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The pedagogical relationship between music, movement and autism: a systematic review

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Abstract

Aim. The pedagogical relationship between music and movement is now well established as schools are moving toward creating activities that use these two forms of non-verbal language to build the harmonious development of learners. The combined action of music and movement activates multiple brain areas that are often underactive in individuals with Autism Spectrum Disorder (ASD)

Material and method. To this end, research is heading towards the strong correlation between music and language to stimulate learning new skills, assisted by the movement to develop coordination, awareness, proprioception, and fine motor skills. The multisystemic approach promotes social inclusion through shared experiences at the basis of the concept of "making music": no competition, but collaboration and interaction between group members leads to shared outcomes. There are many methods of intervention, including Musicocentred Improvisational Music Therapy, Nordoff Robbins Scales (NR), *Results*. Music Education with Psychomotor Enfoque, Rhythmic Auditory Stimulation (RAS®), and ludo-musical activities, which demonstrate how the value of integrating music and movement in pedagogical contexts for ASDs acts to bring benefits in various areas, including communication and socialisation, Motor development, Behavioural and sensorimotor regulation, Cognitive development, involvement and affectivity

Conclusions: In summary, the combination of music and movement is a frontier with a great deal of educational potential and offers the opportunity to create a life-enhancing project for people with ASD.

Key words: *music, movement, autism, Systematic Review.*

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Introduction

Autism Spectrum Disorder (ASD) is characterised by often fragile communication and sociability as well as the presence of restricted and repetitive patterns of behaviour, interests, or activities (American Psychiatric Association [APA], 2000). A growing body of evidence shows that perceptual-motor deficits are very often present in children with ASD (Fournier et al., 2010; Bhat et al., 2011). In recent years, interest in alternative interventions that are effective in individuals with ASD has grown, with a particular focus on the role of music and movement.

According to Donnellan et al. (2013), many professionals have approached the study of this disorder by adopting the music and movement strategy. Approximately 12% of interventions and 45% of alternative treatment strategies used in school settings are music-based (Simpson et al., 2005; Hess et al., 2008). The phenomenon of musical 'earworm' (melodies that repeat involuntarily in the mind) is intense and persistent in some people with ASD and Tourette's syndrome (Sacks, 2008), demonstrating how pervasive music is despite the disorders. Indeed, music, due to its involvement in numerous perceptual and cognitive functions, can be a valuable element in therapy and a potential ally in education. Music practice has been shown to have positive effects on several cognitive functions that are not specifically musical (Schön, 2018); furthermore, a connection between absolute ear (OA) and subclinical autistic traits has been observed in children whose verbal abilities are limited or in individuals who show a predisposition and passion for music, the latter should be placed as a fundamental element for a more harmonious development (Rochon, 2024). This systematic review explores the pedagogical relationship between music, movement, and autism, analysing how these elements support learning, skill development, and the general well-being of people with ASD. We will analyse the foundations underpinning research and treatments, the criteria for music therapy and music education, the role of movement, and different approaches.

To specify the main elements of the survey, we will use the PICO model, which is structured into four main factors:

Table 1. PICO (source: own elaboration)

P	I	C	O
Population	**Interventions**	**Control**	**Outcome**
People with ASD broken down by bands age: children, adolescents, adults, as well as 3 studies that embrace the 3 fields.	Music therapy, education musical, movement.	All Searches included in the revision follow the development of a medical process rehabilitation, but not all come also performed in the system school.	If subjected to targeted and specific strategies, are inferred improvements significant of sociality, and development emotional and personal.

Results

Data sources

The research platform used was EBSCOhost, thanks to which we had access to numerous databases, including MEDLINE, ERIC, APA PsycArticles, SPORTDiscus, Econlit, Environment, and MLA International Bibliography.

No time parameter was applied to include the widest possible range of studies and assess their frequency.

The keywords used were the following: *Music, Movement, Autism*

The various pieces of information obtained through the search were sorted into a table, in which we outlined two large macro-areas, detailed below:

1. *Bibliographic indicators*: authors, title, geographical area, year of publication.
2. *Description of the studies*: sample and characteristics (age, number of participants, gender), purpose, and results.

