Peer-reviewed academic journal

Innovative Issues and Approaches in Social Sciences

IIASS VOLUME 19 (2026)

Innovative Issues and Approaches in Social Sciences

IIASS is a double blind peer review academic journal published 3 times yearly (January, May, September) covering different social sciences: political science, sociology, economy, public administration, law, management, communication science, psychology and education.

IIASS has started as a SIdip – Slovenian Association for Innovative Political Science journal and is being published by ERUDIO Center for Higher Education.

Typeset
This journal was typeset in 11 pt. Arial, Italic, Bold, and Bold Italic; the headlines were typeset in 14 pt. Arial, Bold

Abstracting and Indexing services
COBISS, International Political Science Abstracts, CSA Worldwide Political Science Abstracts, CSA Sociological Abstracts, PAIS International, DOAJ, Google scholar.

Publication Data:
ERUDIO Education Center

Innovative issues and approaches in social sciences, 2026, vol. 19

ISSN 1855-0541

Additional information: www.iiass.com

ROLE OF MUSIC THERAPY IN THE DEVELOPMENT OF LANGUAGE SKILLS IN CHILDREN WITH AUTISM SPECTRUM DISORDER: A SYSTEMATIC LITERATURE REVIEW

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Abstract

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition that typically emerges in early childhood, marked by difficulties in communication, social interaction, behaviour, and emotional regulation. Despite these challenges, many children with ASD demonstrate exceptional musical abilities, making music a powerful medium for enhancing self-expression, fostering social bonds, and supporting neurological development crucial for speech and social skills. Historically, minimally verbal children with ASD were often excluded from research due to the difficulty of assessment using standardised tools; however, recent advancements have enabled more inclusive studies. Over the past decade, naturalistic approaches have gained prominence, with music therapy emerging as a particularly promising intervention. A systematic literature review, based on original research sourced from PubMed, Sage, and ScienceDirect, examined six studies involving children aged two to twelve years with minimal verbal abilities and a clinical diagnosis of autism. These studies consistently found that music therapy significantly supports the development of language and social communication skills, while also enhancing fronto-temporal brain connectivity. The review contributes valuable insights into the current state of research, underscores the importance of early intervention and parental involvement, and lays the groundwork for further exploration into the role of music therapy in language development for children with ASD.

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Keywords: autism spectrum disorder, children, minimal language abilities, social communication, fronto-temporal brain connectivity, music therapy, non-music therapy

INTRODUCTION

Autism Spectrum Disorder (ASD) presents challenges for children primarily in the areas of communication, social interaction, behaviour, and emotional expression (Lord et al., 2020; You et al., 2024). However, many children with ASD demonstrate exceptional musical talent – music thus becomes a natural bridge that can enhance their means of expression and connection, as well as stimulate neurological structures important for speech and social skills.

Autism spectrum disorder in children

ASD is a serious neurodevelopmental disorder that typically emerges in early childhood, characterised by speech and language impairments, difficulties in social communication and interaction, along with restricted and repetitive behaviours (Lord et al., 2020). Specifically, early childhood features of autism include limited eye contact, poor response to name, lack of emotional expressiveness and sharing, absence of gestures by 12 months of age, and loss of language skills and social abilities (You et al., 2024). The global prevalence of ASD in early childhood is estimated at approximately 1–2% of the population (Dean et al., 2020), with around 25–30% of children remaining minimally verbal even after the age of five (Kasari et al., 2013; Tager-Flusberg et al., 2005; Tager-Flusberg & Kasari, 2013). Lack of spoken language is associated with significantly reduced independence (Howlin et al., 2000; Venter et al., 1992) and increased incidence of self-injurious behaviour, aggression, and property destruction (Dominick et al., 2007; Matson et al., 2009), while difficulties in social communication are linked to poor interpersonal relationships (Hsiao et al., 2013), low academic achievement (Kirjava & Witham, 2022), and poor employment outcomes later in life (Chiang et al., 2013).

Music therapy for children with ASD

Until recently, minimally verbal children with ASD were not included in research studies due to the difficulty of assessment, especially using standardised tests. Over the past decade, however, assessment techniques have improved and several studies have been conducted examining the effects of language interventions in this population (Chenausky et al., 2022). Interventions found to be somewhat effective in promoting the development of functional speech in minimally verbal children with ASD include various forms of discrete trial training (Lovaas, 1987; Wolf et al., 1963), such as verbal behaviour (Ross & Greer, 2003), pivotal response training (Koegel et al., 1987), rapid motor imitation antecedent training (Paul et al., 2013), and intensive social communication intervention for preschoolers (Williams et al., 2024). Due to the specific characteristics of ASD, there has been a growing need for more naturalistic approaches in recent years, including music therapy (Chenausky et al., 2022).

Strong musical perception abilities were noted in the earliest descriptions of ASD (Kanner, 1943), and numerous studies report preserved or even exceptional musical skills, such as absolute pitch, enhanced melodic memory, and precise recognition of melodic patterns (Molnar-Szakacs & Heaton, 2012; Ouimet et al., 2012; Quintin et al., 2013). Enhanced brain responses to songs compared to speech have also been observed in fronto-temporal brain regions (Lai et al., 2012; Sharda et al., 2015), along with preserved emotional sensitivity to music (Caria et al., 2011). Altered brain connectivity is one of the features of ASD; several studies (Jack, 2018; Murdaugh et al., 2015; Rudie & Dapretto, 2013; Uddin, 2015) report hyperconnectivity of sensory networks as well as hypoconnectivity of fronto-temporal and cortico-subcortical networks. Given the involvement of these regions in verbal and social communication skills in ASD, they are considered potential targets for treatment (Sharda et al., 2015; Thye et al., 2018). Listening to happy or sad music activates cortical and subcortical brain areas in children with ASD, which can enhance their sense of engagement in learning and social activities, making music therapy a breakthrough method in rehabilitation training and treatment (Attal et al., 1996; Caria et al., 2011). Music therapy promotes greater communication and social interaction among children with ASD, supports the development of social and communication skills, and facilitates their gradual recovery and successful reintegration into society and family (Fan et al., 2024).

