 2014). LaGasse (2014) defined the term social skills as the inability to develop the necessary skills required for relationships, independence, and vocation.

Databases. The present study located four research articles that met the researcher's inclusion criteria. The following databases were searched to locate research articles that met the inclusion criteria for this meta-analysis: Discovery Advanced Search (Databases A-Z), *The Journal of Music Therapy, The Journal of Child: Care, Health, and Development, The Journal of Advanced Biomedical Research, and The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery.* The researcher also searched for research articles that met the inclusion criteria using Google Scholar.

Discovery Advanced Search. The Discovery Advanced Search is an online search engine that provides access to databases A-Z in one search.

The peer reviewed research journals that are specific to the present study are as follows: (1) The Journal of Music Therapy; (2) The Journal of Child: Care, Health, and Development; (3) The Journal of Advanced Biomedical Research; (4) The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery.

The Journal of Music Therapy is a peer reviewed journal that contributes to the science and practice of music therapy (American Music Therapy Association, 2023). Its mission is to provide access to scholarly articles that promote the development and understanding of music therapy interventions (American Music Therapy Association, 2023). The Journal of Music Therapy publishes various types of research, including quantitative, qualitative, mixed methodologies, systematic reviews, integrative reviews, meta-analysis, and meta-synthesis (American Music Therapy Association, 2023). According to the American Music Therapy Association (2023) all research articles are selected based on their quality and contribution to existing research.

The Journal of Child: Care, Health, and Development is an international peer reviewed journal that addresses all areas of health and childhood development (Willey, 2023). This journal accepts both quantitative and qualitative research articles that are related to child healthcare and development (Willey, 2023). The journal also welcomes studies that investigate the effects of social and environmental factors on health and development (Willey, 2023). According to Willey (2023) this journal is particularly interested in publishing articles that relate to those who are physically, developmentally, emotionally, and socially disadvantaged.

The Journal of Advanced Biomedical Research is a multidisciplinary peer reviewed journal that focuses on the improvement and understanding of human health and disease (Advanced Biomedical Research, 2012). According to Advanced Biomedical Research (2012) the journal includes articles that relate to all areas of medicine and biology, including basic science research (e.g., anatomy, cell and molecular biology, cellular biochemistry, cytology, immunology, microbiology, pathology, pharmacology, cell and tissue), and clinical investigations (e.g., cardiology, clinical epidemiology, endocrinology, gastroenterology, gerontology, hematology, neuropathology, oncology, pediatrics, radiology, rheumatology, cardiovascular). The scope also extends to the areas of interdisciplinary, multi-disciplinary, and alternative medicine (Advanced Biomedical Research, 2012).

The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery is a peer reviewed, open access journal that focuses on health, social, and ethical issues in the field of clinical

neurosciences, including neurology, psychiatry, and neurosurgery (Springer Open, 2023). According to Springer Open (2023) *The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery* encourages the submission of research articles with large datasets, color illustrations, and moving pictures. Research articles published in *The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery* can also be located by using the search engines EBSCO Discovery Service, SpringerLink, PubMed Central, Medline, Semantic Scholar, Google Scholar, ProQuest, and SCOPUS (Springer Open, 2023).

A comprehensive search of Databases A-Z (Discovery Advanced Search), *The Journal of Music Therapy, The Journal of Child: Care, Health, and Development, The Journal of Advanced Biomedical Research,* and *The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery* produced 115 articles that were considered for inclusion in this study. The researcher created an inclusion criteria data sheet, inspired by the scholarly work of Tarr (2018) that included all inclusion criteria (See APPENDIX B - Inclusion Criteria Data Sheet). If the research article met an inclusion criterion, the researcher put a check mark in the "Yes" column. If the research article did not meet an inclusion criterion, the researcher put a check mark in the "No" column. After further investigation, the researcher located four research articles that met all the inclusion criteria.

Evaluation of Quality

Articles that met the inclusion criteria were examined for quality using the Evaluative Method (Reichow et al., 2008). The Evaluative Method was created by Reichow et al. (2008) to assist researchers and practitioners in determining the most effective Evidence-Based Practice (EBP) for individuals with autism. The instruments used in the Evaluative Method are as follows: (1) rubric for evaluating the research articles rigor, (2) guidelines for evaluating the research articles strength, (3) criteria for determining the EBP (Reichow et al., 2008).

The instruments described by Reichow et al. (2008) provide a standardized method for the evaluation of interventions used for individuals with autism. According to Reichow et al. (2008) the Evaluative Method also provides individualized ratings for each research article. Assigning individualized ratings for each research article can assist in the evaluation of EBP when a combination of different research methodologies is used (Reichow et al., 2008). The present study evaluated each research article that met the inclusion criteria using the instruments described by Reichow et al. (2008) as the *"Evaluative Method for Determining EBP in Autism."*

Reichow et al. (2008) developed a group research design rubric to evaluate the rigor of research articles. The rubric provided a way for the researcher to evaluate the quality of methodological elements of research articles (Reichow et al., 2008). The rubric included two levels of methodological elements: primary quality indicators and secondary quality indicators (Reichow et al., 2008). According to Reichow et al. (2008) primary quality indicators (participant characteristics, dependent measure, independent measures) are considered critical for demonstrating the validity of a research study. The primary quality indicators are operationally defined using a three-term ordinal scale: high quality, acceptable quality, and unacceptable quality (Reichow et al., 2008).

Although important, secondary quality indicators (interobserver agreement, blind raters, procedural fidelity, generalization and maintenance, social validity) are considered not necessary for demonstrating the validity of a research study (Reichow et al., 2008). The secondary quality indicators are operationally defined using a dichotomous scale: evidence or no evidence (Reichow et al., 2008). The researcher of the present study developed data sheets to evaluate

group research designs, using the Evaluative Method presented by Reichow et al., (2008) (SEE APPENDIX C for the Evaluative Method data sheet).

The guidelines for the evaluation of the research report strength provides a strategy of combining the ratings from the rubric into a strength of research report ratings (Reichow et al., 2008). According to Reichow et al. (2008) the research report is operationalized as either having a strong research report strength, an adequate research report strength, or a weak research report strength. A strong research report strength rating demonstrates solid evidence of a high-quality research report (Reichow et al., 2008). Adequate research report strength shows strong evidence in most, but not all areas (Reichow et al., 2008). Weak research report strength indicates missing elements or mistakes (Reichow et al., 2008). (SEE APPENDIX D for the Evaluative Method rubric)

The reliability of the rubric has been used to evaluate field testing and communication interventions (Reichow et al., 2008). According to Reichow et al. (2008) each test showed high agreement across applications and individuals. Reichow et al. (2008) stated "The high agreement across applications and individuals support the evaluative method as a tool for reliably reviewing autism intervention research" (p. 1316). According to Reichow et al. (2008) the validity of the Evaluative Method was tested for concurrent validity, content validity, and face validity. The validity of each validity type was determined by aligning the definitions of the rubric with prior EBP definitions (Reichow et al., 2008). Further validity can be established by training inexperienced examiners to reliably use the rubric (Reichow et al., 2008). According to Reichow et al., (2008) this process demonstrates good to excellent reliability and is often used to train clinical examiners on how to recognize and diagnose the presence or absence of autism.

Coding

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Developing Coding Instruments. The coding sheet and codebook in this study was specifically designed to reflect the intervention, outcome variables, and statistical analysis. To design a coding scheme that captures all key information, the researcher in this study thoroughly examined each research article included in this meta-analysis. According to Brown et al. (2003) there are four basic categories to code data: (1) methodological and substantive features, (2) study quality, (3) intervention descriptors, and (4) outcome measures. Methodological and substantive features have been identified in past studies as important variables to code in every research synthesis (Brown et al., 2003).

Methodological and substantive features include the source of the study, year of publication, and type of research design (Brown et al., 2003). According to Brown et al. (2003) these features are coded for the purpose of relating the studies characteristics to the findings. In this study, the intervention categories and outcome measures were specific to the research questions presented in this study. Variables specific to this meta-analysis study were included in the coding sheets (SEE APPENDIX E – Coding Sheet/Codebook). After the code sheet was complete, the researcher of this study developed a codebook to guide the coding process. According to Brown et al. (2003) a codebook should theoretically and operationally define each variable to facilitate an inter-coder and intra-coder agreement. Brown et al. (2003) also noted that "the operational definition of each category should be mutually exclusive and collectively exhaustive" (p. 208).

• In this study, the group research study design articles were assessed according to 17 primary and secondary moderators. An excel data sheet was used to code all articles (SEE APPENDIX E – Coding Sheet/Codebook). The following primary and secondary moderators were chosen for this study: area of expertise, source of reference, publication status, location of

study, study design, quality, gender, age, level of severity, type of intervention strategy, setting, implementation specialist, length of each therapy session, total number of therapy sessions, focus of measurement, social skills assessment method, and measurement technique.

