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A Systematic Review of Music Therapy for Children with Autism Spectrum Disorder

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A Systematic Review of Music Therapy for Children with Autism Spectrum Disorder

by

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Dedication

This thesis is dedicated to several important figures in my life.

To my mother, you never doubted me for a second. Without you, I would not be here today. Thank you for believing in me always. You and me.

To my father who never had the chance to see me rise above the challenges of life:

I kept my promise.

To my Tutor, the nights at the kitchen table were nights well spent. Your work and patience paid off. Thank you.

To my family, they say it takes a village to raise a child, and now it is time for the child to give back to the village. Thank you for supporting me even from hundreds of miles away.

To my dear friends at Ole Miss, you all stood behind me and reminded me that there was always a light at the end of the tunnel. Thank you all for being my sunshine in the rain.

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Abstract

Music therapy has been suggested to be effective in Autism. The purpose of this systematic review was to assess the effectiveness of music therapy as a potential treatment option for individuals with autism spectrum disorder, or ASD. To obtain published records, a PubMed search was conducted with the search term “music therapy autism,” which generated 187 studies. Each study was evaluated for relativity to the topic at hand. The remaining 151 articles were assessed for support status, as well as other later suggested research, in order to more confidently support music therapy as a treatment option for ASD patients. Approximately 79% of the articles support music therapy as an effective way to reduce symptoms of ASD, including social communication issues, vocal stereotypies, stimming, and emotional outbursts in stressful situations. 44 articles (29%), both neutral and supporting in status, suggest further research is needed to move forward more confidently with music therapy as a treatment for ASD. This systematic review implies that music therapy is sufficiently supported as an effective means for reducing ASD symptoms and can be considered in the repertoire of treatment options available to those who are diagnosed with ASD.

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LIST OF ABBREVIATIONS

ADOS	Autism Diagnostic Observation Schedule
ASD	Autism Spectrum Disorder
DSM-5	*The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*
NDD	Neurodevelopmental Disorder
NICU	Neonatal Intensive Care Unit
RCT	Random Controlled Trial
SSRI	Selective Serotonin Reuptake Inhibitors
TAU	Treatment as Usual

Introduction

1.1 Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a developmental disorder affecting an individual's verbal and social skills. From a study conducted in 2018 by Dr. Matthew Maenner, et. al, the CDC reports every 1 in 44 children have been identified with autism spectrum disorder across all racial, ethnic, and socioeconomic groups (CDC, 2021). ASD is shown to be more prevalent in males than females between the ages of 3 and 17 (CDC, 2021). According to *The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) (CDC, 2021), a child must present continuous deficits in three social communication and interaction areas in addition to at least two repetitive behaviors. The three social communication and interaction issues may include deficits in social-emotional exchange, deficits in nonverbal behaviors while communicating in a social scenario, and deficits in understanding and upkeep of social relationships. Repetitive behaviors include stereotypies, inability to deviate from routine, hyper-fixation on a current task or interest, or hyper-/hypo-activity to sensory information or sensory components of the environment (CDC, 2021). Ahearn, et. al. defines vocal stereotypy "…as any instance of noncontextual or nonfunctional speech and included singing, babbling, repetitive grunts, squeals, and phrases unrelated to the present situation" (Ahearn, et al, 2007). Vocal stereotypies are a way for children with autism to "stim," or cope with overwhelming situations or

environments. Vocal stereotypies may be a gateway to speech for some children with speech delays. Some children may stim through adulthood and others may develop different coping strategies through several therapy methods offered to individuals with ASD.

1.2 Treatment Options for ASD as Compared to Music Therapy

Several treatment options are available for individuals with ASD to help alleviate symptoms and strengthen verbal and social skills. No one therapy or treatment is suitable across all individuals with ASD, but certain therapies can cater to an individual's needs based on the symptoms they present as well as how severe a symptom is. Some treatments include behavioral management therapy, cognitive behavior therapy, early intervention, educational and school-based therapies, joint attention therapy, medication treatment, nutritional therapy, occupational therapy, parent-mediated therapy, physical therapy, social skills training, and speech-language therapy (NIH, 2022). According to the CDC, speech and language therapy is the most common therapy used in treating ASD patients (CDC, 2022).

There are several other treatment options for ASD, both chemical and therapeutic. All of the following measures were outlined in "Autism" by Jeremy Parr (Parr, 2010). Chemical and enzymatic means of treatment may include digestive enzymes, omega-3 fish oil, probiotics, vitamin A, vitamin B6 plus magnesium, vitamin C, melatonin, methylphenidate hydrochloride, risperidone, immunoglobulins, memantine, selective serotonin-reuptake inhibitors (SSRIs), secretin, and olanzapine. Therapeutic measures aside from music therapy include early intensive behavioral interventions, autism preschool programs, Child's Talk, More Than Words, Picture exchange

communication system, TEACCH, EarlyBird programs, Floortime, relationship-development intervention, and social skills training.

The majority of the chemical means of treatment show little to no improvement in symptoms of ASD excluding risperidone and methylphenidate hydrochloride. Risperidone helps to improve behavioral symptoms including "irritability, social withdrawal, stereotypy, hyperactivity, and inappropriate speech" (Parr, 2010). Methylphenidate hydrochloride may reduce hyperactivity slightly (Parr, 2010). Most chemical means of treatment pose little to no harm to ASD individuals excluding methylphenidate hydrochloride, risperidone, SSRIs, and secretin. Methylphenidate hydrochloride poses the risk of " reduced appetite, difficulty sleeping, abdominal discomfort, and irritability" (Parr, 2010). Risks of risperidone include weight gain and increased serum prolactin levels (Parr, 2010). Prolonged increase of prolactin levels can

> "...cause the production of breast milk in men and in women who are not pregnant and breastfeeding. In women, too much prolactin can also cause menstrual problems and infertility (the inability to get pregnant). In men, it can lead to lower sex drive and erectile dysfunction" (Medline Plus, 2022).

SSRIs can harm ASD patients by increasing agitation, hostility, and suicidal ideation (Parr, 2010). Finally, secretin may produce minor irritability, hyperactivity, and vomiting (Parr, 2010).

