



The Therapeutic Power of Music: A Review of Music Therapy for Autism Spectrum Disorder

Müziğin Terapötik Gücü: Otizm Spektrum Bozukluğu için Müzik Terapisinin Gözden Geçirilmesi

Nikash Chandra¹, Atiksh Chandra²

¹ Cypress Bay High School, Weston, Florida, USA

² Saint Louis University, Saint Louis, Missouri, USA

Abstract

Autism Spectrum Disorder (ASD) is a lifelong developmental condition that is usually identified in early childhood. It's not an illness or disease, but a different way of experiencing the world, characterized by challenges with repetitive behaviors, communication as well as social interaction. While there's no "cure" for ASD, many effective treatments exist to help individuals build on their strengths and manage challenges. These options, which are tailored to each person's specific needs, include various therapies and, at times, medication. Among these, music therapy stands out as a promising and effective option. Music has a remarkable ability to connect with us on a deeply personal level. It can mirror our current emotions and mood, and even evoke memories and feelings tied to past experiences and our culture. Given the significant potential of music therapies as effective alternatives or complements to traditional pharmacological treatments, their application warrants further investigation across diverse therapeutic contexts. Accordingly, this review aims to analyze current treatment modalities and assess the influence of music therapy on individuals with autism spectrum disorders.

Keywords: Autism spectrum disorder (ASD), music therapy, neurodevelopmental disorders, therapeutic interventions, emotional regulation, communication skills, social interaction

Öz

Otizm Spektrum Bozukluğu (OSB), genellikle erken çocukluk döneminde teşhis edilen, yaşam boyu süren bir gelişimsel bozukluktur. Bu bir hastalık veya rahatsızlık değil, dünyayı farklı bir şekilde deneyimleme biçimidir ve tekrarlayan davranışlar, iletişim ve sosyal etkileşimde zorluklar ile karakterizedir. OSB için bir "tedavi" olmasa da, bireylerin güçlü yönlerini geliştirmelerine ve zorlukları yönetmelerine yardımcı olacak birçok etkili tedavi yöntemi bulunmaktadır. Her bireyin özel ihtiyaçlarına göre uyarlanan bu seçenekler arasında çeşitli terapiler ve bazen de ilaç tedavisi yer almaktadır. Bunlar arasında müzik terapisi, umut verici ve etkili bir seçenek olarak öne çıkmaktadır. Müzik, bizimle derin bir kişisel düzeyde bağlantı kurma konusunda olağanüstü bir yeteneğe sahiptir. Müzik, mevcut duygularımızı ve ruh halimizi yansıtabilir, hatta geçmiş deneyimlerimiz ve kültürümüzle bağlantılı anıları ve duyguları uyandırabilir. Müzik terapilerinin geleneksel farmakolojik tedavilere etkili alternatifler veya tamamlayıcılar olarak önemli potansiyeli göz önüne alındığında, bunların uygulanması çeşitli terapötik bağlamlarda daha fazla araştırma yapılmasını gerektirmektedir. Buna göre, bu derleme mevcut tedavi yöntemlerini analiz etmeyi ve müzik terapisinin otizm spektrum bozukluğu olan bireyler üzerindeki etkisini değerlendirmeyi amaçlamaktadır.

Anahtar Kelimeler: Otizm spektrum bozukluğu, müzik terapisi, duygusal düzenleme, iletişim becerileri, sosyal etkileşim, terapötik müdahaleler, nörogelişimsel bozukluklar



INTRODUCTION

Autism Spectrum Disorder (ASD) is a multifaceted mental disorder that often begins to exhibit symptoms in early childhood and continues throughout one's adulthood.^[1] Being a neurodevelopmental disorder, ASD affects many behavioral attributes. Those with the disorder can experience drawbacks in communication, human interaction, and repetitive behaviors.^[2] ASD can be diagnosed in a spectrum of intensities, making Autism a spectrum disorder: a disorder in which the symptoms vary greatly from person to person. In a mild form, an individual may live productive lives, however, greater severities may require lifelong care.^[3] Empirical data has shown that approximately 1 in 36 children are affected by ASD, however, it is 3.8 times more likely to have prevalence in males.^[4]

While there are numerous symptoms of Autism, certain symptoms interfere with the lives of ASD patients more than others. Cognition, social skills, language, and emotional control are the areas in which ASD patients show major offsets.^[5] All of these areas are controlled by the prefrontal cortex of the brain, located just behind the forehead.^[6] Language is an advanced human capability to use for expression and communication, and the passageway for children to be able to connect with others. Language developmental disorders can interfere with learning and understanding languages from very young ages.^[7] Social deprivation can lead to a series of negative effects including fatal diseases, a weak immune system, and severe anxiety.^[8] One of the most common types of language developmental disorders is Autism. Around 63% of children with ASD experience language impairment.^[9]

ASD is currently classified as a lifelong disorder, with no known complete cure. Many patients with spectrum disorder undergo a series of therapies to mediate the symptoms. While proven to be very effective, therapies can have long-lasting effects that impact a patient's life. Invasive therapies can cause paralysis from bleeding in the spinal cord, or the development of arachnoiditis, a lifelong pain.^[10] Similarly, non-invasive therapies can be just as detrimental psychologically.