Area of Expertise (a). The research articles that met the inclusion criteria for this meta-analysis focused on music therapy and different types of social skills. This researcher created this moderator to determine whether the area of expertise influences the outcomes of music therapy on different types of social skills. The codes used for this moderator are (1) family-centered music therapy and taking turns, (2) music therapy and eye gazing, joint attention, and communication, (3) music therapy and understanding/perspective taking ability, responds to others, and maintains interaction, and (4) music therapy and social skills.

Publication Status (b). The present study located four research studies that were published in peer reviewed journals (*The Journal of Music Therapy, The Journal of Child: Care, Y*. *Health, and Development, The Journal of Advanced Biomedical Research,* and *The Egyptian Journal of Neurology, Psychiatry, and Neurosurgery.*). The researcher created this moderator to determine whether a significant difference exists in published vs. unpublished articles. The codes used for this moderator are (1) published and (2) not published.

Location of Study (c). A majority of research studies included in this meta-analysis were conducted Internationally (India, Australia, Norway, Iran). There was one research study that took place in the United States (Colorado). The researcher created this moderator to assess the differences between studies conducted in the United States vs. International. The codes used for this moderator are (1) United States and (2) International.

Quality of Study (d). The present study evaluated each research article that met the inclusion criteria using the instruments described by Reichow et al. (2008) as the *"Evaluative*"

Method for Determining EBP in Autism" (rubric for evaluating the research articles rigor, guidelines for evaluating the research articles strength, criteria for determining the EBP). The researcher created this moderator to assess the quality of each research article. The codes (1) strong, (2) adequate, and (3) weak in accordance with the scoring rubric of Reichow et al. (2011) were used to assess the quality of each research article in this meta-analysis.

Gender of Participants (e). The present study chose this moderator to evaluate whether there is a difference in the effect of music therapy on social skills between males and females. The researcher of this study created three codes for this moderator: (1) Male, (2) Female, (3) Male and Female.

Age of Participants (f). The present study located four research articles that met the inclusion criteria for this meta-analysis. The research articles chosen for this meta-analysis have a combined total of 117 participants between the ages of 1-12. The present study investigated the effect of music therapy on social skills in children who have an autism spectrum disorder and who are between the ages of 1-12. The researcher created this moderator to assess the differences between the two age groups. The codes used in this moderator are (1) 1-6 and (2) 6-12.

Level of Autism Severity of Participants (g). The researchers of the studies chosen for this meta-analysis used the Childhood Autism Rating Scale (CARS) or The Childhood Autism Rating Scale Second Edition (CARS2) to assess the severity level of autism. The researcher created this moderator to assess the differences between the participants' level of autism severity. The researcher of this meta-analysis coded the participants' autism severity level as (1) mild, (2) moderate, (3) severe, (4) more than one level of severity, based on the autism severity level reported by the researchers of that study. **Type of Intervention Strategy (h).** The research articles chosen for this meta-analysis used either active music therapy, passive music therapy, or a combination of both active and passive music therapy as an intervention strategy. Active music therapy can be defined as actively engaging in a musical activity by playing a musical instrument or actively participating in song or dance. Passive music therapy can be defined as listening to music in the background while engaging in normal activities. The researcher created this moderator to assess the differences between active music therapy and passive music therapy. In this meta-analysis, the researcher coded this moderator as (1) active music therapy, (2) passive music therapy, (3) active and passive music therapy, and (777) control.

Setting (i). The studies that met the inclusion criteria for this meta-analysis conducted their study in either a therapeutic setting, school setting, or in-home setting. Two studies were conducted in a therapeutic setting, one study was conducted in a school setting, and one study was conducted in an in-home setting. The researcher created this moderator to assess whether the setting of the intervention influenced the children's social abilities. The researcher of this meta-analysis used the following codes for this moderator: (1) therapeutic, (2) school, (3) community, (4) in-home, (5) more than one setting, and (777) control.

Implementation Specialist (j). In past studies, music therapy has been implemented by various types of specialists (e.g., music therapist, school personnel, researcher). The researcher of this meta-analysis created this moderator to determine whether different types of specialists influenced the children's social abilities. The researcher of this meta-analysis used the following codes for this moderator: (1) music therapist, (2) school personnel, (3) researcher, (4) more than one specialist, (777) control, and (888) not noted.

Length of Each Therapy Session (k). In the studies that met the inclusion criteria for this meta-analysis, the length of each music therapy session varied. The researcher of this meta-analysis created this moderator to determine whether the length of the music therapy session influenced the children's social abilities. The researcher coded this moderator as (1) 1-10 minutes, (2) 11-20 minutes, (3) 21-30 minutes, (4) 31-40 minutes, (5) greater than 41 minutes, and (777) control.

Total Number of Therapy Sessions (1). All research articles that met the inclusion criteria for this meta-analysis were interested in determining the effect of music therapy on social skills in children with autism. The researcher of this meta-analysis created this moderator to determine whether the number of music therapy sessions influenced the children's social abilities. The researcher coded this moderator as (1) 1-5 sessions, (2) 6-10 sessions, (3) 11-20 sessions, (4) 21-30 sessions, (5) greater than 30 sessions, and (777) control.

Focus of Measurement (m). The research articles chosen for this meta-analysis used various categories to identify the social skill observed. The researcher of this meta-analysis created this moderator to determine how the children's social abilities were influenced by the music therapy intervention. This researcher coded this moderator as (1) gives attention, (2) enters into intentional social interaction, (3) understands and expresses emotion, (4) repetitive behaviors, (5) interpersonal behaviors, (6) communication, (7) more than one skill, (777) control, (888) not noted.

• Social Skills Assessment Method (n). All research articles that met the inclusion criteria for this meta-analysis measured social skills by using an indirect method. The researcher of this study created this moderator to determine whether an indirect method of assessing social skills produced different results when compared to the control group. The researcher coded this moderator as (1) direct, (2) indirect, (3) direct and indirect, (777) control, and (888) not noted.

Social Skills Measurement techniques (o). The research articles that met the inclusion criteria for this meta-analysis used various techniques to measure social skills. The social skills measurement techniques used are as follows: Social Skills Rating System (SSRS), Vineland Social-Emotional Early Childhood Scales (VSEEC), Social Responsiveness Scale Preschool Version for 3-Year Olds (SRS-PS), MacArthur-Bates Communicative Development Inventories – Words and Gestures (MBCDI-W&G), Parent-Child Relationship Inventory (PCRI), Music Therapy Diagnostic Assessment (MTDA), Autism Treatment Evaluation Checklist (ATEC), TRIAD Special Skills Assessment (TSSA), and Social Response Scale (SRS). The researcher of this meta-analysis created this moderator to assess whether there is a difference between groups based on the social skill measurement technique. The researcher coded this moderator as (1) SSRS, (2) VSEEC, (3) SRS-PS, (4) MBCDI-W&G, (5) PCRI, (6) MTDA, (7) ATEC, (8) TSSA, (9) SRS, (10) more than one technique, (777) control, and (888) not noted.

Effect Size Calculations

Aggregated Score Studies. The researcher of this study extracted the sample sizes (n), pre and post weighted mean scores, and pre and post pooled SD scores from each research article included in this meta-analysis. The sample size, pre and post weighted mean scores, and pre and post pooled SD scores were used to calculate the effect size according to Cohen's d statistical formula. Gravetter and Wallnau (2011) noted the importance of using Cohen's d to calculate the effect size in a meta-analysis. The effect size is a quantitative measure that measures the treatment effect between groups (Gravetter & Wallnau, 2011). According to Gravetter and Wallnau (2011) Cohen's d is the best method of calculating the effect size in a meta-analysis. This researcher calculated the effect size using the Cohen's d method by subtracting the pre weighted mean scores from the post weighted mean scores divided by the pre and post pooled standard deviation scores (SEE APPENDIX E – Coding Sheet/Codebook).

Basic Meta-Analysis Calculation

The researcher of this study calculated the basic meta-analysis of the effects of music therapy on social skills in individuals with autism using a random effects model described by Schmidt and Hunter (2015). According to Hunter and Schmidt (2004) both fixed and random effect models and procedures have been used in meta-analyses. However, a random effects model and procedures are often used and more appropriate than a fixed effects model to calculate the effects size of a meta-analysis (Hunter & Schmidt, 2000).

A fixed effects model assumes that participants from studies in a meta-analysis are sampled from a population in which the average effect size is fixed (Field, 2005). A random effects model assumes that the average effect size of a population randomly varies between studies (Field, 2005). According to Field and Gillett (2010) a fixed effects model is appropriate for situations in which a generalization of the meta-analysis results occurs only to the studies included in the meta-analysis. However, when a generalization of the meta-analysis results in a larger population is desired, a random effects model should be used (Field & Gillett, 2010).

According to Field (2005) the difference between the fixed and random effects size models is the amount of statistical error. Both effects size models include error, however, the random effects size model includes additional error because it is assumed that participants are from a diverse population with different effect sizes within each study (Field, 2005). According to Hunter and Schmidt (2000) researchers often use fixed effects models more frequently than random effects models because it is "analytically easier to manage."