Music can assist children with ASD in language learning in three key ways: first, autistic children prefer musical stimuli over speech (Blackstock, 1978), and music can increase their attention to speech (Janzen & Thaut, 2018), as confirmed by neuroimaging studies (Lai et al., 2012; Sharda et al., 2015). Music-based language interventions can therefore induce structural and functional changes in the brains of autistic children that facilitate language learning (Williams et al., 2024). Second, autism is associated with enhanced musical processing (Molnar-Szakacs & Heaton, 2012; Ouimet et al., 2012; Quintin et al., 2013), which may lead to promising outcomes in language learning through music (Williams et al., 2024). Third, musical interventions can take two forms: (1) receptive, where the therapist presents musical stimuli, and (2) active, where the child participates in creating music (Geretsegger et al., 2015; Wigram & Gold, 2006). These forms of intervention improve behaviour, social communication, brain connectivity, quality of life, and the child's interpersonal and family relationships (Geretsegger et al., 2015; Wigram & Gold, 2006). In addition to the general forms of music therapy – receptive and active – there are other, more specific subtypes, most commonly auditory-motor mapping training (AMMT; Chenausky et al., 2016; Chenausky et al., 2022) and Orff music therapy (Fan et al., 2024).

Despite certain limitations, children with ASD possess a unique profile of strengths that can be leveraged to design therapeutic approaches that improve functional outcomes. Due to its universal appeal, intrinsically rewarding nature, and significant impact on brain function and behaviour in children with ASD, music-based interventions are a potentially valuable rehabilitation tool (Sharda et al., 2018).

Purpose and objectives

Although the depth of understanding and frequency of use of music therapy has gradually increased in recent years, challenges remain in effectively and feasibly implementing music therapy interventions for children with special needs, such as those with ASD. Due to the difficulty of assessing minimally verbal children with ASD, few studies have examined the role of music therapy in developing their communication abilities (both language and social), necessitating further validation of its effectiveness. The direct link between the effects of musical interventions and brain changes in autism also remains unclear. The aim of this systematic literature review is therefore a thorough analysis of existing scientific and professional literature focusing on the role of music therapy in developing communication skills in minimally verbal children with ASD, and a detailed examination and understanding of its mechanisms of action on brain functional-temporal connectivity. We seek to evaluate and highlight existing music therapy approaches, compare their effects with those of traditional, non-musical therapeutic methods, and contribute to a better understanding of the role of music therapy in developing functional skills in children with ASD through detailed analysis and presentation of research findings.

Before reviewing the literature, we posed a general research question that encompasses our main objective:
What role does music therapy play in the development or improvement of language abilities in children with autism spectrum disorders?

Following the literature review, we refined this into more focused sub-questions:
Do Music Therapy (MT) or Music-Assisted Programmes (MAP) yield better outcomes in the development of language abilities in children with autism spectrum disorders compared to Non-music Interventions (NM)?
Does music therapy play a significant role in improving brain functional fronto-temporal connectivity and thereby in the development of language abilities in children with autism spectrum disorders?
Does music therapy play a significant role in the development of social communication and thereby in the development of language abilities in children with autism spectrum disorders?

METHODS

We prepared the systematic literature review in accordance with the PRISMA guidelines (Page et al., 2021), which provide recommendations for achieving a high-quality systematic review. The literature search strategy was aligned with the aim of the review: to identify and understand the role of music therapy in children with ASD through an examination of research and literature from the past 10 years, and to offer guidance for future investigations based on the findings.

In the first step of source collection, we used the following search terms and phrases: (1) “music therapy” AND “speech development” AND “autistic children”

The literature search was conducted in February 2025 using the following databases: PubMed, Sage, and ScienceDirect. We restricted the search results in the scientific databases using the following criteria: "open access" and "full text". Additionally, we limited the selection to the last 10 years (i.e. 2015–2025). This was to ensure the inclusion of all relevant sources on the topic, especially since minimally verbal children with ASD have only recently been more frequently included in empirical studies. Until recently, they were often excluded from research due to the difficulty of assessing them, particularly with standardised tests that are frequently not adapted to their specific communication and cognitive abilities. We further narrowed the search results by excluding review or systematic review articles.

Table 1
Number of sources for defined search strings across individual databases

Search String	PubMed	Sage	ScienceDirect
1	12	2385	794
*	5	188	45

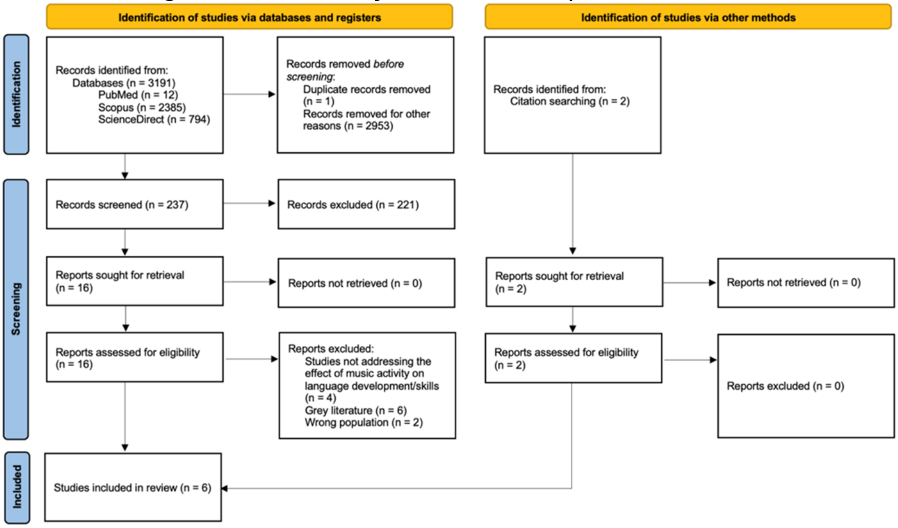
Notes. * Number of sources after applying selection criteria

We excluded a total of 2,953 articles. We also checked for duplicate articles across all three databases. This left us with 237 articles or records for screening. We then reviewed the articles by assessing the relevance of their titles and abstracts, excluding those with content that was not appropriate. Next, we read the remaining articles and assessed their eligibility using the following exclusion criteria:
The study does not address the role of music therapy in the development of language abilities.
Grey literature, which includes all non-original studies and previously excluded review articles – e.g., commentaries, letters to the editor, dissertations, conference abstracts, case studies, unpublished literature.
Incorrect population – the study does not focus on children with ASD.