Inclusion criteria
Studies and discussions that focus on the pedagogical use of music and/or movement of persons with ASD or that assess the relationship between autism and theabove-mentioned evaluation criteria were considered.
Exclusion criteria. Studies focusing exclusively on clinical/diagnostic aspects and not aimed at pedagogical actions were excluded.
Mitigation of Bias Risk:

- Publication bias: Scientific publications with significant results were selected;
- Temporal bias: No temporal parameter was chosen as we wanted to include the broadest scope of research;
- Linguistic bias: Scientific publications selected by major search engines and published in scientific journals in the field.

Data extraction includes:

- Definition of how music and movement in the context of autism have a pedagogical role;
- Specific methodologies and techniques used;
- Learning and development objectives pursued;
- Reported results in terms of the acquisition of cognitive, motor, communication, and social skills;
- Evaluation of progress through specific instruments;
- Comparison and differences between music therapy and music education.

Data synthesis.
The data obtained will be evaluated to assess how pedagogical approaches, through music and movement, support and stimulate the learning of people with ASD.

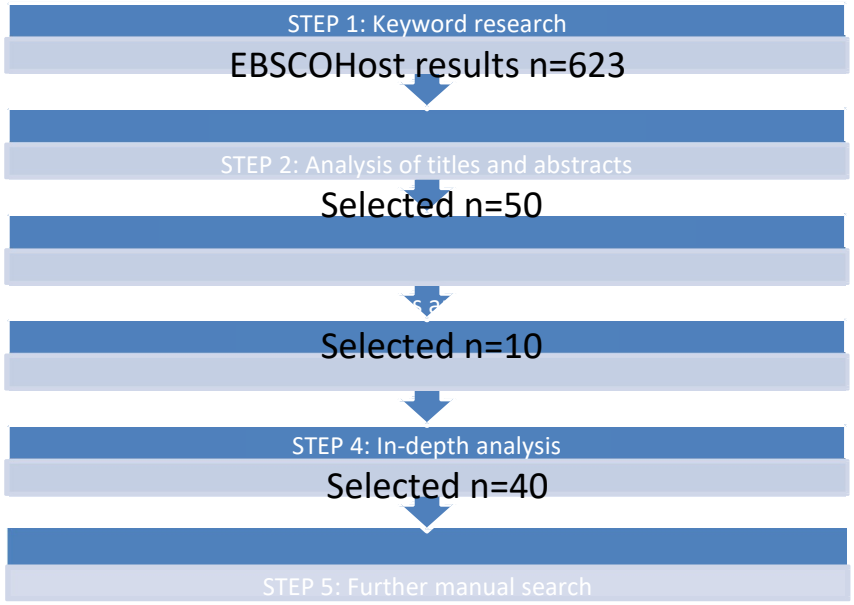

Figure 1. *Flow chart of research phases (source: own elaboration)*

This systematic review included 45 protocols (n=45), which are grouped in the following table. The authors, year, country, publication title, samples, and highlighted results are indicated.

Table 2. Source: own elaboration

Author Year	**Nation**	**Publication title**	**Population sample**	**Achievements**
Gordon 2007	UNITED KINGDOM	The cerebellum and cognition	ADULTS	Timing has been proposed as a fundamental function of the cerebellum underlying its contribution to both motor control and cognitive functions. The study demonstrates that the role of the inferior olive and its fibre system in timing is to mediate the encoding of temporal information independently of motor behaviour, and undoubtedly further research is needed on input from other brainstem nuclei.
Heaton et al. 2008	UNITED KINGDOM	Do social and cognitive deficits curtail musical understanding? Evidence from autism and Down syndrome	CHILDREN 4 to 10 years	Children with typical development and non-musically trained adults were more sensitive to emotion than movement represented in music for the set of musical examples used in this experiment. However, although the affective and movement examples were drawn from the same musical repertoire, conditions could not be equated with difficulty, and this result should be treated with caution when generalising to a broader range of musical compositions.
Lai et al. 2012	USA	Neural systems for speech and song in autism	CHILDREN 8 to 12 years	Research with autistic children showed apparent difficulties in the three key areas of autism. Interaction with others: They showed high scores, averaging 21.18, with some going as high as 24 on a scale where 10 points are sufficient for talking about autism. Communication: The situation was similar, with average scores of 18.87 against a minimum score of 8. Repetitive behaviour: The little ones showed clear signs, with average scores of 6 (some up to 9), well above the threshold of 3.