However, due to the assumption of a diverse population and effect sizes, inadequate results are often produced when a fixed effects model is used (Hunter & Schmidt, 2000). According to Hunter and Schmidt (2000) a Type 1 error (false positive) is seen more often in a fixed effects model than in a random effects model. A Type 1 error occurs when statistical calculations show a significant difference between the independent and dependent variables, but there is no statistical difference (Cooper et al., 2007). Finally, the fixed effects model can jeopardize the accuracy of the meta-analysis results because it often produces restricted confidence intervals (Hunter & Schmidt, 2015).

The present study used the random effects model developed by Schmidt and Hunter (2015). This meta-analysis investigated the effects of music therapy on social skills in individuals with autism. Wendt and Miller (2012) noted that individuals with autism are part of a diverse population. The random effects model differentiates effects sizes and produces reliable confidence intervals for diverse populations (Hunter & Schmidt, 2000). In addition, random effects models also have less Type 1 errors than fixed effects models (Hunter & Schmidt, 2000). Finally, the random effects model can result in a generalization of results to a larger population beyond the meta-analysis (Hunter & Schmidt, 2000). Comprehensive Meta-Analysis (CMA) software was used in this meta-analysis to compute the basic meta-analysis using the random effects model.

P-Value

• The p-value test is a statistical significance test that is used in research to test whether the null hypothesis is correct. According to Dahiru (2008) the p-value measures the probability of a similar result randomly occurring. The p-value does not determine the null hypothesis however, it can suggest as to which hypothesis is most likely correct (Dahiru, 2008). According to Dahiru

(2008) P < .10, P < .05, and P < .01 are commonly used p-values. The present study used the p-value P < .10 to test each moderator.

Publication Bias

Publication bias often happens when a difference between published and unpublished studies exists (Song et al., 2013). According to Song et al. (2013) publication bias can be problematic because of the likelihood of researchers publishing only when acquiring positive results. Publishing only when acquiring positive results will provide misguided information to future researchers (Song et al., 2013). Song et al. (2013) suggested various ways to measure publication bias. A few methods include cohort follow ups, funnel plots, published vs. unpublished study comparison, and statistical methods.

According to Song et al. (2013) funnel plots are used more often because of the likelihood of researchers publishing large studies regardless of their results whereas, small studies are more likely to be published only when their results are positive. The present study used the Begg and Mazumdar Rank Correlation Test. Begg and Mazumdar (1994) suggested that an inverse correlation can test for publication bias. The rank correlation between the treatment effect and the standard error can be computed using the Begg and Mazumdar (1994) method. The results of this meta-analysis is discussed in chapter four.

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Table 1

Steps in a Meta-Analysis Research Study

Steps	Details
1. Inclusion Criteria	 (1) The research must be written in English, (2) The research must be written between the years 2013 and 2023, (3) The research must include participants who have been diagnosed with an Autism Spectrum Disorder who were between the ages of 1-12, (4) The research must include music therapy as the independent variable, (5) The research must include social skills as the dependent variable, (6) The research was conducted using an experimental group research design, (7) The research must quantitatively express the effects of music therapy on social skills so that the necessary data can be extracted and the effect size can be calculated.
2. Search Sources	The researcher searched for research articles that met the inclusion criteria through Google Scholar, and the Bailey Library at Slippery Rock University. The researcher specifically searched through <i>The Journal of Music</i> <i>Therapy, The Journal of Child: Care, Health,</i> <i>and Development, The Journal of Advanced</i> <i>Biomedical Research,</i> and <i>The Egyptian</i> <i>Journal of Neurology, Psychiatry, and</i> <i>Neurosurgery.</i>
3. Search Terms	The researcher used various combinations of the following search terms to locate articles that met the inclusion criteria: music therapy, passive music therapy, active music therapy, group intervention, social skills, social communication, social interaction, autism, autism spectrum disorder, Asperger Syndrome, intellectual disabilities.
4. Calculation of Effect Size	Cohen's <i>d</i> method was used to calculate the effect sizes of group research design studies.
5. Calculation of a Basic Meta-Analysis	Random Effects Model (Schmidt, Hunter, 2015).

Chapter 4 – Results

Introduction

Using extant research, the current investigation examined music therapy's impact on students identified on the autism spectrum. Through a meta-analysis of secondary data, this investigation sought to address the following research questions:

- 1. What is music therapy's impact on students identified with autism?
- 2. What is the effect of music therapy on social skills in experimental group research design studies?
- 3. What are the potential moderators of the impact of music therapy?

The analysis for this investigation was based on data from four studies providing 20 effect size estimates. The sample within the four studies included data from n = 117 participants. The sample size for the effect size analysis was based on a sample of n = 596.

A random-effects model was employed for the analysis. The studies in the analysis were assumed to represent all potential studies. Cohen's *d* effect size estimate was used for all estimations (Borenstein, 2019; Borenstein et al., 2010; Borenstein et al., 2021; Hedges & Vevea, 1998; Higgins & Thomas, 2019). Effect size measures were calculated with means and standard deviations using the formula from Johnson (1989):

$$d = (M_{\rm E} - M_{\rm C}) / S_{\rm pooled}$$

considering:

$$S_{\text{pooled}} = [(n_E - 1) (s_E)^2 + (n_C - 1) (s_C)^2] / (n_E - n_C - 2),$$

where $M_{\rm E}$ is the mean for the experimental group, $M_{\rm C}$ is the mean for the control group, n_E is the number of participants in the experimental group, n_C is the number of participants in the control

group, s_E is the standard deviation of the experimental group, and s_C is the standard deviation of the control group. When means and standard deviations were not available, the effect sizes were calculated using additional formulas. In this meta-analysis, the effect size estimate for studies providing an *F* statistic were calculated using the following formula (Johnson, 1989):

$$d = F \left[(n_E + n_C) / (n_E - n_C) \right]^{\frac{1}{2}}$$

Once effect sizes are calculated for individual studies, the overall effect size measure for all the studies combined can be calculated. According to Glass et al. (1981), this can be done by simply calculating the mean of the individual effect size measures. However, this approach does not take into consideration the fact that the studies vary in sample size. Hedges and Olkin (1985) provide a formula for calculating the overall mean effect size as an unbiased weighted estimate (i.e., weighted by sample size) of the population effect size:

$$d_{+} = \frac{\sum_{i=1}^{k} \frac{d_{i}}{\sigma^{2}(d_{i})}}{\sum_{i=1}^{k} \frac{1}{\sigma^{2}(d_{i})}} = \frac{\sum_{i=1}^{k} w_{i}d_{i}}{\sum_{i=1}^{k} w_{i}}$$

where the variance of *d* is calculated using the following formula:

$$\sigma^{2}(d_{+}) = \frac{\sum_{i=1}^{k} w_{i}^{2} \sigma^{2}(d_{i})}{\left(\sum_{i=1}^{k} w_{i}\right)^{2}} = \frac{\sum_{i=1}^{k} \left(\frac{1}{\sigma^{4}(d_{i})} \cdot \sigma^{2}(d_{i})\right)}{\left(\sum_{i=1}^{k} \frac{1}{\sigma^{2}(d_{i})}\right)^{2}} = \frac{1}{\sum_{i=1}^{k} \frac{1}{\sigma^{2}(d_{i})}}$$

as well as the corresponding confidence intervals using this formula:

$$d_{+} - Z_{\alpha/2}\sigma_{(d_{+})} \leq \delta \leq d_{+} + Z_{\alpha/2}\sigma_{(d_{+})}$$

to calculate a $100(1- \alpha)$ confidence interval (p. 111). The overall mean effect sizes for this meta-analysis were calculated according to the procedures recommended by Hedges and Olkin within the Comprehensive Meta-Analysis, a dedicated meta-analytic software (Borenstein et al., 2022).

The overall mean effect size was a large positive significant effect d = 0.572 with a 95% confidence interval of 0.37 to 0.78. (This was based on the guidelines of d = .10 as a small effect size estimate, d = .30 as a moderate effect size estimate, and d = .50 or greater as a large effect size estimate). The mean effect size suggests a large significant effect from music therapy across all the studies. The Q-statistic tests the null hypothesis that assumes all studies in the analysis share a common effect size. The Q-value was 38.20 with 19 degrees of freedom and p = 0.006, indicating the presence of heterogeneity. Specifically, the true effect size across all effect estimates was not the same in all of these studies. The average effect size estimate by study is presented in Table 2.

Table 2

Study	n	Number of Estimates	d	Lower CI	Upper CI	Sig.
Thompson et al. (2014)	21	4	0.40	0.06	0.75	0.022
LaGlasse et al. (2014)	17	7	1.03	0.46	1.61	< 0.001
Bharathi (2019)	52	6	0.55	0.27	0.82	< 0.001
Ghasemtabar et al. (2015)	27	3	0.34	-0.15	0.83	0.172

Effect Size Estimates by Study

As indicated above, LaGlasse et al. (2014) revealed the largest overall effect size estimate,

followed by Bharaithi (2019). Results were further broken down by effect size estimates with

each study. Figure 1 provides a graphical representation of the effect size estimates, followed by Table 3.