Through database searches, we identified four articles to include in the systematic literature review. Using additional methods (i.e., citation searching), we added two more articles, again based on the exclusion criteria outlined above. Thus, a total of six articles were included in the systematic literature review.

The process of searching, selecting, and retrieving studies is illustrated in the PRISMA diagram in Figure 1.

Figure 1
PRISMA diagram of the study identification process



Notes. Figure prepared according to Haddaway et al. (2022)

RESULTS

We conducted a qualitative synthesis of the studies used. They were compared based on their sample characteristics and methods, results, key findings, and limitations as highlighted by the authors themselves – with a focus on a descriptive comparison of the studies' findings. No sensitivity measurement tools or certainty assessment instruments were used in the preparation of this systematic literature review. The studies included in the review are presented chronologically in Table 2.

Table 2
Characteristics of included studies

Refe-rence	Sample	Methods	Results	Main findings	Limitati-ons
Chen-ausky et al. (2016)	Childre n (N = 30), averag e age 6.5 years;	Matched group design comparing AMMT and SRT; autism diagnosis confirmed via	Assessment of bisyllabic word/phrase pronunciation – trained and untrained; 3 outcome	Intonation-based therapy may be a promising approach for teaching spoken	Small control group size; uncertain effectiven ess of

	music therapy group (total N = 23; matched N = 7) and non-music therapy group (matched N = 7); clinical diagnosis of autism; minimal verbal abilities	CARS or ADOS; minimal verbal abilities confirmed by parent report and tools (KSPT parts 1–2 or phoneme repetition test); measurements at baseline, after 10th, 15th, 20th, and 25th therapy sessions, and 4 and 8 weeks post-therapy; AMMT conducted in two phases (25 or 40 sessions)	measures: % of approximated syllables, % of correctly pronounced consonants, % of correctly pronounced vowels; AMMT group showed improvement in all three; matched AMMT group showed greater improvement in syllables and consonants, no difference in vowels; 40 sessions led to better generalisation to untrained phrases; both groups showed generalisation	language to minimally verbal children with ASD – enhances motivation, music accelerates language learning via shared neural resources; therapy structure resembles speech apraxia therapy, which is common in ASD	long-term therapy
Shar-da et al. (2018)	Children (N = 51), aged 6–12 years; music therapy group (N = 26) and non-music therapy group (N = 25); clinical diagnosis of autism; minimal verbal abilities	Randomised controlled trial comparing MT and NM; baseline assessments conducted using: (1) autism diagnosis tools (ADOS, ADI-R, CARS), behavioural assessments (SRS-II, CCC-2, VABS-MB, FQoL), cognitive assessments (WASI-II, WASI-I/II, WISC-IV/V), language assessments	MT group showed higher scores in social communication assessments, greater resting-state brain connectivity between auditory and subcortical regions and between auditory and fronto-motor regions compared to NM group; lower connectivity between auditory and visual-associative regions in MT	First study to demonstrate that 8–12 weeks of individual music therapy can improve functional brain connectivity and social communication, supporting further research into neurobiologically grounded models of music-based interventions for autism; findings also suggest MT may modulate	Lack of direct observational measures and limited exploration of mediators and moderators in short- and long-term outcomes

		(CELF-4, PPVT-4), musical ability (MBEMA); (2) resting-state functional connectivity between fronto-temporal brain networks via MRI; followed by 8–12 weeks of MT and NM interventions and post-assessment using the same tools	group	excessive connectivity between sensory cortices, improving communication processes	
Chenausky et al. (2022)	Children (N = 14), aged 5.0–10.8 years; music therapy group (N = 8) and non-music therapy group (N = 6); clinical diagnosis of autism; minimal verbal abilities	Randomised controlled trial comparing AMMT and SRT; autism diagnosis confirmed via ADOS-2 and ADI-R; minimal verbal abilities confirmed via KSPT and ADOS-2; receptive vocabulary assessed with PPVT; nonverbal IQ assessed with Leiter-3; measurements taken before therapy, after 25 sessions, and 4 weeks post-therapy	Assessment of bisyllabic word/phrase pronunciation – trained and untrained; 3 outcome measures: % of approximated syllables, % of correctly pronounced consonants, % of correctly pronounced vowels; AMMT group showed increased % of approximated syllables and vowels for trained phrases; mixed results for consonants – AMMT better for trained, SRT better for untrained; both groups showed generalisation to untrained phrases	AMMT is a useful and effective therapy for minimally verbal children with autism, outperforming speech therapy that lacks intonation and drumming; these elements, presented in a socially engaging environment, are key components of AMMT's effectiveness	Small sample size (limited generalisability); questionable group assignment based on ability; unclear whether observed improvements were clinically significant or whether gains in speech production translated to improved language expression

Willia-ms et al. (2024)	Children (N = 19), aged 2–5 years; music therapy group (N = 11) and non-music therapy group (N = 8); clinical diagnosis of autism; minimal or no verbal abilities	Randomised controlled trial comparing MAP and SCIP-I; autism diagnosis confirmed via SRS-II; parents conducted all assessments and interventions under the guidance of a speech therapist via Microsoft Teams; MAP group had access to a dedicated app for support and tracking home practice; outcomes assessed using: (1) number of target words understood/spoken (out of 36), (2) social responsiveness (SRS-II), (3) expressive/receptive language skills (EOWPVT-4/ROWPVT-4), (4) number of words/phrases understood and spoken (MB-CDI), (5) social-communication skills (10-min play video), (6) functional	MAP group showed greater number of understood phrases between baseline and post-intervention, baseline and 3-month follow-up, and mid-intervention to end; more spoken words between baseline and 3-month follow-up; more understood words across all intervals; overall, MAP group demonstrated stronger language gains than SCIP-I group	Greatest improvements observed in social interaction rather than language development; this is encouraging as language development is rooted in parent-child social interaction; training parents to deliver social communication therapy is an effective way to improve social responsiveness and spoken language in autistic children	Some assessments could not be reliably conducted online due to COVID-19-related technical issues; only 5 parents participated in the final interview on music therapy effectiveness, and none from the non-music therapy group, limiting the completeness of outcome evaluation