Other non-traditional therapies being explored include dance therapy and yoga therapy. In addition to these treatments, music therapy is under review, which is the focus of this

study. Other therapeutic measures pose no threat to ASD patients; however, music therapy holds an advantage over these other therapeutic methods in that it combines the methods of behavioral, social, educational, and relational therapies into one central therapy rather than several separate therapies. The patient can attend one session without feeling overwhelmed and gain the same benefits instead of using several therapies.

1.3 Music Therapy

Music therapy is "the use of music to address the physical, emotional, cognitive, and social needs of a group or individual" (Walworth, 2007). Music therapy appears to be an effective treatment for individuals with ASD since the disorder impairs social, emotional, and cognitive abilities. Music therapy sessions utilize improvisational techniques, prepared pieces, and musical games to build trust with the therapist. Once trust is established, the music therapist works to build social and communication skills. Music therapy also aids patients in expressing feelings of frustration or confusion in an appropriate manner to aid with the outbursts associated with autistic individuals. While music therapy helps with social and communicative skills, organized music also aids ASD individuals with focusing their attention on a task. Music therapists may include several different musical options in therapy sessions including hand drums, vocals, stringed instruments, recorders, or other percussion and wind instruments. Music therapy is a low-risk treatment for ASD patients; however, music therapy may do more harm than good for some patients. Overstimulation can cause an emotional breakdown and cause frustration for the patient. Music therapy is an excellent option for treatment, but the amount of stimulation administered to each individual must be considered for better outcomes.

1.4 Other Conditions Using Music Therapy

Music therapy is also used with several other mental health disorders including depression, anxiety, schizophrenia, and dementia. “Music therapy added to treatment as usual (TAU) seems to improve depressive symptoms compared with TAU alone. Music therapy also shows efficacy in decreasing anxiety levels and improving functioning of depressed individuals.” (Aalbers, et al., 2017). Like ASD, music therapy decreases the mental symptoms of depression and anxiety while introducing new methods of controlling depressive episodes. For individuals diagnosed with dementia, one source states, “After meta-analysis, it was shown that the intervention with music improves cognitive function in people living with dementia, as well as quality of life after the intervention and long-term depression” (Moreno-Morales, 2020). Overall, for mental disorders, music therapy is suspected to be successful in symptom relief and providing patients with new coping mechanisms.

Other uses for music therapy include use during child labor, in Neonatal Intensive Care Units, treating pain in post-operative settings, and integrating music therapy into physical therapy. A meta-analysis reviewed how music therapy affected women in labor, especially first-time mothers, in regard to anxiety and pain with overall results showing a decrease in pain and anxiety during labor (Santiváñez-Acosta, et al., 2020). Music therapy in NICU settings was used to help with sucking reinforcement and “multimodal stimulation” (Standley, 2012). In regard to post-operative pain, music therapy was most effective when the music was chosen by the patient. MT helped reduce anxiety and significantly reduce pain (Lin, et al., 2020).

Music therapy can be used in conjunction with physical therapy. “Music encourages participation in exercises and activities. Music can ease the discomfort and difficulty associated with exercise and therapy activities and help ensure consistent participation” **(**Ramsey, et al., 2000). Participation from pediatric patients, specifically, can pose a challenge to physical therapy methods in children with disabilities and injuries. Music therapy offers a more effective way of completing physical therapy exercises in children. The main goals of integrating music therapy with physical therapy include “improving strength, range of motion, balance, communication, and cognition” (Ramsey, et al., 2000). Music therapy provides communication and cognition improvement while physical therapy offers improvement in strength, motion, and balance. As stated before, music therapy offers a holistic approach to healing individuals rather than solely treating the body, or one issue at a time.

1.5 Goal of the Current Study

The goal of this study is to explore studies completed in the past to make assumptions about the effectiveness of music therapy to be used as a treatment for individuals with ASD. The study tries to find any flaws with music therapy and reasonably judge if it is a viable treatment. Voices of concern for further research are considered to ultimately defend the position of the study in the final standings of the systematic review.

Methods

Articles were reached using the PubMed search engine on September 11, 2021. No filters were applied in the PubMed engine. The terms “Music therapy autism” were entered in that order with no commas or separate from each other. From here, each article was read for content relevancy. 36 articles were removed from the list for several different reasons including duplication of a previous article, irrelevant topic, and therapy not related to music therapy. Some studies were fairly close to the current study, but they were included in the analysis due to difference in content matter. The remaining articles were examined to determine whether they support efficacy of music therapy as a treatment for ASD. Three categories for support status are used: those who do support, those who are neutral, and those who do not support music therapy as a treatment for ASD. Some studies stressed the importance of further research on the treatment— these articles were noted separately from their support status.

Results

The initial search discovered 188 articles. 36 were removed in initial screening by title and abstract. A total of 151 articles were fully read and examined. 120 of 151 articles supported music therapy as a viable therapy for patients with Autism Spectrum Disorder. Of these 120 supporting articles, 36 suggest further research would be needed to fully support music therapy in the treatment of ASD. 20 articles hold a neutral stance on the use of music therapy. Of these 20, 8 suggest further research would be needed to support music therapy as a treatment for ASD. The neutral and supporting status articles suggesting further research are outlined in Table 2. The remaining 11 articles assessed the effectiveness of music therapy, and they did not support music therapy as a treatment option for patients with ASD.