Figure 1

Effect Size Estimate Plot by Study Measures

Study	Effect
Thompson 1	0.98
Thompson 2	0.21
Thompson 3	0.13
Thompson 4	0.38
LaGlasse 1	2.33
LaGlasse 2	1.61
LaGlasse 3	0.03
LaGlasse 4	0.36
LaGlasse 5	1.43
LaGlasse 6	0.59
LaGlasse 7	1.29
Bharathi 1	0.15
Bharathi 2	0.45
Bharathi 3	0.90
Bharathi 4	1.00
Bharathi 5	0.61
Bharathi 6	0.22
Ghasemtabar 1	0.12
Ghasemtabar2	0.93
Ghasemtabar 3	0.12

Figure 1 illustrates the heterogeneity across the study measures. Since heterogeneity existed, the effect size estimates across each level of all identified moderators were examined, and the results of this analysis are provided in Table 3.

Table 3

Study name	Focus	d	Lower CI	Upper CI	Sig.
Thompson 1	Primary	0.98	0.46	1.50	< 0.001
Thompson 2	Secondary	0.21	-0.22	0.65	0.333
Thompson 3	Speech & Language	0.13	-0.30	0.56	0.550
Thompson 4	Parent-Child	0.38	-0.06	0.82	0.093
LaGlasse 1	Eye Gaze	2.33	1.10	3.57	< 0.001
LaGlasse 2	Joint Attention Child	1.61	0.51	2.71	0.004
LaGlasse 3	Joint Attention Adult	0.03	-0.92	0.98	0.954
LaGlasse 4	Initiate Comm Adult	0.36	-0.60	1.32	0.462
LaGlasse 5	Initiate Comm Child	1.43	0.36	2.49	0.009
LaGlasse 6	Response to Comm	0.59	-0.38	1.56	0.234
LaGlasse 7	Withdraw	1.29	0.24	2.34	0.016
Bharathi 1	Social Skill Total	0.15	-0.40	0.69	0.597
Bharathi 2	Understanding	0.45	-0.10	1.00	0.109
Bharathi 3	Initiates Interaction	0.90	0.33	1.47	0.002
Bharathi 4	Respond to Others	1.00	0.43	1.58	0.001
Bharathi 5	Maintain Interactions	0.61	0.05	1.17	0.032
Bharathi 6	Social Skills Follow-up	0.22	-0.33	0.77	0.429
Ghasemtabar 1	Posttest	0.12	-0.64	0.87	0.765
Ghasemtabar 2	Follow-up	0.93	0.14	1.73	0.021
Ghasemtabar 3	Overall	0.12	-0.42	0.67	0.654

Effect Size Estimates by Measure Within Studies

Several initially identified moderators revealed no variability across the studies. Therefore, those potential moderators were not analyzed. Those moderators included:

- a source of reference
- publication status

- study design
- study quality
- gender of participants
- social skill assessment method

Primary Moderators Analysis Results

Age

Age was identified as a potential moderator of the overall effect size estimate of the impact of music therapy (MT). This analysis separated students between the ages of 1-6 years and 6-12 years. The results are provided in Table 4.

Table 4

Effect Size Estimates by Age Group

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
1-6 years	4	0.40	0.06	0.75	0.022
6-12 years	16	0.64	0.39	0.90	< 0.001

As indicated above, the effect size estimate for the impact of MT for the 6-12-years group revealed a large positive significant effect, whereas the effect size estimate for the 1-6 years group revealed a moderate positive significant effect. The two levels were found to be significantly different, p < .001.

The severity of the student's disability was also examined. The available data provided two levels of severity (i.e., *severe*, *multiple levels*). The results are provided in Table 5.

Table 5

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
Severe	4	0.40	0.06	0.75	0.022
Multiple Levels of Severity	16	0.64	0.39	0.9	< 0.001

Effect Size Estimate by Severity Level

As indicated, the effect size estimate for the impact of MT was higher for the *multiple levels of* severity than the severe level. Results also indicate that the two levels were significantly different, p < .001.

Intervention strategy was also examined, with two levels being found in the extant research (i.e., *active*, *active* & *passive*). The results of this analysis are provided in Table 6.

Table 6

Effect Size Estimate by Intervention Strategy

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
Active	11	0.70	0.35	1.06	< 0.001
Active & Passive	9	0.49	0.25	0.72	< 0.001

As indicated above, the effect size estimate for the impact of MT was greater for the *active* interventions than the *active* & *passive* interventions. Results also indicate that the two levels were significantly different, p < .001.

The setting of the MT was examined for three levels: *therapeutic*, *school*, and *in-home*. The results are presented in Table 7.

Table 7

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
Therapeutic	10	0.78	0.34	1.23	0.001
School	6	0.55	0.27	0.82	< 0.001
In-Home	4	0.40	0.06	0.75	0.022

Effect Size Estimate by Setting of Music Therapy

As indicated above, the most significant impact of MT was revealed in the *therapeutic* setting, followed by the *school* setting, and then *in-home*. Results also indicate that the three levels were significantly different, p < .001.

The impact of the MT based on who was implementing the therapy was also examined. The three levels of implementation specialist represented in the extant research included: *music therapist, researcher,* and *more than one* specialist. The results of this analysis are presented in Table 8.

Table 8

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
Music Therapist	11	0.70	0.35	1.06	<0.001
Researcher	3	0.34	-0.15	0.83	0.172
More than one	6	0.55	0.27	0.82	<0.001

Effect Size Estimate by Implementation Specialist
As indicated above, the greatest impact of MT was revealed when the implementation specialist was a *music therapist*, followed by *more than one* specialist conducting the implementation. Results also suggest that the three levels differed significantly, p < .001.

The length of the therapy on the impact of the MT was analyzed. The research provided three different lengths of therapy sessions: 21-30 minutes, 31-40 minutes, and 41 minutes or more. These results are provided in Table 9.

Table 9

Effect Size Estimate by Length of Therapy Session

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
21 - 30 minutes	3	0.34	-0.15	0.83	0.172
31 - 40 minutes	10	0.48	0.27	0.69	< 0.001
41 minutes or more	7	1.03	0.46	1.61	< 0.001

Results indicate that the longest sessions (41 minutes or more) resulted in the greatest impact. Results also indicate that the three levels were significantly different, p < .001.

The number of MT sessions was examined. Students were reported to attend *one to five* sessions, six to ten sessions, or 30 or more sessions. These results are presented in Table 10.

Table 10

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
1-5 Sessions	7	0.97	0.58	1.37	< 0.001
6-10 Sessions	7	0.36	0.17	0.56	< 0.001
30 or more Sessions	6	0.54	0.31	0.77	<0.001

Effect Size Estimate by Number of MT Sessions

As indicated above, the greatest impact of MT was revealed for the students attending *one to five* sessions, followed by 30 or more sessions. Results also suggest that the three levels were significantly different, p < .001.

The impact on MT, based on the focus of measurement, was analyzed across five possible actions by the student (i.e., *attention*, *initiate communication*, *respond to communication*, *speech & language*, and *withdraw*). The results of these analyses are presented in Table 11.

Table 11

Effect Size	Estimate	by Focus	of M	leasurement
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Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
Attention	4	1.05	0.17	1.94	0.019
Initiate Communication	3	0.88	0.41	1.35	<0.001
Respond to Communication	4	0.57	0.28	0.85	< 0.001
Speech & Language	1	0.13	-0.30	0.56	0.550
Withdraw	1	1.29	0.24	2.34	0.016
Withdraw	1	1.29	0.24	2.34	0.016

As indicated above, MT had the greatest impact on *withdraw*, followed by *attention* and *initiate communication*. All the estimated effect size estimates of MT were revealed to be large except for the *speech and language* levels. Results also indicate that the five levels were significantly different, p < .001.

Secondary Moderators Analysis Results

Three potential secondary moderators were examined. Three different levels represented the area of expertise of the MT administrator. The results of this analysis are provided in Table 12.

Table 12

Effect Size Estimate by Area of Expertise

Level	Number of Studies	*: d	Lower Limit	Upper Limit	Sig.
Family-Centered Music Therapy and Taking Turns	4	0.38	0.15	0.6	0.001
Music Therapy, Eye Gazing, Joint Attention, and Communication	7	0.97	0.58	1.37	0.001
Music therapy, understanding/perspective taking ability, responds to others, and maintains interaction	9	0.48	0.29	0.68	0.001

As indicated above, the largest effect size estimate was found with *music therapy, eye gazing, joint attention, and communication.* Results also suggest that the three levels were significantly different, p < .001.

The skill measurement taken was also identified as a secondary moderator. The extant research provided three potential measures: *SSRS*, *TSSA*, and *multiple* measures. The results for this analysis are provided in Table 13.

Table 13

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.
SSRS	3	0.34	-0.15	0.83	0.172
TSSA	6	0.55	0.27	0.82	< 0.001
Multiple Measures	11	0.70	0.35	1.06	<0.001

Effect Size Estimate by Skills Measurement Technique

As indicated above, studies using *multiple measures* reported the largest estimated effect size estimate, followed by the *TSSA*. Results also indicate that the three levels were significantly different, p < .001.