		language (10-min play video), (7) communication, daily living skills, socialisation, maladaptive behaviour (VABS-3); measurements taken pre-intervention, mid-intervention (12 weeks), post-intervention, and 3-month follow-up			
Fan et al. (2024)	Children (N = 93), aged 2–6 years; music therapy group (N = 48) and non-music therapy group (N = 45); clinical diagnosis of autism; minimal verbal abilities	Comparison of Orff music therapy with rehabilitation intervention without music therapy; autism diagnosis confirmed via DSM-5; assessments conducted before intervention and at 3 and 6 months post-intervention using ABC, CARS, and PEP-3	Orff group showed significantly lower ABC scores in sensory perception, social contact, language, and total score; greater reduction in CARS scores; greater improvements in PEP-3 scores for expressive and receptive language, social reciprocity, and fine motor skills compared to control group	Orff music therapy led to significant improvements in expressive and receptive language, social skills, cognitive abilities, imitation, emotional expression, and fine motor skills – all closely linked to language development in children with ASD	Small sample size (limited generalisability); only one type of music therapy compared to non-music therapy; study assessed only short-term effects
Zhou et al. (2025)	Children (N = 29), aged 2.6–6.8 years; music	Randomised controlled trial comparing MT and NM; autism diagnosis confirmed via	MT group showed greater reductions in SRS-II scores for social communication and overall;	12-week music therapy added to standard care improved social and language skills in children with	Treatment conducted entirely within research unit

	therapy group (N = 15) and non-music therapy group (N = 14); clinical diagnosis of autism; minimal verbal abilities	DSM-5 and CARS-2; assessments conducted at baseline and immediately after 12-week intervention using: (1) SRS-II (social perception, cognition, motivation, communication, restricted interests/repetitive behaviours), (2) ATEC (speech, language, communication, sociability, sensory/cognitive awareness, health, physical, behaviour), (3) GDS (gross/fine motor, adaptability, language, personal-social development)	greater reductions in ATEC scores for speech, language, communication, and sociability; increased GDS developmental quotient in personal-social domain compared to baseline and control group	ASD; peer interaction and joint attention during music therapy are key predictors of language development; early interventions focusing on joint attention (e.g., pointing, sharing) can support later language skills	(limits generalisability to other settings); wide age range led to dispersed results; assessment tool lacked sensitivity to detect subtle changes

In Table 3, the quality assessments of the included studies are presented according to individual items from the RCT (Randomised Controlled Trial) checklist, based on the CASP methodology (Critical Appraisal Skills Programme, 2023). Our aim was to evaluate the quality, reliability, and applicability of the included randomised controlled trials, thereby ensuring optimal interpretation of the studies.

Table 3
Critical quality assessment of studies according to CASP

Items (CASP – RCT)	Chena-usky et al. (2016)	Sharda et al. (2018)	Chena-usky et al. (2022)	Willia-ms et al. (2024)	Fan et al. (2024)	Zhou et al. (2025)
1 Did the study address a clearly formulated research question?	YES	YES	YES	YES	YES	YES
2 Was the assignment of participants to interventions randomised?	NO *The allocation of participants was more pragmatic, aimed at comparing the groups. However, since it involved both an intervention and a control group, the study is still considered a randomised controlled trial (RCT).	YES	YES	YES	NO * The allocation of participants was more pragmatic, aimed at comparing the two groups. However, since it involved both an intervention and a control group, the study is considered a RCT.	YES
3 Were all participants who entered the study accounted for at its conclusion?	YES	YES	YES	YES	YES	YES
4	(a) NO	(a) NO	(a) NO	(a) NO	(a) NO	(a) NO

(a) Were the participants 'blind' to intervention they were given? (b) Were the investigators 'blind' to the intervention they were giving to participants? (c) Were the people assessing/analysing outcome/s 'blinded'?	*The nature of music or non-music therapy prevents participants from being blind. (b) NO *The nature of music or non-music therapy prevents researchers from being blind. (c) UNCLEAR *Compared to most included studies, the authors do not explicitly state whether those assessing/analysing outcomes were blind.	*The nature of music or non-music therapy prevents participants from being blind. (b) NO *The nature of music or non-music therapy prevents researchers from being blind. (c) YES	*The nature of music or non-music therapy prevents participants from being blind. (b) NO *The nature of music or non-music therapy prevents researchers from being blind. (c) YES	*The nature of music or non-music therapy prevents participants from being blind. (b) NO *The nature of music or non-music therapy prevents researchers from being blind. (c) YES	*The nature of music or non-music therapy prevents participants from being blind. (b) NO *The nature of music or non-music therapy prevents researchers from being blind. (c) UNCLEAR *Compared to most included studies, the authors do not explicitly state whether those assessing/analysing outcomes were blind.	(b) NO (c) YES
5 Were the study groups similar at the start of the randomised controlled trial?	YES	YES	YES	YES	YES	YES
6 Apart from the experimental intervention, did	YES	YES	YES	YES	YES	YES

each study group receive the same level of care (that is, were they treated equally)?						
7 Were the effects of intervention reported comprehensively?	YES	YES	YES	YES	YES	YES
8 Was the precision of the estimate of the intervention or treatment effect reported?	YES	YES	YES	YES	YES	YES
9 Do the benefits of the experimental intervention outweigh the harms and costs?	UNCLEAR *The authors provide too little information about harm and costs to answer objectively and unequivocally.	UNCLEAR *The authors provide too little information about harm and costs to answer objectively and unequivocally.	UNCLEAR *The authors provide too little information about harm and costs to answer objectively and unequivocally.	UNCLEAR *The authors provide too little information about harm and costs to answer objectively and unequivocally.	UNCLEAR *The authors provide too little information about harm and costs to answer objectively and unequivocally.	UNCLEAR *The authors provide too little information about harm and costs to answer objectively and unequivocally.
10 Can the results be	UNCLEAR *The authors do not provide	UNCLEAR *The authors	UNCLEAR *The authors	UNCLEAR *The authors	UNCLEAR *The authors do not provide	UNCLEAR *The authors

applied to your local population/in your context?	sufficient information about the transferability of the study to answer the question objectively and unequivocally.	do not provide sufficient information about the transferability of the study to answer the question objectively and unequivocally.	do not provide sufficient information about the transferability of the study to answer the question objectively and unequivocally.	do not provide sufficient information about the transferability of the study to answer the question objectively and unequivocally.	sufficient information about the transferability of the study to answer the question objectively and unequivocally.	do not provide sufficient information about the transferability of the study to answer the question objectively and unequivocally.
11 Would the experimental intervention provide greater value to the people in your care than any of the existing interventions?	UNCLEAR * There were too few direct comparisons made between the study and other existing studies to answer the question objectively and unequivocally.	UNCLEAR * There were too few direct comparisons made between the study and other existing studies to answer the question objectively and unequivocally.	UNCLEAR * There were too few direct comparisons made between the study and other existing studies to answer the question objectively and unequivocally.	UNCLEAR * There were too few direct comparisons made between the study and other existing studies to answer the question objectively and unequivocally.	UNCLEAR * There were too few direct comparisons made between the study and other existing studies to answer the question objectively and unequivocally.	UNCLEAR * There were too few direct comparisons made between the study and other existing studies to answer the question objectively and unequivocally.