Barnhill 2013	UNITED KINGDOM	Neural connectivity, music, and movement: A response to Pat Amos	ADULTS	Although connectivity studies may provide convincing evidence of a mechanism that explains the power of music, they will not point to a practical pathway to implement it. Therefore, the primary mode of interaction between musical and physiological rhythms must be brought back to the movement.
Blythe Lagasse et al. 2013	USA	Considering Rhythm for Sensorimotor Regulation in Children with Autism Spectrum Disorders	CHILDREN	The traditional classification of ASD does not include motor differences as a feature; however, existing literature suggests that motor differences may be present in some children with ASD. This stems from evidence demonstrating neural differences that would have an impact on the operation of the entire system, including the motor system.
Hardy et al. 2013	USA	Rhythm, movement, and autism: using rhythmic rehabilitation research as a model for autism	ADULTS	Social and communication deficits primarily define autism; however, current literature suggests that motor differences play a role in autism and that this component merits further investigation. If the clinical treatment of autism addressed motor deficits, appropriate therapeutic goals to affect functional change could include motor coordination, planning, and developing functional motor skills. Rhythmic auditory cueing might be an appropriate technique to provide a predictable structure to stabilise variability in movement patterns and facilitate motor planning. Given the current evidence, this is an area where further research is needed to better understand the potential impact of rhythmic movement on people with ASD.

Sudha et al. 2013	USA	A review of 'music and movement' therapies for children with autism: embodied interventions for multisystem development	CHILDREN 3 to 12 years	We believe that new multisystemic interventions based on embodied rhythm, singing, music production, joint action, and social synchrony can alleviate the significant social communication deficits and perceptual-motor and behavioural comorbidities of children with ASD. Current evidence of the effectiveness of music therapies in children with ASD comes from a handful of studies without systematic study designs, evaluations, and treatment protocols. There is an urgent need for systematic research in this field.
Whippl e et al. 2015	USA	Do Communicatio n Disorders Extend to Musical Messages? An Answer from Children with Hearing Loss or Autism Spectrum Disorders	CHILDREN 11 to 14 years	The results of this study indicate that children with ASD who present deficits in social and emotional areas but who are at the higher end of the ASD spectrum in terms of behavioural, cognitive, and language skills can effectively decode and recognise musical signals symbolising emotions or movements with levels of accuracy comparable to those of a TD-NH group.
Spiro et al. 2016	UNIT ED KING DOM	Analysing change in music therapy interactions of children with communication difficulties	CHILDREN 4 to 7 years	Multimodal communication is constantly evolving, and the results show a promising interaction between the verbal and musical domains stimulated by the aforementioned educational approaches that increasingly show their validity.
Bruschw ei l er-Stern 2017	SWITZERLAN D	The Music of Dan's Life	ALL AGE GROUPS	The study is based on how music influenced learning and Dan's entire life. He made the most of whatever he went through in his youth in his work. With his creative mind and rich and complex vitality, he has shed light on a world that is so intimately part of us that we hardly see it. At times, while writing his book, Dan was discouraged: "There is nothing there, it is just air," he would say, or "It was enough for me to transmit my enthusiasm and confidence to strengthen the wind, revitalise its momentum and further reveal to us the music of this air, so transparent but so dynamic."

Andr é et al. 2018	BRAZIL	Análise psychométrica das Escalas Nordoff-Robbins como instrumento de avaliação no tratamento musicoterapêuti co de crianças autistas em acompanhamen t o no Hospital das Clínicas da UFMG (HC-UFMG). Per Musi. Belo Horizonte: UFMG. p.1- 12	CHILDREN From 2 to 6 years	In Spearman's correlation, based on the inter-examiner score, is Status Found a significant result in all tests ($p<0.001$). In the Child Therapist Relationship Scale in the co-active musical experience, correlations were strong in both domains: levels of participation ($\rho=0.791$) and quality of resistivity ($\rho=0.756$); and in total ($\rho=0.858$). Strong correlations were also found in the Musical Communicability Scale in all domains: Instrumental ($\rho=0.735$), Vocal ($\rho=0.809$), and Bodily ($\rho=0.820$). In the total for Musical Communicability, the correlation was average ($\rho=0.695$). Therefore, the NR scales present a good reliability among evaluators.
Yoo et al. 2018	KOREA	Dyadic Drum Playing and Social Skills: Implications for Rhythm-Mediated Intervention for Children with Autism Spectrum Disorder	CHILDREN 11 to 16 years	This two-part study aimed to identify how social skills and aspects of dyadic drumming are related (Study 1) and, subsequently, to develop a rhythm-mediated intervention based on an understanding of how these aspects can be used to improve children's social skills with ASD (Study 2).
Forti et al. 2020	ITALY	Soundbeam imitation intervention: Training children with autism to imitate meaningless body gestures through music	CHILDREN 5 to 9 years	While presenting interesting and promising data, this study also has some limitations, including a small sample size and the fact that some children missed one of the sessions. Adult-directed behavioural interventions to teach imitation to children with ASD and based on highly structured artificial reinforcement have been criticised for their inability to produce a spontaneous imitation generalised, which is maintained in the absence of reinforcement.