Article #	Title	Authors	Support Status
1	Music therapy for people with autism spectrum disorder	Geretsegger M, Elefant C, Mössler KA, Gold C.	Supports
2	Music therapy for children with autism: investigating social behaviour through music	Sharda M, Silani G, Specht K, Tillmann J, Nater U, Gold C.	Supports
3	History of music therapy treatment interventions for children with autism	Reschke-Hernández AE.	Neutral
4	Music Therapy for Children With Autism Spectrum Disorder	Broder-Fingert S, Feinberg E, Silverstein M.	Neutral
5	Autism Spectrum Disorder: Classification, diagnosis and therapy	Sharma SR, Gonda X, Tarazi FI.	Supports

6	Effects of Improvisational Music Therapy vs Enhanced Standard Care on Symptom Severity Among Children With Autism Spectrum Disorder: The TIME-A Randomized Clinical Trial	Bieleninik L, Geretsegger M, Mössler K, Assmus J, Thompson G, Gattino G, Elefant C, Gottfried T, Igliozzi R, Muratori F, Suvini F, Kim J, Crawford MJ, Odell-Miller H, Oldfield A, Casey Ó, Finnemann J, Carpente J, Park AL, Grossi E, Gold C; TIME-A Study Team.	Does not support
7	Attunement in Music Therapy for Young Children with Autism: Revisiting Qualities of Relationship as Mechanisms of Change	Mössler K, Schmid W, Aßmus J, Fusar-Poli L, Gold C.	Does not support
8	Social outcomes in children with autism spectrum disorder: a review of music therapy outcomes	LaGasse AB.	Supports
9	Music Therapy and Other Music-Based Interventions in Pediatric Health Care: An Overview	Stegemann T, Geretsegger M, Phan Quoc E, Riedl H, Smetana M.	Supports
10	Assessing the Impact of Music Therapy on Sensory Gating and Attention in Children With Autism: A Pilot and Feasibility Study	LaGasse AB, Manning RCB, Crasta JE, Gavin WJ, Davies PL.	Supports
11	Effects of a music therapy group intervention on enhancing social skills in children with autism	LaGasse AB.	Supports
12	The potential role of rhythmic entrainment and music therapy intervention for individuals with autism spectrum disorders	Bharathi G, Jayaramayya K, Balasubramanian V, Vellingiri B.	Supports
13	Music improves social communication and auditory-motor connectivity in children with autism	Sharda M, Tuerk C, Chowdhury R, Jamey K, Foster N, Custo-Blanch M, Tan M, Nadig A, Hyde K.	Supports
14	International multicentre randomised controlled trial of improvisational music therapy for children with autism spectrum disorder: TIME-A study	Crawford MJ, Gold C, Odell-Miller H, Thana L, Faber S, Assmus J, Bieleninik Ł, Geretsegger M, Grant C, Maratos A, Sandford S, Claringbold A, McConachie H, Maskey M, Mössler KA, Ramchandani P, Hassiotis A.	Does not support
15	Music therapy: An effective approach in improving social skills of children with autism	Ghasemtabar SN, Hosseini M, Fayyaz I, Arab S, Naghashian H, Poudineh Z.	Supports
16	A randomized controlled trial of 25 sessions comparing music therapy and music listening for children with autism spectrum disorder	Rabeyron T, Robledo Del Canto JP, Carasco E, Bisson V, Bodeau N, Vrait FX, Berna F, Bonnot O.	Supports
17	Autism	Parr J.	Neutral

18	Music therapy for children and adolescents with behavioural and emotional problems: a randomised controlled trial	Porter S, McConnell T, McLaughlin K, Lynn F, Cardwell C, Braiden HJ, Boylan J, Holmes V; Music in Mind Study Group.	Neutral
19	Music therapy in the assessment and treatment of autistic spectrum disorder: clinical application and research evidence	Wigram T, Gold C.	Supports
20	Neurophysiology and neurobiology of the musical experience	Boso M, Politi P, Barale F, Enzo E.	Neutral
21	Music Therapy and Social Skills in Autism: Underlying Biological Mechanisms	Fluegge K.	Neutral
22	Music-Evoked Reward and Emotion: Relative Strengths and Response to Intervention of People With ASD	Quintin EM.	Supports
23	Why is music therapeutic for neurological disorders? The Therapeutic Music Capacities Model	Brancatisano O, Baird A, Thompson WF.	Supports
24	Music therapy for autistic spectrum disorder	Gold C, Wigram T, Elefant C.	Supports
25	Salivary α-amylase as a marker of stress reduction in individuals with intellectual disability and autism in response to occupational and music therapy	Poquérusse J, Azhari A, Setoh P, Cainelli S, Ripoli C, Venuti P, Esposito G.	Supports
26	Effectiveness of cognitive, developmental, and behavioural interventions for Autism Spectrum Disorder in preschool-aged children: A systematic review and meta-analysis	Su Maw S, Haga C.	Supports
27	Interventions Targeting Sensory Challenges in Autism Spectrum Disorder: A Systematic Review	Weitlauf AS, Sathe N, McPheeters ML, Warren ZE.	Supports
28	The Therapeutic Relationship as Predictor of Change in Music Therapy with Young Children with Autism Spectrum Disorder	Mössler K, Gold C, Aßmus J, Schumacher K, Calvet C, Reimer S, Iversen G, Schmid W.	Supports
29	Music interventions for children with autism: narrative review of the literature	Simpson K, Keen D.	Supports
30	Beyond Broadway: Analysis of Qualitative Characteristics of and Individual Responses to Creatively Able, a Music and Movement Intervention for Children with Autism	Lakes KD, Neville R, Vazou S, Schuck SEB, Stavropoulos K, Krishnan K, Gonzalez I, Guzman K, Tavakoulnia A, Stehli A, Palermo A.	Supports

31	Music therapy services for individuals with autism spectrum disorder: a survey of clinical practices and training needs	Kern P, Rivera NR, Chandler A, Humpal M.	Supports
32	Music therapy as social skill intervention for children with comorbid ASD and ID: study protocol for a randomized controlled trial	Yum YN, Lau WK, Poon K, Ho FC.	Supports
33	Auditory integration training and other sound therapies for autism spectrum disorders (ASD)	Sinha Y, Silove N, Hayen A, Williams K.	Does not support
34	The effect of music therapy sessions on the interactions between children and their parents and how to measure it, with reference to attachment theory	Wang S, Oldfield A.	Support
35	Randomised controlled trial of improvisational music therapy's effectiveness for children with autism spectrum disorders (TIME-A): study protocol	Geretsegger M, Holck U, Gold C.	Support
36	Analysing change in music therapy interactions of children with communication difficulties	Spiro N, Himberg T.	Support
37	The use of music therapy within the SCERTS model for children with Autism Spectrum Disorder	Walworth DD.	Support
38	Music therapy assessment in school settings: a preliminary investigation	Wilson BL, Smith DS.	Support
39	Emotional, motivational and interpersonal responsiveness of children with autism in improvisational music therapy	Kim J, Wigram T, Gold C.	Support
40	Interventions Targeting Sensory Challenges in Children With Autism Spectrum Disorder—An Update	Weitlauf AS, Sathe NA, McPheeters ML, Warren Z.	Support
41	Long-Term Perspectives of Family Quality of Life Following Music Therapy With Young Children on the Autism Spectrum: A Phenomenological Study	Thompson GA.	Support
42	Common Characteristics of Improvisational Approaches in Music Therapy for Children with Autism Spectrum Disorder: Developing Treatment Guidelines	Geretsegger M, Holck U, Carpente JA, Elefant C, Kim J, Gold C.	Support