Notes. Table prepared according to the Critical Appraisal Skills Programme (2023)

Characteristics of included studies

In this systematic literature review, we analysed six studies published between 2016 and 2025, with their main characteristics presented in Table 2. All included studies were critically assessed using the RCT checklist based on the CASP methodology. Four of the studies were explicitly identified by the authors as RCTs, while the remaining two did not specify the study design. However, since both studies divided participants into intervention and control groups, we also evaluated their quality using the RCT checklist. Table 3 presents the findings of the critical quality assessment, indicating that all included studies were well-designed, methodologically sound, with clearly defined populations and precise implementation procedures. Based on these findings, we conclude that all included studies are of high quality and reliable for further interpretation.

All studies examined samples of children with a clinical diagnosis of autism and minimal language abilities, confirmed using various instruments. The most commonly used tools for confirming autism diagnosis were CARS and ADOS (and their variants), while minimal language abilities were most frequently confirmed using the KSPT instrument. The age range of children varied across studies, spanning from a minimum of two years (Fan et al., 2024) to a maximum of twelve years (Sharda et al., 2018). In all studies, children were assigned to one of two groups – either receiving music therapy or non-music therapy.

Chenausky et al. (2016) compared the AMMT music therapy intervention (Auditory-Motor Mapping Training) with the SRT non-music therapy intervention (Speech Repetition Therapy). The authors posed two main research questions: (1) whether 25 AMMT sessions improve language expression in minimally verbal children with ASD, and (2) whether AMMT leads to greater improvement than SRT. Both interventions assessed participants' ability to repeat two sets of 15 bisyllabic words or phrases – learned and unlearned. The key difference was that AMMT stimuli were sung and accompanied by drumming, while SRT stimuli were spoken without musical accompaniment. Visual cues were used in both groups. Learned stimuli were practised during therapy, while unlearned stimuli were assessed but not practised, to evaluate generalisation.

Sharda et al. (2018) compared MT (music therapy) with NM (non-music therapy). Their goal was to determine whether 8–12 weeks of music-based intervention could improve social communication, family quality of life (FQoL), and brain functional connectivity in children with ASD. Both interventions involved weekly 45-minute individual sessions over 8–12 weeks, delivered by certified music therapists. MT included musical instruments, songs, and rhythmic prompts to encourage communication, role exchange, sensorimotor integration, social appropriateness, and musical interaction. NM was structurally similar but used verbal communication and toys without music.

In a later study, Chenausky et al. (2022) again compared AMMT and SRT, with a modified methodology and smaller sample. Measurements were taken at baseline, after 25 sessions, and four weeks post-intervention. Unlike the 2016 study, there was no comparison of different therapy durations. Participants' ability to repeat bisyllabic words or phrases was reassessed, with AMMT involving sung stimuli and drumming, and SRT following the same structure but without music. Learned stimuli were practised; unlearned ones were assessed but not practised.

Williams et al. (2024) compared MAP (Music-Assisted Programme) with SCIP-I (Social Communication Intervention for Pre-schoolers–Intensive). Their aim was to assess the feasibility and effectiveness of an RCT comparing music-assisted language intervention with best-practice communication intervention for children with ASD. Both interventions taught 36 new words over 36 therapist-led sessions (45 minutes, twice weekly, for 18 weeks). Due to COVID-19 regulations, parents conducted assessments and interventions under the guidance of a speech therapist via Microsoft Teams. One session per week was recorded and reviewed to support parental reflection and treatment adaptation. MAP parents used a custom Android app to track home practice. The app introduced 11 songs containing the target words, taught through singing, dancing, vocalisation, improvisation, and musical games. SCIP-I followed standard clinical practice for children with minimal or no speech, based on the SCIP programme (Loucas & Fincham-Majumdar, 2019). At the end of the intervention, interviews were conducted with some MAP parents to analyse perceived acceptability.

Fan et al. (2024) compared Orff music therapy with a non-music rehabilitation intervention. Their goal was to explore the clinical effects of Orff music therapy from the perspectives of parents, evaluators, and therapists. The control group received: (1) sensory system training (5×/week, 30 min), (2) language training (5×/week, 30 min), (3) daily activity training (5×/week, 30 min), (4) social interaction training (5×/week, 30 min), and (5) family guidance (1×/week, 1 hour). The music therapy group received the same rehabilitation programme plus Orff music therapy, which included imitation-based experiential games and creative activities such as improvisation, free conversation, or artistic expression. Orff therapy was delivered twice weekly, with each session lasting 40 minutes.

Zhou et al. (2025) compared MT (music therapy) with NM (non-music therapy), aiming to assess the effects of music therapy on social skills in children with ASD. MT was delivered in small groups of 3–5 children, lasting 30 minutes, three times a week, over 12 weeks. Activities included singing greeting and farewell songs, playing Orff instruments, and passing them between children. The control group received standard care involving group activities to promote social communication, led by trained therapists.

The results of the literature review are categorised according to the review's objectives:
Outcomes of music therapy versus non-music therapy in language development.
The role of music therapy in improving brain functional fronto-temporal connectivity.
The role of music therapy in developing social communication.