Khyzhn to 2020	UKRAINE	Music Therapy as an Important Element in Shaping Communication Competences in Children with Autism Spectrum Disorder	CHILDREN	Music therapy influences (Błeszyński, 2005) the development of language and communication skills of children with autism spectrum disorder and reduces the incidence of echolalia. Sensory experiences are also beneficial for their development: hearing and listening to the sound emitted and comparing the energy involved in sound creation (sound dynamics). Vocal improvisation, imitation sounds, or singing songs release spontaneity but are also used for articulation. Relaxing music reduces tension and anxiety.
Pickard et al. 2020	NORWAY	"It's Not What's Done, But Why It's Done": Music Therapists' Understanding of Normalisation, Maximisation and the Neurodiversity Movement	ADULTS	The Movement for Neurodiversity is an opportunity to reflect on these important ontological considerations: How do we conceptualise differences in our practice, and what do we consider the intent of music therapy? We do not intend to advocate a single or particular modality of practice or approach, but rather to promote critical reflection on our assumptions, intentions, and positioning as music therapists. We also seek to problematise normocentric positions (Mottron, 2017) and support autistic forms of expression or neurodivergents.
Amonka R. et al. 2021	AUSTRALIA	Effects of Creative Movement Therapies on Social Communication Behavioural-Affective, Sensorimotor, Cognitive, and Functional Participation Skills of Individuals With Autism Spectrum Disorder: A Systematic Review	ALL AGE GROUPS	Our quantitative synthesis of the published literature suggested solid evidence and consistent small to considerable improvements in social communication skills following music and martial arts training, and of medium to significant improvements in motor and cognitive skills following martial arts and yoga training. Currently, there is limited evidence to support theatre and dance-based approaches, as well as the usefulness of all CMT approaches in improving affective, sensorimotor, and functional participation skills in individuals with ASD.

Barnes a et al. 2021	USA	Child-Robot Interaction in a Musical Dance Game: An Exploratory Comparison Study between Typically Developing Children and Children with Autism	CHILDREN	The therapists thought that using a robot (which performs repetitive behaviour) might appeal to children with ASD. It would also be useful for therapists, as thousands of repetitions are required to teach new behaviours and are tiring for most adults. It was suggested that a robot could be used to teach very simple and basic conversations, greetings, good manners, etc. The simplicity of a robot's face might be easier for children with ASD to look at than a human face.
Bergma n n et al. 2021	GERMANY	The Autism-Competency-Group AutCom. A promising approach to promote social skills in adults with autism spectrum disorder and intellectual disability	ADULTS	An overall construct, such as quality of life, is multifaceted and cannot be clearly attributed to a single intervention or training. However, with AutCom, we seek to improve mental health and contribute to a fulfilling life for persons with intellectual disabilities in comorbidity with autism spectrum disorder.
Lou r or 202 1	BRAZIL	Ensino musical e Autismo: relato de uma experiência a partir de uma pesquisa de doutorado em neurociências	ADOLESCENTS 11 years	The study reveals that even people with autism spectrum disorder can learn music if the teaching is adapted to their specific abilities and needs. The positive results of the research were favoured by the introduction of playful activities, constant movement, and diverse teaching materials during the lessons.
Danie l et al. 2022	CANADA	Rhythmic Relating: Bidirectional Support for Social Timing in Autism Therapies	ALL AGE GROUPS	Social timing support should facilitate perceptual discrimination, synchronisation, and contiguity of sensory inputs (e.g., by reducing audio 'noise' and latency). It should also facilitate temporal integration of multimodal information for motor planning and timely prediction of communicative acts. Finally, it should facilitate the rhythm and phraseology of play. It should facilitate the alignment of the movement/sound patterns of the trainee and practitioner in a sufficiently synchronised manner.