43	An analysis of music therapy program goals and outcomes for clients with diagnoses on the autism spectrum	Kaplan RS, Steele AL.	Support
44	Feasibility of a Trial on Improvisational Music Therapy for Children with Autism Spectrum Disorder	Geretsegger M, Holck U, Bieleninik Ł, Gold C.	Support
45	Effect of long-term interactive music therapy on behavior profile and musical skills in young adults with severe autism	Boso M, Emanuele E, Minazzi V, Abbamonte M, Politi P.	Support
46	Music Therapists' Perceptions of the Therapeutic Potentials Using Music When Working With Verbal Children on the Autism Spectrum: A Qualitative Analysis	Epstein S, Elefant C, Thompson G.	Support
47	Using the SCERTS model assessment tool to identify music therapy goals for clients with autism spectrum disorder	Walworth DD, Register D, Engel JN.	Support
48	[Application of music therapy in medicine]	Zárate P, Díaz V.	Support
49	Family-centred music therapy to promote social engagement in young children with severe autism spectrum disorder: a randomized controlled study	Thompson GA, McFerran KS, Gold C.	Support
50	A survey of the use of aided augmentative and alternative communication during music therapy sessions with persons with autism spectrum disorders	Gadberry AL.	Support
51	Using embedded music therapy interventions to support outdoor play of young children with autism in an inclusive community-based child care program	Kern P, Aldridge D.	Support
52	Evaluation of a Music Therapy Social Skills Development Program for Youth with Limited Resources	Pasiali V, Clark C.	Support
53	The effects of music therapy incorporated with applied behavior analysis verbal behavior approach for children with autism spectrum disorders	Lim HA, Draper E.	Supports
54	Effects of music on vocal stereotypy in children with autism	Lanovaz MJ, Sladeczek IE, Rapp JT.	Does not support

55	A review of "music and movement" therapies for children with autism: embodied interventions for multisystem development	Srinivasan SM, Bhat AN.	Supports
56	A Preliminary Investigation of a Specialized Music Therapy Model for Children with Disabilities Delivered in a Classroom Setting	Mendelson J, White Y, Hans L, Adebari R, Schmid L, Riggsbee J, Goldsmith A, Ozler B, Buehne K, Jones S, Shapleton J, Dawson G.	Supports
57	Increasing social responsiveness in a child with autism. A comparison of music and non-music interventions	Finnigan E, Starr E.	Supports
58	The Influence of Music on Facial Emotion Recognition in Children with Autism Spectrum Disorder and Neurotypical Children	Brown LS.	Neutral
59	Mental health implications of music: insight from neuroscientific and clinical studies	Lin ST, Yang P, Lai CY, Su YY, Yeh YC, Huang MF, Chen CC.	Supports
60	Music Therapy for Children With Autistic Spectrum Disorder and/or Other Neurodevelopmental Disorders: A Systematic Review	Mayer-Benarous H, Benarous X, Vonthron F, Cohen D.	Supports
61	The effects of improvisational music therapy on joint attention behaviors in autistic children: a randomized controlled study	Kim J, Wigram T, Gold C.	Supports
62	Insular function in autism: Update and future directions in neuroimaging and interventions	Nomi JS, Molnar-Szakacs I, Uddin LQ.	Neutral
63	Supporting coordination of children with ASD using neurological music therapy: A pilot randomized control trial comparing an elastic touch-display with tambourines	Cibrian FL, Madrigal M, Avelais M, Tentori M.	Supports
64	Reliability of the Music in Everyday Life (MEL) Scale: A Parent-Report Assessment for Children on the Autism Spectrum	Gottfried T, Thompson G, Elefant C, Gold C.	Supports
65	Complementary and Alternative Therapies for Autism Spectrum Disorder	Brondino N, Fusar-Poli L, Rocchetti M, Provenzani U, Barale F, Politi P.	Supports
66	Music in intervention for children and adolescents with autism: a meta-analysis	Whipple J.	Supports
67	Music intervention as system: reversing hyper systemising in autism spectrum disorders to the	Jaschke AC.	Neutral

	comprehension of music as intervention		
68	Parents and Young Children with Disabilities: The Effects of a Home-Based Music Therapy Program on Parent-Child Interactions	Yang YH.	Supports
69	Social Skills Instruments for Children with Autism Spectrum Disorder: A Critical Interpretive Synthesis	West R, Silverman MJ.	Supports
70	What do Cochrane systematic reviews say about interventions for autism spectrum disorders?	Lyra L, Rizzo LE, Sunahara CS, Pachito DV, Latorraca COC, Martimbianco ALC, Riera R.	Does not support
71	Music-based Autism Diagnostics (MUSAD) - A newly developed diagnostic measure for adults with intellectual developmental disabilities suspected of autism	Bergmann T, Sappok T, Diefenbacher A, Dames S, Heinrich M, Ziegler M, Dziobek I.	Supports
72	Integrative Approaches to Caring for Children with Autism	Klein N, Kemper KJ.	Supports
73	The effect of a music therapy social skills training program on improving social competence in children and adolescents with social skills deficits	Gooding LF.	Supports
74	Music therapy, a description of process: engagement and avoidance in five people with learning disabilities	Toolan PG, Coleman SY.	Supports
75	[Examples of the use of music in clinical medicine]	Myskja A, Lindbaek M.	Supports
76	The effect of background music and song texts on the emotional understanding of children with autism	Katagiri J.	Supports
77	Joint engagement and movement: Active ingredients of a music-based intervention with school-age children with autism	Latif N, Di Francesco C, Custo-Blanch M, Hyde K, Sharda M, Nadig A.	Supports
78	Introduction to The neurosciences and music IV: learning and memory	Altenmüller E, Demorest SM, Fujioka T, Halpern AR, Hannon EE, Loui P, Majno M, Oechslin MS, Osborne N, Overy K, Palmer C, Peretz I, Pfordresher PQ, Särkämö T, Wan CY, Zatorre RJ.	Supports
79	Response to "brief report: the effects of Tomatis sound therapy on language in children with	Gerritsen J.	Neutral