Music has been shown to have profound effects on individuals with autism, but what impact does it have on the human brain? Well as it turns out, music is an effective tool in relieving stress. Music possesses the unique ability to match our current emotions, feelings, mood, and can even go as far as relating to past experiences and our culture.^[11] When music connects to our past, it's activating an emotional response in the brain's hippocampus and amygdala.^[12] This can later translate to motivation and act as a reward in our limbic system, creating a feedback loop hooking us to music.

Once we feel a prominent or strong emotion with a sound, it can be hard to let go. In fact, this can work in the exact opposite way. Humans possess the ability to ignore noise like cars on the road or thunderstorms when we sleep, but at the sound of a baby's cry we immediately wake up.

This is because the amygdala can also associate sounds with negative emotions, leading to alertness rather than calm feelings.^[13] This review article will examine current treatment options and explore the impact of music therapy on individuals with ASD.

METHODOLOGY

To evaluate the multifaceted perspectives on the effectiveness of music therapy for ASD, a systematic literature review was conducted from April through September 2025. The search strategy involved a comprehensive query of major academic databases—specifically PubMed, Google Scholar, the Cochrane Library, and JSTOR—utilizing targeted keywords such as "music therapy," "autism spectrum disorder," and "cognitive functions." To ensure the highest level of methodological quality, the search was restricted to English-language publications. Each result underwent a rigorous manual screening process to verify the inclusion of at least one specific music-based intervention and a clearly defined clinical outcome related to ASD.

Current Treatments

Since autism is recognized as a developmental disability, there is currently no definitive cure. It manifests differently in everyone, resulting in a broad range of therapies and treatments available today.

Behavioral Therapies

Applied Behavioral Analysis (ABA) therapy encourages desired behaviors and discourages undesired ones.^[14] By utilizing positive reinforcement, favored actions and behaviors are produced in the long term. This treatment consists of 2 main forms, Discrete Trial Training (DTT) and pivotal response training (PRT).^[15] Discrete Trial Training simplifies tasks that require many basic steps into their rudimentary processes, explaining each level in detail. This allows a series of discrete steps to eventually become a continuous voluntary process. Pivotal response therapy targets pivotal areas of development and focuses on a range of improvements rather than a few. Areas commonly targeted by PRT include motivation, cue response, social interaction, and self-management.^[16]

Recently following the Coronavirus pandemic, many ABA therapists resorted to telehealth as their primary therapy delivery method.^[17] The ability for specialized care to be available frequently can aid in tracking and monitoring progress in patients over long periods of time. Telehealth creates cost effective alternatives for families in poorer socioeconomic brackets and creates environments for spontaneous care.^[18] Technician-delivered telehealth care was found to be beneficial for some clients with autism.^[17] Early Intensive Behavioral Intervention (EIBI) is a form of ABA therapy delivered at a young age to target abnormalities early. When conducting a study on various ASD patients, those treated with EIBI therapy outperformed the other participants in both IQ and adaptive behavior measures.^[19]

The central focus of ABA therapies is to improve many essential skills of ASD diagnosed patients. While involving positive reinforcement, it can also be viewed as punishing autistic behaviors, leading to emotional turmoil. For younger patients, this causes enhanced emotional intelligence drawbacks at an older age. A musical intervention paired with ABA therapies can soothe nerves and provoke a positive and calm mind. Introducing music into a frequent therapy routine can associate positive characteristics with favored traits rather than negative emotions to autistic traits.