De Los Pinos et al. 2022	SPAIN	The Influence of Music on the Behaviour of Persons with Autism Spectrum Disorder (ASD) and Low Cognitive Functioning: A Systematic Observational Study	ADULTS From 9 to 21 years	This pilot study highlighted the trend that listening to consonant music (considered pleasant in previous studies by Maslennikova et al., 2013) could reduce the frequency of certain disturbed behaviours caused by the previous exposure to dissonant (unpleasant) music. In contrast, silent conditions after dissonant music did not produce the same level of reduction of disturbed behaviour.
Liu et al. 2022	USA	Parent-child nonverbal engagement during spoken versus sung book-sharing in preschoolers with and without autism	CHILDREN From 2 to 6 years	The comparison between the songbook activity and the picture book activity showed that visual attention was more relevant in the former case, both for the children and the caregivers. This outcome reinforces the initial hypothesis on the usefulness and effectiveness of the approach through music.
Raposo et al. 2022	PORTUGALO	Approaches: An Interdisciplina ry Journal of Music Therapy 16 (2) 2024	CHILDREN From 2 to 8 years	Evidence of inter-rater reliability and convergent validity has been found with significant results, as previously described by Waldon et al. (2015) with MASA-R, Bergmann et al. (2015) with Music-based Autism Diagnostics (MUSAD), and Gattino et al. (2017) with the Brazilian version of Kategorisystem Musiktherapie (KAMUTHE), although future studies are needed to increase the level of evidence of validity for the IMCAP-ND outcome measure.
Ren et al. 2022	CHINA	Examining the efficacy of dance movement and music mixed treatment on social communication impairment in children with autism - Based on family parent-child situation	CHILDREN 5 to 8 years	Given the obvious social impairment in children with ASD, existing research focuses on the effects of individual manual therapy or DMT interventions, and few studies have examined interventions on social impairment in children with ASD within the parent-child family system. Therefore, this study designed a mixed therapy intervention manual and DMT and conducted a 3-month intervention and training programme for children with ASD in a family context.

Romer et al. 2022	USA	Effects of Music on Driving Performance of Experienced Drivers With and Without Autism Spectrum Disorder	ADULTS Average age 23 years	The results showed that music did not significantly affect driving performance, contradicting previous studies. However, most previous studies aimed at novice drivers, and experience will likely make a difference. Of greater significance is the higher performance of drivers with ASD compared to their neurotypical peers. This suggests that experienced drivers with ASD might be better drivers with sufficient experience, as they are more likely to comply with the road rules.
Salvador-García et al. 2022	SPAIN	Socio-Ecological Correlates of Physical Activity in Children with Autism Spectrum Disorder: A Cross-Sectional Study in Spain	CHILDREN From 4 to 14 years	The results of this cross-sectional study contribute to the explanations provided by the ecological approach on how different domains may influence physical activity behaviour in individuals with ASD to a greater extent than their individual characteristics (Memari et al., 2013). Specifically, it appears that variables in the individual domain (e.g., gender, age, comorbidities/characteristics of children with ASD, and curricular adaptations) and the family domain (e.g., presence of siblings and parental physical activity) may be correlated with the physical activity levels of children with ASD who participated in the study, which supports the hypothesis consolidated.
Seifi et al. 2022	JAPAN	Haptics: Science, Technology, Applications p. 310	CHILDREN	Overall, Furekit was well-received and encouraged spontaneous physical movement in children with ASD. In the future, we plan to design more wearable versions of Furekit and continue to explore its applications as an educational and communicative tool through its collaborative use. We will further discuss how Furekit can be more integrated into their social life and potentially be used for other neurodevelopmental disorders.