	autism", July 3, 2007, Journal of Autism and Developmental Disorders		
80	Music research with children and youth with disabilities and typically developing peers: a systematic review	Brown LS, Jellison JA.	Supports
81	Novel and emerging treatments for autism spectrum disorders: a systematic review	Rossignol DA.	Supports
82	Joint attention responses of children with autism spectrum disorder to simple versus complex music	Kalas A.	Supports
83	Effect of "developmental speech and language training through music" on speech production in children with autism spectrum disorders	Lim HA.	Supports
84	Questioning a Previous Autism Spectrum Disorder Diagnosis: Can You "Lose" the Diagnosis?	Zaro C, Jeon H, Harstad E, Conrad C, Solomon D, Augustyn M.	Supports
85	A pilot study on the efficacy of melodic based communication therapy for eliciting speech in nonverbal children with autism	Sandiford GA, Mainess KJ, Daher NS.	Supports
86	Auditory integration training and other sound therapies for autism spectrum disorders	Sinha Y, Silove N, Wheeler D, Williams K.	Neutral
87	The effects of different combinations of perceptual-motor exercises, music, and vitamin D supplementation on the nerve growth factor in children with high-functioning autism	Moradi H, Sohrabi M, Taheri H, Khodashenas E, Movahedi A.	Supports
88	A review of recent reports on autism: 1000 studies published in 2007	Hughes JR.	Supports
89	Age Related Differences in Response to Music-Evoked Emotion Among Children and Adolescents with Autism Spectrum Disorders	Heaton P.	Neutral
90	Brief report: the effects of Tomatis sound therapy on language in children with autism	Corbett BA, Shickman K, Ferrer E.	Does not support
91	Daily life therapy: a Japanese model for educating children with autism	Quill K, Gurry S, Larkin A.	Supports

92	[Music and brain (II): evidence of musical training in the brain]	Soria-Urios G, Duque P, García-Moreno JM.	Supports
93	The effect of musical attention control training (MACT) on attention skills of adolescents with neurodevelopmental delays: a pilot study	Pasiali V, LaGasse AB, Penn SL.	Supports
94	To What Extent Do Practitioners Need to Treat Stereotypy During Academic Tasks?	Cook JL, Rapp JT.	Supports
95	Effectiveness of Non-Pharmacological Interventions on Stereotyped and Repetitive Behaviors of Pre-school Children With Autism: A Systematic Review	Zarafshan H, Salmanian M, Aghamohammadi S, Mohammadi MR, Mostafavi SA.	Supports
96	Autism as a neurodevelopmental disorder affecting communication and learning in early childhood: prenatal origins, post-natal course and effective educational support	Trevarthen C.	Supports
97	The Place of Complementary Medicine in the Treatment of Autistic Children	Konaç ÖT, Baldemir E, İnanç BB, Kara B, Topal Y, Topal H.	Does not support
98	Aut'-sider: the invisible talent of Simona Concaro†	Fusar-Poli L, Rocchetti M, Garda M, Politi P.	Supports
99	Music therapy in the treatment of autistic children. Medico-sociological data from the Federal Republic of Germany	Evers S.	Supports
100	"Bill is now singing": joint engagement and the emergence of social communication of three young children with autism	Vaiouli P, Grimmet K, Ruich LJ.	Supports
101	Auditory-musical processing in autism spectrum disorders: a review of behavioral and brain imaging studies	Ouimet T, Foster NE, Tryfon A, Hyde KL.	Supports
102	Dyadic Drum Playing and Social Skills: Implications for Rhythm-Mediated Intervention for Children with Autism Spectrum Disorder	Yoo GE, Kim SJ.	Supports
103	Sensory Processing and Attention Profiles Among Children With Sensory Processing Disorders and Autism Spectrum Disorders	Crasta JE, Salzinger E, Lin MH, Gavin WJ, Davies PL.	Neutral
104	A case of co-occuring synesthesia, autism, prodigious talent and strong structural brain connectivity	Riedel A, Maier S, Wenzler K, Feige B, Tebartz van Elst L, Bölte S, Neufeld J.	Supports

105	Improving a Parent Coaching Model of Music Interventions for Young Autistic Children	Hernandez Ruiz E, Braden BB.	Supports
106	Rhythm, movement, and autism: using rhythmic rehabilitation research as a model for autism	Hardy MW, Lagasse AB.	Supports
107	Music Improves Social and Participation Outcomes for Individuals With Communication Disorders: A Systematic Review	Boster JB, Spitzley AM, Castle TW, Jewell AR, Corso CL, McCarthy JW.	Supports
108	Do communication disorders extend to musical messages? An answer from children with hearing loss or autism spectrum disorders	Whipple CM, Gfeller K, Driscoll V, Oleson J, McGregor K.	Supports
109	Attenuated adenylosuccinate lyase deficiency: a report of one case and a review of the literature	Jurecka A, Zikanova M, Jurkiewicz E, Tylki-Szymańska A.	Neutral
110	Relaxation response-based yoga improves functioning in young children with autism: a pilot study	Rosenblatt LE, Gorantla S, Torres JA, Yarmush RS, Rao S, Park ER, Denninger JW, Benson H, Fricchione GL, Bernstein B, Levine JB.	Supports
111	Music and handicapped children	Ricketts L.	Supports
112	Illustrating a Supports-Based Approach Toward Friendship With Autistic Students	Vidal V, Robertson S, DeThorne L.	Supports
113	Expanding our understanding of sensory gating in children with autism spectrum disorders	Crasta JE, Gavin WJ, Davies PL.	Supports
114	Spontaneous imitation by children with autism during a repetitive musical play routine	Stephens CE.	Supports
115	Fostering Spontaneous Visual Attention in Children on the Autism Spectrum: A Proof-of-Concept Study Comparing Singing and Speech	Thompson GA, Abel LA.	Supports
116	The long-term effects of auditory training on children with autism	Bettison S.	Supports
117	Child-Robot Interaction in a Musical Dance Game: An Exploratory Comparison Study between Typically Developing Children and Children with Autism	Barnes JA, Park CH, Howard A, Jeon M.	Supports
118	Effects of three types of noncontingent auditory stimulation on vocal stereotypy in children with autism	Saylor S, Sidener TM, Reeve SA, Fetherston A, Progar PR.	Supports
119	Autism treatment survey: services received by children with autism	Hess KL, Morrier MJ, Heflin LJ, Ivey ML.	Neutral