Lastly, the location of the research study (i.e., *domestic*, *international*) was analyzed for any differences across estimated effect size estimates. The results of this analysis are provided in Table 14.

Table 14

Effect Size Estimate by Location of Research

Level	Number of Studies	d	Lower Limit	Upper Limit	Sig.	
Domestic	7	1.03	0.46	1.61	<0.001	
International	13	0.45	0.26	0.64	<0.001	

As indicated above, the results reveal that *domestic* studies reported large positive significant effect size estimates overall, while *international* studies reported a moderate to large effect size estimate. Results also indicate that the two levels were significantly different, p < .001.

Publication Bias

All studies in the current investigation were published and reported an overall positive result. As indicated above, the Q-statistic showed that heterogeneity existed across the studies, with variability across the mean effect size estimates, ranging from d = -.14 to d = 1.28 (a range of 1.42). Figure 2 illustrates the true mean effect size estimates of the studies included in the current investigation.

Figure 2



As indicated above, the mean effect size was .57 with a 95% confidence interval of .36 to .78. So, while there was variability in the individual effect size estimates, the distribution of effect size estimates was all positive for the published studies. Therefore, it is likely that publication bias exists.

Conclusion

This meta-analysis examined the existing research on music therapy with students identified on the autism spectrum. Based on the available research, the overall result revealed a significant positive effect of music therapy on students with autism therapy. Additionally, the results reveal statistically significant heterogeneity across the identified studies and the different effect size measures examined within those studies. All the potential primary moderators, including the age of students, the severity level of diagnosis, MT intervention strategy, setting of MT, administrator of MT, length of session, number of sessions, and focus of behavior being measured, were significant and positive. Secondary moderators, including the administrator's area of expertise, the study's location, and the measurement of the skills used, were also found to be positive and significant. Since all four studies were published and reported positive results, publication bias is likely. These results and their implications are discussed in Chapter Five.

Chapter 5 – Discussion

Introduction

Autism spectrum disorder (ASD) is a life-long disability characterized by developmental deficits in social communication, and restricted and repetitive patterns of behavior (Volkmar & Pauls, 2003; Yum el al., 2020). It has been suggested that social and behavioral impairments in individuals with ASD are a result of a debilitated central nervous system (Azbell & Laking, 2006). The high rate of epilepsy and tenacious neurological involvement has strongly suggested brain involvement in individuals with ASD (Volkmar & Pauls, 2003). A range of neurological abnormalities such as neuron depletion and reduced dendritic arborization in the limbic system have been reported in past studies (Volkmar & Pauls, 2003).

Social processes have also been reported as an area of focus in individuals with ASD, applying social meaning to visual stimuli is often observed as a very difficult task (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) this may be due to the highly unusual pattern of visual searching individuals with ASD demonstrate when exposed to social interaction. Social difficulties experienced by individuals with ASD are known to persist throughout a lifetime (Volkmar & Pauls, 2003). According to Volkmar and Pauls (2003) social skills taught during childhood and adolescence may provide substantial social gains to support independent living during adulthood. These findings are of interest because of the nature of social difficulties found in individuals with ASD (Volkmar & Pauls, 2003).

. Social skills have been defined as a complex interaction of skills used to perform social tasks (Ghasemtabar et al., 2015; Thompson et al., 2013). In past studies, it has been suggested that a profound deficiency in social skills is a primary feature of ASD (White et al., 2007). Social deficits often involve speech, verbal communication, and interpersonal synchrony (White et al.,

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2007). Problem areas may also include dwelling on a particular subject, lack of emotional expression, and lack of understanding sarcasm and metaphors (White et al., 2007). According to White et al. (2007) the major cause of disability is not a lack of social interest, but the lack of ability to determine when to apply the skill is the major cause of social impairment.

Treatments that address social deficits are aimed toward minimizing social impairments in individuals with ASD (Rankin et al., 2016). The National Autism Council's National Standards Report (2023) suggests using an intervention practice that focuses on the development of social skills in individuals with ASD. In past studies, music has created a foundation for social interaction, and provided a structured environment that promotes social development in individuals with ASD (LaGasse, 2017). According to past research, music therapy interventions have been known to improve attention, and promote social development in individuals with ASD (LaGasse, 2014).

Music therapy (MT) is a music based intervention that targets communication skills according to individualized needs, preferences, and abilities (LaGasse, 2017). According to Ghasemtabar et al. (2022) music is a valuable tool that can be used to develop social behaviors and reduce social impairments in individuals with ASD. In past studies, researchers have accentuated the importance of MT in childhood development (Aldridge, 1994). Calming effects and reduced feelings of fear and anxiety have been reported (Aldridge, 1994).

In the early 1940's, music education, singing groups, and folk dancing were used to improve socialization, and self-expression (Marquez-Garcia et al., 2021). As the years passed, clinicians began to recognize music as a way of improving social skills in individuals with ASD (Marquez-Garcia et al., 2021). Today, many clinicians use MT as an alternative intervention treatment for ASD (Marquez-Garcia et al., 2021). According to LaGasse (2017) there are several reasons why MT improves socialization skills in individuals with ASD.

In past studies, the rhythmic component of music has been known to encourage neural organization and appropriate response cues (LaGasse, 2017). According to LaGasse (2017) using structured music as an outline for response time could create a foundation for positive social interaction. Furthermore, MT may also provide a way for individuals who are non-verbal to engage in social interaction (LaGasse, 2017). A significant increase in social engagement, joint attention, and peer interaction has been observed in past studies (LaGasse, 2017).

Over the years, MT has brought about positive changes in social behavior (Ghasemtabar et al., 2022). Evidence from past studies have shown that MT can help individuals recognize social cues, cooperate in social groups, and transition between activities (Ghasemtabar et al., 2022). Despite the many approaches to MT, focusing on individualized needs is prominent for successfully designing a treatment plan to address the physical, social, and emotional needs of individuals with ASD (LaGasse, 2017). These studies provide research-based evidence that MT can create positive social changes in individuals with ASD.

The current study combined the results of 4 research studies that met the following inclusion criteria: the research is written in English, the research is published between the years 2013-2023, the research includes MT as the independent variable, the research includes social skills as the dependent variable, the research includes participants who have a medical diagnosis of autism and who are between the ages of 1-12, the research was conducted using aggregated data or a group research design that includes a functional analysis, the research quantitatively expressed the effects of MT on social skills so that the necessary data can be extracted and the effect size can be calculated.

The 4 articles were analyzed according to 17 primary and secondary moderators. The following primary and secondary moderators were initially evaluated for use in this study: area of expertise, source of reference, publication status, location of study, study design, quality, gender, age, level of severity, type of intervention strategy, setting, implementation specialist, length of each therapy session, total number of therapy sessions, focus of measurement, social skills assessment method, and measurement technique. Since several initially identified moderators revealed no variability across studies, those moderators were not analyzed. Those moderators included: source of reference, publication status, study design, study quality, gender, and social skill assessment.

The overall mean effect size had a large positive significant effect d = 0.572 with a 95% confidence interval of 0.37 to 0.78. (This was based on the guidelines of d = .10 as a small effect size estimate, d = .30 as a moderate effect size estimate, and d = .50 or greater as a large effect size estimate). The mean effect size suggests a large significant effect from MT across all the studies. The Q-statistic tests the null hypothesis that assumes all studies in the analysis share a common effect size. The Q-value was 38.20 with 19 degrees of freedom and p = 0.006, indicating the presence of heterogeneity. Specifically, the true effect size across all effect estimates was not the same in all studies.

Moderators

Age. This moderator was separated into the following age groups: 1-6 years, and 6-12 years. The results of this moderator indicated that the effect size estimate for the impact of MT for the 6-12 years level showed a large positive significant effect size (d = 0.64). The effect size estimate for the 1-6 years level showed a moderate positive significant effect size (d = 0.40). The two levels within this moderator were found to be significantly different (p < 0.001).

Severity Level. This moderator was separated into the following levels of severity: severe, and multiple levels of severity. The results of this moderator indicated that the effect size estimate for the impact of MT for the severe level showed a moderate positive significant effect size (d = 0.40). The effect size estimate for multiple levels of severity showed a large positive significant effect size (d = 0.64). These results also indicate that the two levels were significantly different (p < 0.001).

Intervention Strategy. This moderator was examined using the following two levels: active, and active & passive. The results of this moderator indicated that the effect size estimate for the impact of MT was higher for the active interventions (d = 0.70) than the active & passive interventions (d = 0.49). The effect size estimate for the active interventions showed a large positive significant effect, whereas the active & passive interventions showed a moderate positive significant effect. The results also indicated that the two levels were significantly different (p < 0.001).

Sitting of Music Therapy. This moderator was examined for the following three levels: therapeutic, school, and in-home. The results of this moderator indicated that the effect size estimate for the impact of MT for both the therapeutic and school settings showed a large positive significant effect size (d = 0.78; d = 0.55), whereas the effect size estimate for the in-home setting showed a moderate positive significant effect size (d = 0.40). According to the results, the therapeutic level revealed the most significant impact of MT, followed by the school setting, and then the in-home setting.