Results and findings of included studies

Results of music therapy compared to non-music therapy in language development

Music therapy AMMT (Auditory-Motor Mapping Training) showed greater improvement than non-music therapy SRT (Speech Repetition Therapy) in the proportion of approximated syllables – i.e., roughly correctly pronounced consonant-vowel syllables produced by the child during testing (Chenausky et al., 2016). AMMT also led to a greater improvement in the proportion of correctly pronounced consonants (Chenausky et al., 2016). However, no improvement was observed in the proportion of correctly pronounced vowels, and no significant difference was found between the music and non-music groups. Both groups showed signs of generalisation – i.e., improvement in untrained bisyllabic words/phrases (Chenausky et al., 2016). A higher number of AMMT sessions (40 vs. 25) was associated with better transfer of pronunciation skills to untrained stimuli (Chenausky et al., 2016). Most of the 23 AMMT participants responded positively across all three outcome measures, with significantly more participants responding in the AMMT group than in the SRT group (Chenausky et al., 2016). Additionally, statistically significant improvements were observed in the AMMT group between the best baseline and the 10th assessment (vowel pronunciation), and between the best baseline and the 15th assessment (approximated syllables and consonant pronunciation), with performance stabilising after the 15th session – suggesting that the greatest gains typically occur within the first 15 therapy sessions.

The follow-up study (Chenausky et al., 2022) confirmed previous findings and added that AMMT was associated with significantly greater progress than SRT in approximated syllables for trained stimuli and in vowel pronunciation. Results for consonant pronunciation were mixed – AMMT was more effective for trained stimuli, while SRT was more effective for untrained stimuli. Both groups again showed generalisation effects.

Williams et al. (2024) also found that MAP (Music-Assisted Programme) had more positive effects on language abilities in children with ASD compared to SCIP-I (Social Communication Intervention for Pre-schoolers–Intensive). Children in the MAP group demonstrated a greater number of understood phrases between baseline and post-intervention, baseline and three-month follow-up, and mid-intervention and post-intervention. They also produced more spoken words between baseline and follow-up. The number of understood words was higher in the MAP group across all measured intervals.

Music therapy added to standard care had a positive impact on language development compared to standard care alone (Zhou et al., 2025) – specifically, children receiving music therapy showed improvements in speech, language, and communication. Music therapy was found to alter functional brain activity in children with ASD, leading to improvements in functional communication (Sharda et al., 2018). Orff music therapy, in particular, improved both expressive and receptive language, as well as fine motor skills and cognition, which are directly linked to language development (Fan et al., 2024).

Role of music therapy in improving brain functional fronto-temporal connectivity

Sharda et al. (2018) found that music therapy increased functional connectivity between auditory and subcortical regions, and between auditory and fronto-motor regions – areas often underconnected in autism. Additionally, hyperconnectivity between auditory and visual regions decreased in the music group, which is significant as such hyperconnectivity is commonly observed in autism. Improvements in brain connectivity were associated with enhanced communication abilities in children with ASD. This study was the first to demonstrate that even 8–12 weeks of music therapy can improve brain functional connectivity, supporting further research into neurobiologically grounded models of music-based interventions for autism.

Role of music therapy in developing social communication

The most notable changes from MAP were observed in social interaction rather than language development (Williams et al., 2024). Training parents to deliver social communication therapy proved effective in improving social responsiveness and language in children with ASD. Parents reported improvements in both the quality and quantity of social interactions – children were more engaged during play and initiated interactive activities (Williams et al., 2024). Through MAP, parents recognised the importance and effectiveness of regular active involvement in activities that promote language and social skills. Overall, parents rated MAP as successful in developing their child's language and social competencies (Williams et al., 2024).

Music therapy added to standard care positively influenced the development of social skills compared to standard care alone (Zhou et al., 2025) – with social communication showing the greatest improvement among all assessed areas, alongside sociability and developmental quotient in personal and social activity. Music therapy had a more significant positive effect on social communication than non-music therapy, contributing to progress in pragmatics, reducing inappropriate communication initiations, and fostering better social relationships and interests (Sharda et al., 2018). Although both intervention groups received support, only parents of children in the music group reported improvements in family quality of life (FQoL), particularly in family interaction and connectedness. Orff music therapy, compared to non-music therapy, significantly improved social skills – specifically social reciprocity, imitation ability, and emotional expression, all of which are linked to social communication (Fan et al., 2024).

Although the studies provide valuable insights into the role of music therapy in language development, social communication, and brain connectivity, the authors highlighted several limitations that must be considered when interpreting the findings. Half of the studies cited small sample sizes and limited generalisability as major limitations (Chenausky et al., 2016; Chenausky et al., 2022; Fan et al., 2024). Chenausky et al. (2016) also questioned the effectiveness of long-term therapy (25 or 40 sessions), noting that improvements were evident after just 15 sessions, and shorter interventions may yield better therapist and participant engagement. Sharda et al. (2018) noted insufficient direct observational measures and limited exploration of mediators and moderators (e.g., therapeutic relationship quality, cognitive, language, and motor profiles, symptom severity, and musical interest) in short- and long-term outcomes.

Chenausky et al. (2022) raised concerns about participant grouping based on abilities – more severely affected children may require simpler stimuli than bisyllabic words and show greater improvement with personally meaningful words (e.g., favourite snacks, activities, or people) rather than generic word sets. They also noted uncertainty about whether the observed improvements were clinically significant and whether gains in speech production translated into better language expression. Williams et al. (2024) identified the COVID-19 pandemic as a major limitation – some assessments could not be reliably conducted online or via video. Additionally, the final interview lacked sufficient parental participation, limiting conclusions about the therapy's effectiveness. Fan et al. (2024) highlighted the limitation of comparing only one type of music therapy with non-music therapy and assessing only short-term effects. Zhou et al. (2025) noted concerns about participant engagement outside the research setting, a wide age range, dispersed results, and insufficiently sensitive tools for detecting subtle changes.

DISCUSSION

At the outset of this systematic literature review, we posed a general research question, followed by three more focused sub-questions: We were interested in the role of music therapy in the development or improvement of language abilities in children with ASD. We also explored whether music therapy or music-assisted programmes yield better outcomes in language development than non-music therapy or conventional speech and language interventions. Additionally, we investigated whether music therapy plays a significant role in improving brain functional fronto-temporal connectivity and thereby supports language development. Finally, we examined whether music therapy contributes meaningfully to the development of social communication and, consequently, language development in children with ASD.