	spectrum disorders in public school classrooms		
120	The utility of assessing musical preference before implementation of noncontingent music to reduce vocal stereotypy	Lanovaz MJ, Rapp JT, Ferguson S.	Supports
121	Infantile autism: patients and their families	DEMyer MK.	Neutral
122	The association of auditory integration training in children with autism spectrum disorders among Chinese: a meta-analysis	Li N, Li L, Li G, Gai Z.	Supports
123	Some aspects of treatment and habilitation of children and adolescents with autistic disorder in Northern-Finland	Kielinen M, Linna SL, Moilanen I.	Supports
124	Use of songs to promote independence in morning greeting routines for young children with autism	Kern P, Wolery M, Aldridge D.	Supports
125	Auditory-motor mapping training as an intervention to facilitate speech output in non-verbal children with autism: a proof of concept study	Wan CY, Bazen L, Baars R, Libenson A, Zipse L, Zuk J, Norton A, Schlaug G.	Supports
126	Evaluation of interventions to reduce multiply controlled vocal stereotypy	Scalzo R, Henry K, Davis TN, Amos K, Zoch T, Turchan S, Wagner T.	Does not support
127	[A way out of speechlessness. Music therapy opens new life chances to mute and multiple handicapped children]	Kirchner-Enders S.	Neutral
128	[Musical dialogue--music therapy in social contact disorder and communication difficulties]	Schumacher K.	Supports
129	The effects of noncontingent music and response interruption and redirection on vocal stereotypy	Gibbs AR, Tullis CA, Thomas R, Elkins B.	Supports
130	Adjunctive hypnotherapy with an autistic boy	Gardner GG, Tarnow JD.	Supports
131	The use of music with autistic children	Baker BS.	Supports
132	Efficacy of a sound-based intervention with a child with an autism spectrum disorder and auditory sensory over-responsivity	Gee BM, Thompson K, St John H.	Supports
133	Leaving concert hall for clinic, therapists now test music's 'charms'	Marwick C.	Neutral

134	Sound attenuation and preferred music in the treatment of problem behavior maintained by escape from noise	Kettering TL, Fisher WW, Kelley ME, LaRue RH.	Supports
135	Visual versus auditory (musical) stimulus preferences in autistic children: a pilot study	Thaut MH.	Supports
136	Some motivational properties of sensory stimulation in psychotic children	Rincover A, Newsom CD, Lovaas OI, Koegel RL.	Supports
137	Further evaluation of methods to identify matched stimulation	Rapp JT.	Supports
138	Auditory integration training for children with autism: no behavioral benefits detected	Mudford OC, Cross BA, Breen S, Cullen C, Reeves D, Gould J, Douglas J.	Does not support
139	Musically adapted social stories to modify behaviors in students with autism: four case studies	Brownell MD.	Supports
140	Auditory integration training and facilitated communication for autism. American Academy of Pediatrics. Committee on Children with Disabilities		Does not support
141	The effects of embodied rhythm and robotic interventions on the spontaneous and responsive social attention patterns of children with Autism Spectrum Disorder (ASD): A pilot randomized controlled trial	Srinivasan SM, Eigsti IM, Neelly L, Bhat AN.	Supports
142	The use of music and colour theory as a behaviour modifier	Barber CF.	Supports
143	The musical life of an autistic boy	O'Connell TS.	Supports
144	[Effects of auditory integrative training on autistic children]	Zhang GQ, Gong Q, Zhang FL, Chen SM, Hu LQ, Liu F, Cui RH, He L.	Supports
145	Adapted melodic intonation therapy: a case study of an experimental language program for an autistic child	Miller SB, Toca JM.	Supports
146	Reinforcement of autistic children's responses to music	Schmidt DC, Franklin R, Edwards JS.	Supports
147	A comparison of the effects of rhythm and robotic interventions on repetitive behaviors and affective states of children with Autism Spectrum Disorder (ASD)	Srinivasan SM, Park IK, Neelly LB, Bhat AN.	Supports
148	The limits and motivating potential of sensory stimuli as reinforcers for autistic children	Ferrari M, Harris SL.	Supports

149	[Play, music and potential space in psychotic children]	Dubois Y, Corti H.	Supports
150	[Voice, sounds and music; allies for taking care]	Lovino M, Kels J, Reynal P.	Neutral
151	[Music in the treatment of the autistic child (author's transl)]	Katanec N.	Neutral

Table 1-Summary of articles reviewed including support status

Article number	Article Title	Support Status
1	Music therapy for people with autism spectrum disorder	Supports
2	Music therapy for children with autism: investigating social behaviour through music	Supports
3	Effects of a music therapy group intervention on enhancing social skills in children with autism	Supports
4	The potential role of rhythmic entrainment and music therapy intervention for individuals with autism spectrum disorders	Supports
5	Music improves social communication and auditory-motor connectivity in children with autism	Supports
6	International multicentre randomised controlled trial of improvisational music therapy for children with autism spectrum disorder: TIME-A study	Supports
7	Effectiveness of cognitive, developmental, and behavioural interventions for Autism Spectrum Disorder in preschool-aged children: A systematic review and meta-analysis	Supports
8	Interventions Targeting Sensory Challenges in Autism Spectrum Disorder: A Systematic Review	Supports
9	Music interventions for children with autism: narrative review of the literature	Supports
10	Randomised controlled trial of improvisational music therapy's effectiveness for children with autism spectrum disorders (TIME-A): study protocol	Supports
11	Music therapy assessment in school settings: a preliminary investigation	Supports
12	Interventions Targeting Sensory Challenges in Children With Autism Spectrum Disorder—An Update	Supports
13	Common Characteristics of Improvisational Approaches in Music Therapy for Children with Autism Spectrum Disorder: Developing Treatment Guidelines	Supports
14	Feasibility of a Trial on Improvisational Music Therapy for Children with Autism Spectrum Disorder	Supports
15	A survey of the use of aided augmentative and alternative communication during music therapy sessions with persons with autism spectrum disorders	Supports
16	Evaluation of a Music Therapy Social Skills Development Program for Youth with Limited Resources	Supports
17	A Preliminary Investigation of a Specialized Music Therapy Model for Children with Disabilities Delivered in a Classroom Setting	Supports
18	Mental health implications of music: insight from neuroscientific and clinical studies	Supports
19	Music Therapy for Children With Autistic Spectrum Disorder and/or Other Neurodevelopmental Disorders: A Systematic Review	Supports