Cognitive Therapies

Cognitive Behavioral Therapy (CBT) focuses on formulating a clear idea of thought. A key value is identifying distressing thoughts and coping with challenging feelings. This therapy can find out if certain repeated behaviors provoke problems or strong emotions.^[20] It is effective at targeting anxiety symptoms because it focuses on the relationship between cognitive thought and the actions associated with them.^[21] Accessibility of this therapy can be a problem for many. Apps created to deliver CBT aim to simplify the therapy process and provide further accessibility. A study by Europe PubMed Central shows that taking advantage of telehealth is a hopeful route to continue the progression of CBT in Autism therapies.^[22]

CBT is extremely effective in anxiety related symptom relief for ASD. Russel et al. showed that adults with ASD that were treated with CBT had a significant reduction in symptom severity.^[23] However, being a spectrum disorder, autism has a variety of severities. It is inevitable that certain severity is unable to be lessened by CBT, but rather, some symptoms may even become worse. A research study conducted by Wang et al. selected randomized control trials to deliver CBT and suggests that CBT may improve the symptoms of ASD along with a worsening of social-emotional problems. This occurred in both children and adolescents.^[24]

Drugs

The Food and Drug Administration (FDA) has approved two drugs to lessen irritability in people with ASD: risperidone for children ages five and up and aripiprazole for children ages six to seventeen.^[25] Risperidone is commonly used to treat bipolar I disorder, schizophrenia, mixed episodes, and irritability from ASD. It can calm such symptoms by exhibiting antagonism at dopamine D2 receptors and blocking serotonin receptors to mitigate strong emotions.^[24] Oral tablets are the most common form of administration and are preferred when used on an ASD patient. Other forms include injections.^[24] Aripiprazole is used to lessen symptoms of Tourette syndrome and major depressive disorder as well as the disorders that risperidone can treat.^[25] Like risperidone, aripiprazole attaches to both presynaptic and postsynaptic receptors in the brain to display antagonism.^[26] This drug has a larger impact on symptom mitigation hence why it is recommended for older ages. Like risperidone, it is taken orally.

Aripiprazole has high accuracy in lessening symptom severity. Lauren E Hirsch et. Al. found that the drug reduced irritability and hyperactivity while improving proper speech. Certain children and adolescents showed a reduction in relapses, returning to old problematic behaviors, after being prescribed aripiprazole.^[27] Side effects of aripiprazole are also present. A study in 2023 found that the proper dosage of aripiprazole needed to lessen symptoms in ASD can cause motor symptoms, sedation, and weight gain.^[28] Sedation can lower attention span and concentration, hindering ASD patients in understanding new information. On the contrary, sedation can be an essential component for delivering certain therapies. Music therapy requires focus and less susceptibility to distractions.^[29] When sedated, patients are less likely to go on a free tangent, especially after musical stimulation.

Music Therapy

The use of musical immersions to accomplish steps that assist in the individual needs of a patient to reach their therapeutic goals is defined as music therapy.^[30] A wide range of music therapy techniques result in a scope of potential benefits in outcomes.

The process of conducting music therapy is significantly more diverse than typical therapies. Music therapy can exercise one's ability to listen to, read, compose, play, sing, or repeat music. Formally, the therapy has been divided into four different sections with correlating applications: compositional, improvisation, receptive, and re-creative music therapy.^[31] Compositional music therapy has the client compose vocal or instrumental music with assistance. Improvisational music therapy has the therapist draw conclusions on the client's feelings and mood based on the lyrics or sounds of a unique composition that the client created. In receptive music therapy, rather than the client playing music, the therapist creates music and allows the client to respond freely through body language or words. Finally, Re-creative music therapy encourages the client to recreate pieces of music, a teaching technique commonly used outside of music therapy to help student's perfect musical skills.^[31]

Advantages of Music Therapy

Emotional Control

Across various patient populations, music therapy has emerged as a novel method for improving mood and controlling emotions. Current literature suggests that repeated intervals of music incorporated into a therapy can produce spikes of dopamine leading to increased joy.^[32] Evidence shows that music therapy significantly lessens children's anxiety as well as pain during dental and medical procedures.^[33] For hospice patients, music therapy was found to be highly effective at improving their quality of life and decreasing stress.^[34] Given the indication of sustained development in patient mood via music therapy, it may have application in ASD as well.

Studies have shown that music therapy improves behavioral symptoms like social interaction, emotional expression and recognition, imitation, and social skills. Patients in a Cochrane Library study who participated in music therapy interventions for up to seven months showed significant improvements. They demonstrated more joy, better social adaptation, and a higher quality of parent-child relationships.^[35] Irritability and emotional dysregulation are common symptoms of Autism and can occur on several occasions in a day.^[36] Unlike other therapies, music is accessible to all patients. When incorporated into a therapy, certain sounds and tunes can calm emotions and reduce the severity of such symptoms. The Journal of Environmental Research and Public Health found that patients investigated with music-based interventions experienced less emotional and behavioral problems.^[37]