Implementation Specialist. This moderator was examined for the following levels of implementation specialists: *music therapist, researcher, and more than one* specialist. The results of this moderator indicated that the effect size estimate for the impact of MT for the *music*

therapist, and the more than one specialist levels revealed a large positive significant effect size (d = 0.70; d = 0.55). The effect size estimate for the researcher level revealed a moderate positive significant effect size (d = 0.34). The greatest impact of MT was revealed when the implementation specialist was a music therapist, followed by more than one specialist, and then the researcher. The results of this moderator also indicated that the three levels are significantly different (p < 0.001).

Length of Therapy Session. This moderator was examined using the following levels: 21-30 minutes, 31-40 minutes, and 41 minutes or more. The results of this moderator indicated that the effect size estimate for the impact of MT for the 21-30 minutes, and the 31-40 minutes sessions revealed a moderate positive significant effect size (d = 0.34; d = 0.48), whereas the effect size estimate for the 41 minutes or more session revealed a large positive significant effect size (d = 1.03). According to the results, the 41 minutes or more session revealed the most significant impact of MT, followed by the 31-40 minutes session, and then the 21-30 minutes session. The results also indicate that the three levels were significantly different (p < 0.001).

Number of Music Therapy Sessions. This moderator was examined using following levels: 1 to 5 sessions, 6-10 sessions, and 30 or more sessions. The results of this moderator indicated that the effect size estimate for the impact of MT for the 30 or more sessions, and the 6-10 sessions revealed a moderate positive significant effect size (d = 0.54; d = 0.36). The effect size estimate for the 1-5 sessions revealed a large positive significant effect size (d = 0.97). According to the results, 1-5 sessions revealed the most significant impact of MT, followed by 30 or more sessions, and then 6-10 sessions. The results also indicate that the three levels were significantly different (p < 0.001). **Focus of Measurement.** This moderator was examined using the following levels: attention, initiate communication, respond to communication, speech & language, and withdraw. The results of this moderator indicated that the effect size estimate for the impact of MT for attention, initiate communication, respond to communication, and withdraw revealed a large positive significant effect size (d = 1.05; d = 0.88; d = 0.57; d = 1.29). The effect size estimate for speech & language revealed a small positive significant effect size (d = 0.13). According to the results, withdraw revealed the most significant impact of MT, followed by attention, initiate communication, respond to communication, and then speech & language. The results also indicate that the five levels were significantly different (p < 0.001).

Area of Expertise. This moderator was examined using the following levels: family-centered music therapy and taking turns, music therapy, eye gazing, joint attentions, and communication, and music therapy, understanding/perspective taking ability, responding to others, and maintaining interaction. The results of this moderator indicated that the effect size estimate for the impact of MT for music therapy, eye gazing, joint attention, and communication revealed a large positive significant effect size (d = 0.97).

The effect size estimate for family-centered music therapy and taking turns, and music therapy, understanding/perspective taking ability, responding to others, and maintaining interaction revealed a moderate positive significant effect size (d = 0.38; d = 0.48). The largest effect size estimate was found in the music therapy, eye gazing, joint attention, and communication level, followed by the music therapy, understanding/perspective taking ability, responds to others, and maintains interaction level, and then the family-centered music therapy and taking turns level. The results also indicated that the levels were significantly different (p < 0.001).

Skills Measurement Technique. This moderator used three levels of measure: SSRS, TSSA, and multiple measures. The results of this moderator indicated that the effect size estimate for the impact of MT for multiple measures revealed a large positive significant effect size (d =0.70). The effect size estimate for the SSRS, and TSSA measures revealed a moderate positive significant effect size (d = 0.0.34; d = 0.55). The largest effect size estimate was found in the multiple measures level, followed by the TSSA, and then the SSRS levels. The results also indicated that the three levels were significantly different (p < 0.001).

Location of Research. This moderator examined the following levels: *domestic*, and *international*. The results of this moderator indicated that the effect size estimate for the impact of MT for the *domestic* level revealed a large positive significant effect size (d = 1.03). The effect size estimate for the *international* level revealed a moderate positive significant effect size (d = 0.45). The largest effect size estimate was found in the *domestic* level, followed by the *international* level. The results also indicated that the two levels were significantly different (p < 0.001).

Implication of the Results

According to Ghasemtabar et al. (2020) music therapy has brought about positive changes in social behavior. Music intervention techniques have also been known to harness musical talents and reduce social impairments in individuals with ASD (Ghasemtabar et al., 2022). Despite the problems in processing and controlling everyday emotions, individuals with ASD can discern emotions in music the same as non-exceptional peers (Ghasemtabar et al., 2022). Past research has also revealed that music therapy can help individuals recognize social cues, cooperate in social groups, and transition between activities (Ghasemtabar et al., 2022).

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LaGasse (2017) noted that music therapy interventions are a great way to address the social needs of individuals with different levels of ASD. According to Bharathi et al. (2019) music therapy has been used as a therapeutic approach to enhance the physical, social, and emotional needs of individuals with ASD. Music therapy sessions can provide an opportunity for individuals with ASD to socially interact with peers in an environment that is safe and non-judgmental (Eren, 2015). According to LaGasse (2017) music alone does not improve social behaviors, it is the presence of music within another intervention that encourages positive change.

In this current study, it was hypothesized that the quantitative analysis of studies that have researched the effects of music therapy on social skills in individuals with ASD will reveal a positive significant effect of music therapy on individuals with ASD. Past research has demonstrated that music therapy interventions have improved social skills in individuals with ASD regardless of whether the intervention specialist utilized active or passive music therapy.

The overall result of this current study revealed a positive significant effect of music therapy on social skills in individuals with ASD. All primary (age, severity level, intervention strategy, setting, implementation specialist, length of session, number of sessions, and focus of measurement) and secondary (area of expertise, study location, and skills measurement technique) moderators used in this study were found to be positive and significant.

This meta-analysis also reveals statistically significant heterogeneity across all studies and the different effect size measures examined within those studies. The Q-statistic showed variability across the mean effect size estimates (d = -0.14 to d = 1.28). Even though there was variability within the individual effect size estimates, the distribution of effect size estimates were all positive for the published studies and therefore, it is likely that publication bias existed.

Limitations

A meta-analysis is a valuable analytical tool that can provide information on the mean and variance of underlying population effects, the variability in effects across studies, and potential moderator variables (Field & Gillett, 2010). The main purpose of a meta-analysis is to summarize the results of multiple studies, analyze the differences between studies, and increase the accuracy of the effect size estimates (Walker et al., 2008). According to Walker et al. (2008), there are a few critical issues in a meta-analysis that need to be addressed, including publication bias, the identification and selection of studies, the heterogeneity of results, and the availability of data.

Publication bias happens when research is published based on the studies findings (Walker et al., 2008). According to Walker et al. (2008) database searches are unlikely to produce a representative sample because studies that show positive outcomes are more likely to be published than studies that do not. Walker et al. (2008) suggested that publication bias occurs because publishers favor positive studies that create catching headlines and recognition. In a recent study, researchers found that 97% of studies that showed positive results were published vs 12% of studies that showed negative results (Walker et al., 2008). Researchers also found that when unpublished studies are excluded in an analysis, the positive effects of the study may increase up to 69% (Walker et al., 2008).

According to Walker et al. (2008) important steps should also be taken when identifying relevant studies to include in a meta-analysis. First, a complete set of keywords should be used when searching a database for inclusion articles (Walker et al., 2008). The search engine you use for searching articles is also important because using multiple search engines can help increase the number of studies found (Walker et al., 2008). This step will help locate a long list of studies

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that may or may not be directly relevant to the meta-analysis (Walker et al., 2008). When selecting articles, the list should also be subject to clearly defined inclusion criteria (Walker et al., 2008). This step will help reduce differences among studies, and improve the quality of the research study (Walker et al., 2008).

According to Walker et al. (2008) the funnel plot technique can be used to detect the possibility of biases in the identification and selection phases. In a funnel plot, the effect size is "plotted on the horizontal axis against standard error, or sample size on the vertical axis" (Walker et al., 2008, p. 434). If no bias exists, the graph will have a symmetrical funnel shape, whereas when the graph shows lack of symmetry, negative studies are missing (Walker et al., 2008). However, it is important to keep in mind that funnel plots can sometimes be misleading. According to Walker et al. (2008) a lack of symmetry can also be caused by heterogeneity.

Heterogeneity refers to the degree of variance in the results of a research study (Walker et al., 2008). Walker et al. (2008) noted that the forest plot is an effective tool to determine the level of heterogeneity. A forest plot estimates the effect of each study, and creates a line that represents a confidence interval (Walker et al., 2008). When the confidence intervals overlap, the effects are similar, and therefore the level of heterogeneity is low (Walker et al., 2008). At the point of no effect, the forest plot also includes a reference line (Walker et al., 2008). When the effects lie on opposite sides of the reference line, the level of heterogeneity is high (Walker et al., 2008). According to Walker et al. (2008) high levels of heterogeneity can compromise the conclusion of a meta-analysis.