20	Social Skills Instruments for Children with Autism Spectrum Disorder: A Critical Interpretive Synthesis	Supports
21	Integrative Approaches to Caring for Children with Autism	Supports
22	The effect of a music therapy social skills training program on improving social competence in children and adolescents with social skills deficits	Supports
23	The effect of musical attention control training (MACT) on attention skills of adolescents with neurodevelopmental delays: a pilot study	Supports
24	Effectiveness of Non-Pharmacological Interventions on Stereotyped and Repetitive Behaviors of Pre-school Children With Autism: A Systematic Review	Supports
25	Auditory-musical processing in autism spectrum disorders: a review of behavioral and brain imaging studies	Supports
26	Improving a Parent Coaching Model of Music Interventions for Young Autistic Children	Supports
27	Rhythm, movement, and autism: using rhythmic rehabilitation research as a model for autism	Supports
28	Music Improves Social and Participation Outcomes for Individuals With Communication Disorders: A Systematic Review	Supports
29	Do communication disorders extend to musical messages? An answer from children with hearing loss or autism spectrum disorders	Supports
30	Spontaneous imitation by children with autism during a repetitive musical play routine	Supports
31	The long-term effects of auditory training on children with autism	Supports
32	Child-Robot Interaction in a Musical Dance Game: An Exploratory Comparison Study between Typically Developing Children and Children with Autism	Supports
33	The utility of assessing musical preference before implementation of noncontingent music to reduce vocal stereotypy	Supports
34	Visual versus auditory (musical) stimulus preferences in autistic children: a pilot study	Supports
35	Some motivational properties of sensory stimulation in psychotic children	Supports
36	The use of music and colour theory as a behaviour modifier	Supports
37	Music therapy for children and adolescents with behavioural and emotional problems: a randomised controlled trial	Neutral
38	Neurophysiology and neurobiology of the musical experience	Neutral
39	Insular function in autism: Update and future directions in neuroimaging and interventions	Neutral
40	Auditory integration training and other sound therapies for autism spectrum disorders	Neutral
41	Age Related Differences in Response to Music-Evoked Emotion Among Children and Adolescents with Autism	Neutral
42	Autism treatment survey: services received by children with autism spectrum disorders in public school	Neutral

43	Infantile autism: patients and their families	Neutral
44	Leaving concert hall for clinic, therapists now test music's 'charms'	Neutral

Table 2- Supporting and neutral articles that claim need for further research to fully support music therapy as a treatment for ASD

Discussion

This systematic review found that 79.4% of the total articles support music therapy as a safe, effective, and viable treatment for individuals with Autism Spectrum Disorder. Outcomes from these studies are not homogeneous depending on experiment set up. Some studies with more successful outcomes administered music therapy for longer durations resulting in increased relief of symptoms. 36 of the supporting articles suggested further research is needed to solidify their stance on music therapy as a treatment for ASD via controlled experiments. Few articles suggest more appropriate licensing and education is needed for music therapists to fully meet the needs of ASD patients. The majority of supporting articles suggest that symptoms of ASD including vocal stereotypies, stimming, social communication skills, and emotional control improved after several weeks of repeated music therapy sessions. Trust between therapist and patient as well as patient and parent relations increased over the course of several weeks of therapy sessions.

The neutral stance articles suggest music therapy has the potential for treating patients with ASD. Some neutral articles available for this study were in other languages and only the abstract was available in English. No further information was provided to support further research or provide additional comments concerning individual studies and observations as well as the results from those studies. Other neutral stance articles p

resented results that show little variation in symptom relief when compared to other treatments for ASD patients. One neutral article stated, “In order for music therapy to become recognized as a valid and effective treatment method for children with autism, future researchers should strive to recruit larger sample sizes and increase the number of well-designed comparative studies” (Bieleninik, et al., 2017). Several studies, both supporting and neutral, suggest similar design errors in their studies which inhibits them from being able to fully support music therapy as an ASD treatment.

The articles that do not support music therapy have several reasons for not supporting.

> “Among children with autism spectrum disorder, improvisational music therapy, compared with enhanced standard care, resulted in no significant difference in symptom severity based on the ADOS social affect domain over 5 months. These findings do not support the use of improvisational music therapy for symptom reduction in children with autism spectrum disorder.” (Lyra, et al., 2017)

This is an example of one article not in support, but there are five other articles with fairly similar results. Most articles failing to support music therapy as a treatment option report very little change in symptoms, especially vocal stereotypies, or claim to have “very low quality of evidence” (Bharathi, et al., 2019) from their studies.

There were five articles fairly close to our current study included in order to further support music therapy in treating ASD. Two meta-analyses were included: “Effectiveness of cognitive, developmental, and behavioural interventions for Autism Spectrum Disorder in preschool-aged children: A systematic review and meta-analysis” and “Music in intervention for children and adolescents with autism: a meta-analysis.” The former was

included because it states, “Music therapy appears to be an effective tool for improving social interaction in preschool-aged children with ASD” (Haga, et al., 2018). The study itself focuses on the communication and behavioral skills as they fare through several different durations of music therapy. This study concludes that shorter duration, lower intensity music therapy sessions were the most effective in managing symptoms of ASD in children. The latter meta-analysis analyzed nine studies comparing music to non-musical treatment conditions. This study concludes, “All effects were in a positive direction, indicating benefits of the use of music in intervention” (Whipple, 2004). Both meta-analyses support the current systematic review conducted.