Several studies over the years have demonstrated the positive effects of music on individuals with ASD. Katagiri^[38] investigated how background music and song lyrics could be used to teach emotional understanding to children with autism. The participants, students in Japan with a primary diagnosis of autism (mean age 11.5 years), showed notable improvements. Music not only enhanced their ability to recognize and comprehend emotions but also supported their ability to maintain focus and attention. Another study by Brown^[39] examined the impact of music with strong emotional valence (happy or sad) on the ability of children with ASD to label emotions shown in facial photographs, as well as on their response times. The findings indicated that music influenced how children with ASD perceived and identified emotions. Challenging behaviors are most commonly observed in individuals with ASD and tend to become more frequent as the severity of intellectual disability increases.^[40] Lundqvist et al.^[41] experimentally investigated the effects of vibroacoustic music on self-injurious, stereotypical, and aggressive-destructive behaviors in 20 individuals with ASD and developmental disabilities. Their findings revealed that vibroacoustic music not only reduced challenging behaviors in children with ASD but also decreased the frequency of self-injurious behaviors. Music therapy stimulates the cortical and subcortical brain areas of children with ASD, which are linked to emotions and rewards.^[42] This type of stimulation has been shown to enhance social motivation and emotional responsiveness in children with autism.^[43] Moreover, participation in musical activities has been shown to strengthen the mirror neuron system in the brain, thereby facilitating the enhancement of imitative behaviors.^[44]

Social Interaction

Individuals with ASD exhibit core impairments in communication and social interaction, which are central to the condition's diagnostic criteria.^[45] Music therapy is proving to be a valuable way to help manage these challenges by leveraging structured musical experiences

to promote engagement, social reciprocity, and emotional expression.^[35] The therapeutic process emphasizes the development of interpersonal relationships through shared musical activities, providing a nonverbal medium through which individuals with ASD can communicate and express themselves more effectively.^[46] By integrating these musical and relational components, music therapy aims to target fundamental social-communicative deficits characteristic of ASD.

Research shows that individuals with ASD and developmental delays often respond to music in unique ways, and a growing body of evidence suggests that music can substantially improve physiological, social and neurological outcomes in children with ASD.^[47] Several parts of one's brain function are heavily impacted by music. By engaging the auditory cortex in the temporal lobe, which processes sensory input and plays a critical role in language, this region serves as a key information-processing hub for patients with ASD. Both musical and non-musical thought are provoked in the temporal lobe when listening to music. This maximizes favorable behavior through synchronized neurological firings.^[48] A random controlled trial by Research in Developmental Disability found that music therapy could effectively aid social skills and have a positive impact on language ability.^[49] Because of an enhanced ability to perceive language with music, test subjects were also able to respond to language signs and key words more effectively.

Music therapy has increasingly been recognized as a crucial intervention in the treatment of ASD, with its rising application reflecting the broader shift toward personalized and individually tailored therapeutic modalities that are essential for addressing the heterogeneity of symptom presentations within the disorder.^[50] In people with ASD, music therapy promotes both nonverbal and verbal communication. It can potentially reduce language development delays and improve the overall quality of their interactions with others. The predictability and rhythm of music can provide a sense of security, making it easier for individuals with ASD to engage and connect.^[51] In a recent study, researchers looked at how music therapy affects children with ASD. Thirty-seven children between the ages of four and seven were randomly assigned to either a music therapy group or a music listening group. After the study, researchers used three different measures to evaluate the results: Clinical Global Impression (CGI), Childhood Autism Rating Scale (CARS) & Aberrant Behavior Checklist (ABC). The study found that the group receiving music therapy showed significant improvements in communication skills and social responsiveness compared to the group that only listened to music.^[52] A recent meta-analysis of 600 people with ASD investigated the effectiveness of music therapy (MT). By comprehensively evaluating data from all eligible research on the subject, the study determined that MT significantly improved social skills in people with ASD.^[48]

This review of music therapy for ASD serves as a vital bridge between scientific research and bedside care, transforming individual success stories into a rigorous, evidence-based standard. In the academic realm, it synthesizes data to prove that music therapy significantly improves social interaction and communication, while also identifying critical gaps in long-term research that guide future scholars. Clinically, it provides the "gold standard" proof necessary for therapists to secure insurance reimbursement and helps practitioners standardize techniques—like improvisational music therapy—to ensure more predictable outcomes for patients.

Our current treatment algorithm for Music Therapy is based on the American Music Therapy Association (AMTA) Standards of Practice. This framework ensures that interventions for ASD follow a standardized, goal-oriented process consisting of four critical phases: a comprehensive assessment of the individual's functional levels, the development of an individualized treatment plan, the implementation of tailored musical experiences, and the ongoing evaluation of clinical outcomes.