The availability of data within a research study is also important. Most research articles include a summary of results which may include the mean, standard deviation, confidence interval, t-test, P, and Cohen's *d*. According to Walker et al. (2008) when this information is

lacking within a research article it can severely limit the results of a meta-analysis. In this current study, the availability of data was lacking in several research articles that were considered for inclusion in this meta-analysis. The research articles that were lacking information were excluded from this meta-analysis.

Recommendations for Future Research

The use of music therapy as an intervention for improving social skills in individuals with ASD has been a common practice for many years (Yum et al., 2020). A comprehensive search of the literature produced several articles that were considered for inclusion in this meta-analysis, however only four articles met the inclusion criteria. Due to the small number of studies included in this meta-analysis, several initially identified moderators were not analyzed due to no variability across studies. It is evident that future research is needed to better understand the effects of music therapy on social skills in individuals with ASD. Specifically, more research is needed to provide future researchers with the data required to analyze the initially identified moderators excluded from this meta-analysis.

A few studies included in this meta-analysis also warrant further investigation. Bharathi et al. (2019) investigated the effects of music therapy on social skills in children with ASD. The study was designed using a pre-test/post-test/follow-up method. Fifty-four children were assigned into two groups: active and passive (Bharathi et al., 2019). A limitation to their study was that the participants were selected from only one city, and the age of the children with ASD was limited to 6-12 year olds (Bharathi et al., 2019). Therefore, it has been suggested that more research is needed among various populations, age groups, and severity levels (Bharathi et al., 2019).

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Thompson et al. (2013) investigated the effects of family centered music therapy on social skills in children with ASD. The study was a parallel randomized trial that included twenty-three children with severe ASD (Thompson et al., 2013). A limitation to their study was that their study had a small sample size. According to Thompson et al. (2013) the small sample size "limited the study's power to detect effects other than on the primary outcome where the effect was very large" (p. 847). Therefore, it has been suggested that larger studies are needed to determine the effectiveness of the intervention (Thompson et al., 2013).

Finally, Ghasemtabar et al. (2022) investigated the effects of music therapy on improving social skills in children with ASD. Ghasemtabar et al. (2022) designed a clinical trial study that included pre-test/post-test/follow-up data. A limitation to their study was that their study was limited to the community of Tehran city, and the study's sample size was limited to children who are between the ages of 7-12 (Ghasemtabar et al., 2022). Therefore, it has been suggested that '' more research is needed to investigate other samples with different demographic characteristics (Ghasemtabar et al., 2022).

Conclusion

The current study conducted a meta-analysis on the effects of music therapy on social skills in individuals with ASD. The analysis for this study was based on data from four research studies providing 20 effect size estimates. The sample within the four studies included data from 117 participants. The sample size for the effect size analysis was based on a sample size of n = 596. The four articles included in this meta-analysis produced an overall large positive significant effect size of d = 0.572 with a 95% confidence interval of 0.37 to 0.78. The mean effect size suggests a large significant effect from music therapy across all studies.

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All studies included in this current investigation published and reported overall positive results. The Q-statistic tests revealed significant heterogeneity across all studies, with variability across the mean effect size estimates, ranging from d = -0.14 to d = 1.28. It is evident that there is variability in the individual effect size estimates, however the effect size estimates were all positive for the published studies. Therefore, it is likely that publication bias existed in the studies used in this meta-analysis. Furthermore, according to Walker et al. (2008) high levels of heterogeneity can compromise the conclusion of a meta-analysis, therefore future research is also needed to help decrease the level of heterogeneity across studies.

Music therapy interventions have been known to improve emotional understanding and increase emotional engagement in individuals with ASD (LaGasse, 2014). Music therapy interventions have also been known to decrease ASD related behaviors and increase joint attention, social greetings, peer interaction, and cognitive social skills (LaGasse, 2014). The results of this meta-analysis revealed that music therapy is an effective intervention treatment for improving social skills in individuals with ASD. All primary moderators, including the age of students, the severity level of diagnosis, MT intervention strategy, setting of MT, administrator of MT, length of session, number of sessions, and focus of behavior being measured, were significant and positive. All secondary moderators, including the administrator's area of expertise, the study's location, and the measurement of the skills used, were also found to be positive and significant.

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Appendices

Appendix A – IRB Approval Documentation

TO: Dr. Christopher Tarr, Special Education

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

DATE: May 1, 2023

RE: Protocol Approved

Protocol #: 2023-090-88-A

Protocol Title: The Effects of Music Therapy on Social Skills in Individuals with Autism- A Meta-Analysis

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

You may begin your project as of May 1, 2023. Your protocol will automatically close on April 30, 2024, unless you request, in writing, to keep it open.

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

Inclusio	on Criteria Data Sheet	
Date:		
Article Reference:		
Criteria	Yes	No
The research is written in English.		
The research is written between the years 2013 and 2023.		
The research includes participants who have been diagnosed with an autism spectrum disorder, and who were between the ages of 1-12.		
The research includes music therapy as the independent variable.		•:
The research includes social skills as the dependent variable.		
The research was conducted using aggregated data or a group research design that includes a functional analysis.		
The research quantitatively expressed the effects of music therapy on social skills so that the necessary data can be extracted, and the effect size can be calculated.		
Met Inclusion Criteria:		

Appendix B – Inclusion Criteria Data Sheet

1

Author(s):			
Article Title:			
Year:			
Primary Quality Indicators	High Quality	Acceptable Quality	Unacceptable Quality
Participant Characteristics			
Independent Variable			
Comparison Condition			
Dependent Variable			
Link Between Research Question and Data Analysis			
Use of Statistical Tests			
Secondary Quality Indicators	Eviden	ce	No Evidence
Random Assignment			
Interobserver Agreement			
Blind Raters			
Fidelity			
Attrition			
Generalization			
Effect Size			
Social Validity			
	The Overall Strength	of the Research Report	t:
Strong	Adequa	ite	Weak
Comments:			

Appendix C – Evaluative Method Data Sheet
Qualit	ty of the Evaluative Meth	nod for Group Research	Rubric
Primary Quality Indicators	High Quality	Acceptable Quality	Unacceptable Quality
Participant Characteristics	 Age and gender are provided for all participates, diagnostic information is provided for all participants with autism, information on the characteristics of the interventionist is provided (Reichow et al., 2008). 	An acceptable rating is given to a study that met two out of three criterions.	An unacceptable rating is given to a study that met less than two criterions.
Independent Variable	Details about the treatment are provided and replicable (Reichow et al., 2008).	An acceptable rating is given to a study that provides adequate detail about the independent variable but excludes specific detail.	An unacceptable rating is given to a study that does not provide adequate details about the independent variable.
Comparison Condition	The quality of the conditions for the comparison group are replicable (Reichow et al., 2008).	An acceptable rating is given to a study that provides an adequate description of the conditions for the comparison group.	An unacceptable rating is given to a study that does not provide an adequate description of the conditions for the comparison group.
Dependent Variable	The quality of the dependent measure is (1) operational, (2) replicable, (3) shows a transparent link to the dependent variable, (4) collected at appropriate times (Reichow et al., 2008).	An acceptable rating is given to a study that met three out of four criterions.	An unacceptable rating is given to a study that meets less than three criterions.
Link Between Research Question and Data Analysis	Data analysis is strongly linked to the research question(s)	An acceptable rating is given to a study in which the data	An unacceptable rating is given to a study in which the

Appendix	D	- Eva	luative	Method	Scoring	Rubric
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	usi me var al.,	ng correct units of asure on all iables (Reichow et 2008).	analysis is ad linked to the question(s) a adequately c units of mea all variables.	dequately research and uses orrect sure on	data analysis does not adequately link the research question(s) and does not use correct units of measure on all variables.
Use of Statistical Tests	Eac mea pro ana ade san et a	ch statistical asure showed per statistical lyses with equate power and pple size (Reichow l., 2008).	An acceptab is given to a which the sta measure reve adequate stat analysis with adequate pow sample size.	le rating study in atistical caled an tistical n an wer and	An unacceptable rating is given to a study in which the statistical measure does not reveal an adequate statistical analysis, power, and sample size.
Secondary Quality		Evidence	ce		No Evidence
Random Assignment		A random assignm procedure was used participants to grou (Reichow et al., 20	ent d to assign aps 08).		
Interobserver Agreemen	nt	IOA was collected participants, raters, conditions with go $(k \ge .60)$ (Reichow 2008).	across all , and od reliability v et al.,	¥.	
Blind Raters		Raters are blind to participants' treatm condition (Reichov 2008).	the lent v et al.,		
Fidelity		Fidelity of the proc treatment is continue evaluated across para and conditions (Re 2008).	edure or ually articipants ichow et al.,		
Attrition .		Articulation is com across conditions (1 al 2008)	parable Reichow et		
Generalization		Generalization and maintenance were of after collection of t outcome measure (al., 2008).	/or evaluated he final Reichow et		
Effect Size		Effect sizes are des 75% of the outcom	cribed for e measures		

		Y
	and are equal or greater than	
	.40 (Reichow et al., 2008).	
Social Validity	The research study contains the	
	following:	
	(1) dependent variables are	
	socially valued,	
	(2) intervention was time and	
	cost effective,	
	(3) comparisons are observed	
	between, individuals with and	
	without disabilities,	
	(4) the behavior change is	
	clinically significant,	
	(5) results were socially	
	acceptable,	
	(6) independent variables are	
	manipulated by people who	
	had contact with the	
	participant,	
	(7) the context of the study	
	occurred naturally (Reichow et	
	al., 2008).	
Th	e Overall Strength of the Research	n Report:
Strong	Adequate	Weak
All primary quality	Four or more primary quality	Less than four primary quality
indicators received high	indicators received high	indicators received high quality
quality ratings and	quality ratings and revealed	ratings and revealed evidence of
revealed evidence of four	evidence of two secondary	less than two secondary quality
or more secondary quality	quality indicators (Reichow et	indicators (Reichow et al.,
indicators (Reichow et al.,	al., 2008).	2008).
2006).		