The AMMT music intervention proved more effective than the SRT non-music intervention in developing language abilities in children with ASD (Chenausky et al., 2016). Several factors may explain AMMT's greater effectiveness: Many children with ASD enjoy listening to and creating music (Parker Hairston, 1990). Incorporating enjoyable musical activities may have enhanced AMMT's effectiveness by creating more learning opportunities than a less engaging environment. Additionally, AMMT's structure requires children to strike tuned electronic drums with each syllable spoken, which may act as a reward and boost motivation (Chenausky et al., 2016). Musical activities – such as singing words/phrases or bilateral drumming – activate the auditory-motor brain network (Lahav et al., 2007; Özdemir et al., 2006), and hand movements share neural correlates with articulatory gestures (Gentilucci et al., 2000; Meister et al., 2003; Tokimura et al., 1996; Uozumi et al., 2004), supporting the idea that hand tapping helps link sounds with orofacial and articulatory movements. Given the shared neural resources between music and spoken language, AMMT may support language learning in minimally verbal children with ASD (Heaton et al., 2007).

Another possible reason for AMMT's effectiveness relates to the hypothesis that some minimally verbal children with ASD may also have childhood apraxia of speech (Newmeyer et al., 2007). AMMT shares mechanisms with apraxia therapy; if children have both ASD and apraxia, combining task types from apraxia therapy with intoned stimuli and bilateral tapping may act as a catalyst for improved speech expression beyond what either method could achieve alone (Chenausky et al., 2016). These findings have important clinical implications for treating minimally verbal children with ASD. The authors advocate for further research to reduce current study limitations and identify predictors of therapeutic progress, as no single therapy is equally effective for all children with ASD.

Music therapy also positively affects family quality of life (FQoL) (Sharda et al., 2018). These results are promising, as the family is the primary support system for children with ASD throughout life, and parents often experience high stress levels that can negatively impact their well-being. FQoL is therefore a key component in evaluating music therapy's role – not only in terms of child progress but also in holistic family support (McStay et al., 2014). Neuroscientific research shows that participating in musical activities activates a multimodal network of brain regions involved in sound perception, movement, emotion, reward, and memory (Klein et al., 2016; Li et al., 2018; Wollman et al., 2018; Zatorre et al., 2007; Zatorre & Salimpoor, 2013). This engagement allows music's therapeutic effects to transfer to non-musical domains through structural and functional brain changes (Stegemöller, 2014). However, a direct link between music intervention effects and brain changes in autism has not yet been proven (Cheever et al., 2018; Janzen et al., 2018), making Sharda et al.'s (2018) study the first to empirically demonstrate that music intervention alters brain activity in individuals with ASD, leading to improved functional communication.

Based on previous research, two mechanisms of music-induced neuroplasticity may support social functioning (Janzen et al., 2018; Koelsch, 2009; Särkämö et al., 2016; Stegemöller, 2014): (1) "Top-down" cortical modulation based on reward, where music's intrinsic reward value enhances learning of non-musical behaviours (e.g., social interaction), and (2) "Bottom-up" integration of sensorimotor information through sound and auditory-motor synchronisation, which modulates atypical sensory processing and improves social communication. Sharda et al.'s (2018) findings support the bottom-up integration of sensorimotor brain networks, leading to improved social functioning. These results have important clinical implications for treating minimally verbal children with ASD, especially through neuroimaging to better understand behavioural improvements resulting from music therapy. Future research should aim to reduce current study limitations and identify individuals who benefit most from music therapy, incorporating neuroimaging into multicentre clinical trials of these therapeutic approaches.

Chenausky et al. (2022) again confirmed AMMT's superiority over SRT in language development for children with ASD. Although a larger phonetic inventory at baseline predicts greater progress in both AMMT and SRT (Chenausky et al., 2018), it remains unclear which factors predict better outcomes with AMMT. The authors suggest that intonation and bilateral movements are key predictors of AMMT's effectiveness (Chenausky et al., 2022); intonation may focus attention on vowels, while drumming may reinforce correct responses. Additionally, therapists actively engage children's social attention by alternating stimuli and offering praise, which may further enhance AMMT's effectiveness. These findings have important clinical implications, and future research should test AMMT's effectiveness in other settings. Although AMMT was presented in a format similar to Discrete Trial Training (DTT), it could also be delivered in play-based or Naturalistic Developmental Behavioural Intervention (NDBI) formats.

Williams et al. (2024) demonstrated the feasibility and effectiveness of an RCT comparing music-assisted language intervention with best-practice communication intervention for children with ASD. The study successfully identified, recruited, and retained minimally verbal autistic children. Feasibility was supported by low dropout rates after the first session (dropouts were due to prolonged illness during the global pandemic). A key strength of the study was comparing two active approaches with equal participant engagement, unlike studies comparing new interventions with routine care, inactive controls, or waitlists (Aldred et al., 2004; Green et al., 2022; Boyd et al., 2014; Heitzman-Powell et al., 2023). The findings align with the PACT study, which examined parent-mediated social communication therapy for children with ASD (Green et al., 2022); the greatest changes were seen in social interaction, not language development, which is encouraging given the close link between language development and parent-child social interaction (Levickis et al., 2022). Mechanisms behind improved social interaction through music likely relate to music's biological and cultural role in human connection (Savage et al., 2021). Music enhances social-communication skills such as imitation and joint attention (Kraus & White-Schwoch, 2016), which are crucial for language development in children with ASD (Luyster et al., 2008). Improved parental responsiveness is a key component of early parent-led interventions (Gulsrud et al., 2016; Pickles et al., 2015); music acts as a mechanism to foster parental attunement and support children's social and language development. These findings have important clinical implications, and future research should address current limitations, including conducting assessments in clinical or home settings. Technical issues revealed that video-based interaction assessments were problematic. Having a research assistant present at home could ensure video validity and proper assessment execution. Future studies should also better predict dropout rates, set more specific language goals, and incorporate popular songs aligned with child and parent interests to create ecologically valid and effective interventions.

Orff music therapy has positive clinical effects on language development in children with ASD (Fan et al., 2024). Kim et al. (2023) report that Orff therapy's interactive nature fosters role exchange between therapist and child, enhancing responsiveness and joint attention, which supports language development. Orff therapy has high social validity, and parents expressed satisfaction with its use, recognising its role in emotional expression and cognitive development (Kaplan & Steele, 2005). Parents observed improved concept learning, faster knowledge acquisition, and enhanced communication skills. Orff therapy also improves social interaction and language communication skills while reducing repetitive behaviours (Redondo et al., 2021). Improvements in fine motor skills reported by Fan et al. (2024) are supported by research linking fine motor development to cognitive and language abilities. Enhanced motor skills improve daily functioning and social interaction, as practical experiences boost attention, memory, and cognition (Guthrie et al., 2023). These findings have important clinical implications, and future research should include gross motor training to improve balance, limb coordination, vestibular proprioception, and spatial awareness.