In addition to the two meta-analyses, three systematic reviews were included close to the present topic: “Music Therapy for Children With Autistic Spectrum Disorder and/or Other Neurodevelopmental Disorders: A Systematic Review,” “Autism,” and “Music research with children and youth with disabilities and typically developing peers: a systematic review.” The first study was included because it did not focus solely on ASD but discovered music therapy and its use with other neurodevelopmental disorders (NDDs) such as intellectual disability, communication disorder, developmental coordination disorder, specific learning disorder, and attention/deficit hyperactivity disorder. While covering a broad spectrum of disorders, ASD is covered most thoroughly across the 39 articles included in their study. The conclusion of this study states, “Improvisational music therapy in children with NDDs appears relevant for individuals with both ASD and ID” (Mayer-Benarous, et al., 2021). “Autism” was included because it covered a wide assortment of treatments for ASD patients including applied behavioral analysis, auditory integration training, preschool programs, different diets, cognitive behavioral therapy, enzyme

therapies, prescription treatments, relationship development interventions, social skills training, and music therapy. The study poses no support or disagreement with the use of music therapy in treating autism, “We found no clinically important results from RCTs, quasirandomised trials, or cohort studies about the effects of music therapy on the symptoms of autism in children” (Parr, 2010). The final systematic review is included because it, too, covers a wide range of NDDs. This study included 45 articles covering several NDDs including ASD. The conclusion of the study states, “The findings from this review and comparisons to the earlier review reveal important implications for practices with children with autism and preparation of researchers to design and conduct studies in inclusive music settings” (Brown, 2012). All four meta-analyses and systematic reviews support the use of music therapy in reducing symptom severity in ASD individuals, but they all suggest further research is necessary to fully understand which duration, intensity, and type of music therapy works best in treating ASD. The current study differs from the systematic reviews and meta-analyses because it focuses solely on music therapy and its effects on individuals with ASD.

The duration of music therapy session attendance may be correlated with symptom reduction in ASD patients. Different stages of music therapy present different decreases in symptoms. In one study, communication skills improved faster than normal speech therapy. “The MBCT group progressed significantly in number of verbal attempts after weeks 1 through 4 and number of correct words after weeks 1 and 3, while the traditional group progressed significantly after weeks 4 and 5” (Sandiford, et al., 2013). Another study suggested that around 8-12 weeks of music intervention, social communication further progressed (Sharda, et al., 2018). The longer an individual with ASD engages in music

therapy, the further symptoms are reduced due to increased trust with the therapist. Patients can gain skills to help them cope in upsetting situations which help in reducing stereotypies and tantrums when stressed. Like most therapies, the longer the exposure to the therapy and more methods learned from the therapist, the more successful the individual is after discharge.

Music therapy helps reduce specific symptoms such as stereotypies, relationships between parent and client as well as therapist and client, increase social communication skills, and introduce new ways to manage stress in unfamiliar situations. In regard to stereotypies, specifically vocal stereotypies, they decreased with music therapy treatment. “For two participants, stereotypy decreased when instructors provided standard instruction plus antecedent intervention for stereotypy with continuous music” (Cook, et al., 2020). In this study, music was implemented in educational settings. This treatment reduced vocal stereotypy. A more compelling article states, “The music condition was the most effective in decreasing vocal stereotypy to near-zero levels, resulted in the highest parent social validity ratings, and was selected as most preferred in treatment preference evaluations” (Saylor, et al., 2012). This study touched on two areas of interest: vocal stereotypies and parent social interactions. In both symptoms, music therapy decreased intensity and increased social skills. Again, on vocal stereotypies,

> “For 3 of the 4 participants, high preference music (a) produced lower levels of vocal stereotypy than low-preference music and (b) reduced vocal stereotypy when compared to a no-interaction condition. Results underscore the potential

importance of assessing musical preference prior to using noncontingent music to reduce vocal stereotypy" (Lanovaz, et al., 2011).

Not only did music therapy decrease vocal stereotypies in patients but allowing them to choose their own music aided in the decrease of stereotypies in patients. Three more articles provide evidence that supports the notion that music therapy successfully reduces vocal stereotypy associated with ASD patients: "Evaluation of interventions to reduce multiple controlled vocal stereotypy," "The effects of noncontingent music and response interruption and redirection on vocal stereotypy," and "Further evaluation of methods to identify matched stimulation."

Parent-child relationship quality increased following music therapy sessions. "Furthermore, in secondary outcome areas, music therapy may contribute to increasing social adaptation skills in children with ASD and to promoting the quality of parent-child relationships" (Geretsegger, et al., 2014). Through communication in therapy sessions with the therapist, other social relationships are promoted especially in the home. "Mothers perceived long-term benefits to social relationships within the family, leading to perceived enrichment in child and family quality of life following music therapy sessions" (Thompson, 2018). Music therapy is seen again succeeding in promoting healthy relationships in the home setting by offering communication tools through the use of music.

A specific use for music therapy is to increase communication skills in non-verbal ASD children. Ten articles support the increase in communication after attending music therapy sessions. "The overall results indicated that improvisational music therapy was more

effective at facilitating joint attention behaviors and non-verbal social communication skills in children than play" (Kim, et al., 2009). Engaging in communication in therapy allowed for non-verbal ASD children to gain social communication skills better than through play with other children. "We found the music therapeutic relationship to be an important predictor of the development of social skills, as well as communication and language specifically" (Mössler, et al., 2019). Increased communication skills are used as benchmarks for success in music therapy sessions with ASD patients.

Conclusion

Overall, music therapy is overwhelmingly supported as a treatment for individuals with autism spectrum disorder. Around 74% of the articles pulled from the PubMed website show support for music therapy as a treatment option. Though there are some articles suggesting there is still work to do, it may be assumed that the articles assessed in this systematic review offer support to consider music therapy as an effective treatment able to be used with patients with ASD to alleviate symptoms such as stereotypies, specifically vocal stereotypies, stimming, and to help increase social communication skills. Music therapy and improvisational music can be issued to help ASD patients better control their emotions when in stressful situations, aid in increasing the quality of relationships between child and parent and establish trust between music therapist and patient.

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