Appendix E - Coding

	lic .	Social Skills Measurement Technique	(I) SSRS	(2) VSEEC	(3) SRS-PS	(4) MBCDI-W&G	(5) PCRI	(6) MTDA	(7) ATEC	(8) TSSA	(9) SRS	(10) More than One Technique	(777) Coutrol	(888) Not Noted
	Dependent Variab	Social Skills Assessment Method	(1) Direct	(2) Indirect	(3) Direct and Indirect	(777) Control	(888) Not Noted							
		Focus of Measurement	(1) Gives Altention	(2) Entens Into Intentional Social Interactions	(3) Understands and Expresses Emotion	(4) Repetitive Behaviors	(5) Interpersonal Behaviors	(6) Communication	(7) More Than One Skill	(777) Control	(888) Not Noted			
		Total # of Therapy Sessions	(1) 1-5 Sessions	(2) 6-10 Sessions	(3) 11-20 Sessions	(4) 21-30 Sessions	(5) Greater than30 Sessions	(777) Control						
	e	Length of Each Therapy Session	(1) 1-10 Minutes	(2) 11-20 Minutes	(3) 21-30 Minutes	(4) 31-40 Minutes	(5) Greater than 41 Minutes	(777) Control						
	adependent Variabi	Implementation Specialist	(1) Music Therapist	(2) School Personne	(3) Researcher	(4) More Than One Specialist	(777) Control	(888) Not Noted						
odebook	I	Setting	(1) Theraputic	(2) School	(3) Coanmunity	(4) In-Home	(5) More than One Setting	(777) Control						
E - Coding Sheet/C		Type of Intervention Strategy	(1) Active Music Therapy	(2) Passive Music Therapy	 (3) Active and Passive Music Therapy 	(777) Control						•:		
Appendix	B	Level of Severity	(I) MEId	(2) Moderate	(3) Severe	(4) More Than One Level of Severity	(888) Not Noted							
	irticipant	Age	(1) 1-6	(2) 6-12										<i>i</i>
	Pa	Gender	(1) Male	e (2) Fernale	(3) Male and Female									
		Quality	l) Strong	2) Adequat	3) Weak									
		Study Design	(1) Experimental ((2) Obscrvational (0			4						
	9	Location of Study	(1) Domestic	(2) International										
	Study I	Publication Status	(1) Published	(2) Not Published										
		Source of Reference	farmel (1)	(2) Book	(3)Dissertation	(4) Thesis	(5) Other							
		Area of Expertise	(1) family-Centered Music Therapy and Taking Turns	(2) Music Therapy and Eye Gazing, Joint Attention, and Communication	(3) music therapy and understanding/pe rspective taking ability, responds ability, responds no others, and mainbains interaction	(4) Music Therapy and Social Skills								

Appendix E - Coding

		1	dwin					Participant ID	Appen	dix E - Coding Sl	seet/Codebook	inderse dare Verlehie				Marked Variable					
		6	any IM			I		C RUNCED AND AND	I			storting and an and an an		I		PEDEDERI VATAD			Nat	stics	
Authors and Year	Area of Expertise	Source of Reference	Publication Status	Location of Study	Study Design	Quality	Gender	Age	Level of Severity	Type of Intervention Strategy	Setting	Implementation Specialist	Length of Each Therapy Seeston	Total # of Therapy Seemions	Facus of Measurement	Social Skills Assessment Method	Messurement Technique	Cohem's #	Lower CI	Upper CI	Sile
Thompson, G., McFerran, K., & Gold, C. (2014). (Primery)	1	1	1	2	1	1	ħ	1	5	-	4	1	*	3	6	2	10	96.0	0.46	1.5	100.0>
Thompson, G., McFerran, K., & Gold, C. (2014). (Secondary)	1	1	-	2	1	-	e	1	3	-	4	I	4	Э	6	2	10	0.21	-0.22	0.65	0.333
Thompson, G., McFerran, K., & Gold, C. (2014). (Speach & Language)	1	I	1	2	I	1	3	1	3	-	4	1	4	3	6	2	16	0.13	-0.3	0.56	0.55
Thronpson, G., McFarran, K., & Gold, C. (2014). [Parrest-Child]	1	Ŧ	1	2	ş		r5	1	3	-	4	1	*	e	6	2	91	0.38	-0.06	0.82	0.093
LaGasse, A. (2014). (Eye Glaze)	2	1	1	1	1	1	3	2	4	1	1	1	5	2	6	1	10	2.33	1.1	3.57	<0.001
LaGasse, A. (20)4). (Juint Attention Child)	2	1	1	1	1	1	E	2	4	1	1	1	5	2	6	2	IĐ	1.61	0.51	2.71	0.004
LoGerre, A. (2014). (foint Attention Adult)	2	1	I	1	1	1	Э	2	4	-	1	1	5	2	6	2	10	0.03	-0.92	0.98	0.954
LoGasse, A. (2014). (Initiate Communication Adait)	11	Ţ	*1	1		wit	¢î.	м	4	-	1	1	5	2	6	м	10	0.36	-0.6	1.32	0.462
LaGasse, A. (2014). (fattlate Communication Child)	2	1	1	1	4		55	2	4	-	1		\$	2	6	2	10	1.43	0.36	2.49	0.009
LoCasse, A. (2014). (Respense to Communication)	5	1	Ţ	1	1	1	(1)	2	4	-	1	1	5	2	6	2	10	0.59	-0.38	1.56	0.234
LaGasse, A. (2014). (Withdraw)	2	1	1	1	3	1	3	2	4	1	1	1	5	2	6	7	10	1.29	0.24	2.34	0.016
Hharathi, G., Vœnugopal, A., & Vellingin, B. (2019). (Sectal Skill Totad)	3	1	1	2	1	1	3	2	4	3	2	4	4	S	Ð.	2	8	0.15	-0.4	0.69	0.597
Bharathi, G., Venugopsl, A., & Vellingiri, B. (2019). (Understanding)	3	1	1	2	Ţ		3	2	*	3	2	4	•	5	Q,	2	8	0.45	-0.1	I	0.109
Bharathi, G., Verugopal, A., & Vellingiri, B. (2019). (Imtilates Interaction)	£	-	1	2		1	3	2	4	ñ	2	4	4	S	o.	2	ж	0.9	0.33	1.47	0.002
Bharathi, G., Venugopal, A., & Vellingrit, B. (2019). (Respond to Others)	3		м	2	Ţ		E	м	4	З	2	4	4	S	æ	2	50	1	0.43	1.58	100'0
Bharnthi, G., Venugopal, A., & Vellingri, B. (2019). (Matarath Interactious)	8	1	1	2	15	1	e.	R	4	3	2	4	4	5	6	2	8	0.61	0.05	1.17	0.032
Btharathi, G., Varugopal, A., & Vellingrit, B. (2019). (Social Skills Pollerv-ap)	3	1	1	2	1	1	Е	2	4	3.	2	4	4	ş	6	2	8	0.22	-0.33	0.77	0.429
Chasemnahar, S., Hossenini, M., Fayyaz, I., Anah, S., Naghashinen, H., & Poudineh, Z. (2015). (Posthast)	n	**	ĩ	2	m		εī	2	4	m	1	£	£	E	6	2	I	0.12	-0.64	0.87	0.765
Chasermiahar, S., Hossoini, M., Fayyaz, I., Arab, S., Naghashian, H., & Poudinch, Z. (2015). (Fotlow-up)	60	nt	mt	7	net		m	2	7	£	ı	ę	е	m	6	N	1	0.93	0.14	1.73	0.021
Chaseomanbar, S., Hoszefri, M., Fayyaz, L., Arab, S., Naghashian, H., & Poudineh, Z. (2015). (Orterall)	m	uri	gan)	ы	pre .		ť	61	4	я		P	m	m	σ	Pl	1	0.12	-0.42	0.67	0.654