Music therapy significantly improves social skills in children with ASD, confirmed by both parent questionnaires and objective developmental scales (Zhou et al., 2025). Rhythm and melody easily capture attention and help children become more aware of their surroundings (Shi et al., 2024). In music's positive environment, individuals with ASD are more likely to express and understand emotions, enhancing social participation and connection (Shi et al., 2024). Music activities provided opportunities for interaction: In steps one and four of the therapy programme, selected songs included social scenes like greetings and farewells, encouraging behaviours such as handshakes and hugs. The relaxed musical background improved social interaction. Research confirms that peers are influential in developing social skills in autistic children (Ghasemtabar et al., 2015; Vincent et al., 2023). Group music settings foster skills like imitation, patience, reciprocity, joint attention, shared emotion, and empathy (Molnar-Szakacs & Overy, 2006). Group therapy enhances interpersonal engagement, builds trust, and helps children respond appropriately to social cues. Among social skills, music therapy had the greatest impact on social communication (Zhou et al., 2025); music promotes non-verbal communication (e.g., eye contact), which improves social competence (LaGasse, 2014). Pitch is processed in the right temporal lobe, which is also involved in speech, suggesting music may enhance interpersonal communication.

In step two of music therapy (Zhou et al., 2025), children exchanged instruments – first pointing to them, then requesting them from the therapist, and finally sharing them with peers. Research shows that initiating and responding to joint attention is key to language development in children with ASD (Kissine et al., 2023). Early interventions focused on joint attention – such as pointing and handing over objects – can significantly improve later language skills (Gulsrud et al., 2014). Step three involved playing instruments with songs tailored to developmental stages (e.g., body parts, numbers, animals). Therapists incorporated frequently used words and animal sounds, guiding children to imitate physical and verbal language through play and singing. Music therapy is ideal for promoting communication skills, as song lyrics introduce vocabulary, express emotions, and convey broader ideas (Boster et al., 2021). Repetitive lyrics reinforce learning, expand vocabulary, and improve language comprehension and expression (Zhou et al., 2025). These findings have important clinical implications, and future research should reduce current limitations, include motion capture technology to monitor behavioural changes, and assess music therapy's effectiveness in social interactions. Future studies should also explore music therapy's mechanisms and its social benefits in improving social skills.

Following PRISMA guidelines helped ensure systematic and reliable findings. However, some limitations and areas for improvement must be noted: The number of included sources was limited, raising questions about generalisability to larger populations or different contexts. As research into music therapy's role in language development is still emerging, we expect more related studies to become available, making it worthwhile to repeat or expand this review. Another limitation is that only three databases were used, meaning relevant studies may have been missed. To better answer the research questions, future reviews should include longitudinal studies, which were unavailable at the time. Longitudinal studies would allow tracking communication, social skills, and behaviour over time, providing invaluable insights into music therapy’s long-term effects on challenges faced by children with ASD. These studies are essential to bridge the current gap in understanding music therapy’s holistic role in child development.

CONCLUSIONS

Through this systematic literature review, we successfully addressed the review’s objectives and fulfilled its purpose of analysing existing scientific and professional literature on the selected topic. We included studies whose findings were categorised into three thematic areas in line with the review’s aims:

Results of music therapy compared to non-music therapy in the development of language abilities.

The role of music therapy in improving functional fronto-temporal brain connectivity.

The role of music therapy in developing social communication.

Based on this, we conclude that music therapy plays a significant role in the development of language abilities, in enhancing functional fronto-temporal brain connectivity, and in supporting social communication in children with ASD.

The main limitation of this review is the small number of included sources, which raises questions about the generalisability of the results. In the future, as more related studies become available, we recommend conducting an expanded literature review that includes a larger number of studies, draws from a broader range of databases, and incorporates longitudinal research.

Our literature review can make a meaningful contribution to understanding the role of music therapy in the development of language abilities in children with ASD. The study of music therapy’s role is important and continues to evolve, and our systematic review offers a valuable insight into the current state of research on this topic. It highlights the importance of early intervention and parental involvement. As previously mentioned, the findings span several thematic areas where music therapy has shown a significant positive impact, making this review a useful foundation for further, more in-depth research.

Abbreviations
ABC: Autism behavior checklist
ADI-R: Autism diagnostic interview − revised
ADOS: Autism diagnostic observation schedule
ADOS-2: Autism diagnostic observation schedule – second edition
AMMT: Auditory-motor mapping training
ATEC: Autism treatment evaluation checklist
CARS: Childhood autism rating scale
CARS-2: Childhood autism rating scale – second edition
CCC-2: Children's communication checklist – second edition
CELF-4: Sentence repetition subtest of the clinical evaluation of language fundamentals – fourth edition
EOWPVT-4: Expressive one-word picture vocabulary test – fourth edition
FQoL: Beach center family quality of life scale
GDS: Gesell developmental schedules
KSPT: Kaufman speech praxis test
MB-CDI: MacArthur-Bates communicative development inventories
MBEMA: Montreal battery for evaluation of musical abilities
PACT: Preschool autism communication trial
PEP-3: Psycho-educational profile − third edition
PPVT: Peabody picture vocabulary test
PPVT-4: Peabody picture vocabulary test – fourth edition
ROWPVT-4: Receptive one-word picture vocabulary test – fourth edition
SCIP-I: Social communication intervention for pre-schoolers – intensive
SRS-II: Social responsiveness scale – second edition
SRT: Speech repetition therapy
VABS-3: Vineland adaptive behavior scales – third edition
VABS-MB: Vineland adaptive behaviour scales − maladaptive behavior
WASI-I: Wechsler's abbreviated intelligence scale – first edition
WASI-II: Wechsler's abbreviated intelligence scale – second edition
WISC-IV: Wechsler intelligence scale for children − fourth edition
WISC-V: wechsler intelligence scale for children − fifth edition

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