Disadvantages of Music Therapy

A crucial component of successful music therapy is the significant commitment required from both the child and their parent or guardian. The therapeutic benefits extend beyond the weekly session, necessitating the consistent implementation of learned musical techniques within the home and community environments.^[53] This demand for continuous engagement can, however, place considerable stress on families already managing the complexities of their child's special needs and a demanding schedule of other therapies. The added responsibility of integrating therapeutic activities into daily life can challenge a family's coping mechanisms.^[54]

Music therapy is an intervention that fosters developmental growth from within, establishing a strong foundation for the acquisition of essential skills. The gradual nature of this progress can sometimes be a source of concern for parents who may have anticipated more rapid strides in areas such as social skills or language development. Nevertheless, these outcomes are often dependent on the time it takes for a child to establish and strengthen foundational capacities.^[55]

The therapeutic process in music therapy is not a "quick fix" but a developmental journey that supports a child's internal growth. This can lead to a disconnect between parental expectations for immediate, observable progress and the actual, more subtle gains being made.^[56] Understanding this developmental framework is crucial for managing parental expectations and appreciating the long-term benefits of therapy.

Music therapy is not a "quick fix" but rather a developmental process that helps a child build skills from the inside out.^[55]

This means that a therapist will first work on foundational skills, such as self-regulation, attention, and emotional expression, before moving on to more complex goals like language and social skills. Because these foundational skills are often internal and not immediately visible, it can be easy for parents to feel discouraged when they don't see immediate changes in their child's day-to-day life.

Consistency is a cornerstone of successful music therapy, but it can be a significant challenge for many families to implement. The benefits of weekly sessions are greatly enhanced when parents integrate therapeutic musical activities into their child's daily life.^[56] This collaboration between the therapist and the family is what gives the therapy a lasting impact, allowing the child to generalize newly acquired skills to other aspects of their life.

The financial burden of private music therapy is a significant obstacle for many families. A significant proportion of private health insurance plans exclude coverage for music therapy, and when coverage is offered, it is often limited to out-of-network services.^[57] This lack of comprehensive in-network coverage often results in higher out-of-pocket costs for families, as they may face higher deductibles, coinsurance, or have to pay the full cost upfront and seek reimbursement later.

While Applied Behavioral Analysis (ABA) is widely used for children with ASD and often produces rapid, early results within the first three to six months of treatment. However, recent research on music therapy has yielded less conclusive findings. A study published in the JAMA60 highlights the slow-acting nature of music therapy. The study included 362 children with ASD, aged 4 to 7, who were assigned to either improvisational music therapy or enhanced standard care. After a five-month period, the results were inconclusive, as both groups showed similar characteristics and progress. This study therefore indicates that music therapy may have limited short-term effectiveness. For music therapy to show initial results, it often requires a more extended period of treatment, which can be a significant point of concern for parents seeking more immediate changes.

The effectiveness of music therapy for autism varies significantly from person to person, making it hard to draw a decisive deduction about its efficacy compared to more traditional therapies like Applied Behavioral Analysis (ABA). While some research has shown positive outcomes, other studies have yielded inconclusive results.

A systematic review by Weitlauf et al.^[58] of 20 randomized control trials found that while music therapy could lead to enhancements in cognitive skills, the same could not be said for language abilities. This highlights a key point of contention in the research: the benefits of music therapy may be limited to specific areas and may not be as broad as those seen in other interventions.

CONCLUSION

Autism Spectrum Disorder is a lifelong neurodevelopmental condition characterized by persistent challenges in social communication, reciprocal interaction, and behavioral flexibility. While the clinical presentation varies widely across the spectrum, moderate to severe cases often necessitate substantial, long-term support. Many of the executive and social-cognitive deficits observed in ASD are associated with the functional architecture of the prefrontal cortex. Although there is no definitive cure for ASD, various therapeutic modalities are employed to mitigate these challenges. Among these, music therapy has gained significant prominence as a non-invasive intervention that offers therapeutic benefits with a high safety profile. By facilitating emotional regulation and social engagement, music therapy serves as a versatile tool for enhancing functional outcomes.

The evolution of the field is currently marked by the integration of neuroimaging and artificial intelligence (AI) to create highly individualized treatment protocols. By utilizing neurological feedback, researchers can monitor how musical stimuli modulate specific brain regions, allowing for more targeted interventions. Furthermore, AI frameworks are being developed to analyze these physiological responses, potentially enabling the real-time adaptation of therapeutic elements—such as tempo, rhythm, and instrumentation—to align with a patient's unique neurobiological profile. This convergence of neuroscience and technology aims to transition music therapy toward a model of precision medicine, fostering interventions that are both data-driven and tailored to the individual.

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