Tergeis t et al. 2022	GERMANY	MUSAD-Short - A music-based screening tool to assess autism spectrum disorder in people with intellectual disability	ADULTS From 10 to 33 years	As an observational instrument, the MUSAD- Short complements existing screening instruments and can be conducted face-to-face, similar to other instruments such as the ADOS. Although the implementation time of the MUSAD- Short (about half an hour) is comparable to the processing time of the PDD-MRS (Kraijer & Bildt, 2005), additional material is required, i.e., congas, an oceanic drum, two wooden croaking frogs, a balloon, and a musical device. Therefore, the instrument is beneficial for music therapists, for whom these instruments are standard.
Xia T.and Li Z. 2022	CHINA	Behavioral Training of High-Functioning Autistic Children by Music Education of Occupational Therapy	CHILDREN 5 to 6 years	The number of autistic children is increasing year by year and, according to data, is rising at a rate of 10-18% each year. Currently, there are more than one million autistic children, and no definitive cure has yet been found. Only different forms of intervention can be used to compensate their maximum rehabilitation.
Ahn et al. 2023	JAPAN	Objective Measurement of Social Gaze and Smile Behaviors in Children with Suspected Autism Spectrum Disorder During Administration of the Autism Diagnostic Observation Schedule, 2nd Edition	CHILDREN Pre-school age	The Furekit is a wearable and tactile musical instrument kit aimed at developing the non-musical learning of children with ASD. The reaction of the pupils was immediately positive, stimulating the researchers' attention and willingness to continue making improvements to Furekit, as it has proven to be an educational and communicative tool with a lot of potential thanks to its collaborative use.

Lipska et al. 2023	POLAND	Art therapy for children with autism spectrum disorder	CHILDREN	Art therapy is one of the oldest and longest-lasting therapeutic modalities for children with ASD. Different types of art offer different therapeutic benefits, but all should have a common therapeutic effect, namely the improvement of social skills in children with ASD. Most studies show a high percentage of successful art therapy cases, with improvements in social skills reported by parents or a reduction in symptoms of anxiety and depression by the same patients.
Posner et al. 2023	USA	Prologue: The Interpersonal World of the Autistic Infant, Part 2: Modes of Treatment	CHILDREN	The ability to discern the communicative intentions of others, as expressed through the non-verbal exchange of dynamic forms of vitality, is emphasised. "Being in tune and united musically, "the child experiences a relationship in a way that might be difficult to do otherwise. Just as dance can lead to early relationship development, so music therapy can catalyse the development of an emerging sense of self, enhancing the capacity for 'emotional regulation, flexibility and cooperative relationship, both within and outside therapy'.
Sedighi et al. 2023	IRAN	Effectiveness of Simultaneous Musical-Motor Activities on Balance Improvement in Children with High-Functioning Autism Spectrum Disorder	CHILDREN 8 to 9 years old	This study explores the effectiveness of simultaneous music-motor activities in improving balance in children with high-functioning autism spectrum disorder. The researchers compared a group performing motor exercises with music (Orff music) with a group doing the same exercises without music and a control group, finding that the combined intervention significantly improved static and dynamic balance. The results suggest that music-motor activities can be recommended as a therapeutic intervention to address balance problems in these children, highlighting the role of music in facilitating sensory integration and motorisation.

That n 2024	USA	Bridging the gap: fostering interactive stimming between non-speaking autistic children and their parents	CHILDREN 5 to 18 years	Given the contrasts between autistic and neurotypical minds, achieving a common experience is almost impossible. Important is how autism constitutes a unique culture: music can produce profoundly different results with autistic individuals and neurotypicals.
Hatahe t et al. 2024	HUNGARY	Music Therapy as a Tool to Unveil Musical Potential or Hidden Savant in Children with Autism: A Case Study	CHILDREN Up to 17 years	This study demonstrates how music therapy with children with ASD improves not only the learning of a musical instrument, but, above all, in terms of their quality of life by acting on social, cognitive processing, and especially emotional regulation, which is usually quite impaired in people with ASD.
Mülle r et al. 2024	HUNGARY	The Experiences of Motor Skill Development in Children with Autism Spectrum Disorder (ASD) Reflected through Parental Responses	CHILDREN 3 to 10 years	The warning that this research aims at is to raise awareness among clinicians, researchers, and policy-makers by demonstrating that a holistic and complex approach to people with ASD shows a significant improvement in several aspects of quality of life, supporting children in achieving their highest potential.
Ni Moo et al. 2024	CHINA	Family-centred creative arts therapies for children with autism: A configurative systematic review	CHILDREN From 2 to 17 years	The action of Creative Arts Therapies (CAT), focused on families with children with ASD, highlights how this approach is a key foundation for shaping behaviour, using body movement and physical action as a therapeutic strategy. These findings are intended to stimulate the practice and research of family life education in contexts where there is a child with ASD.
Raposo et al. 2024	PORTUGAL O	The Individual Music-Centred Assessment Profile for Neurodevelop mental Disorders (IMCAP-ND) for use in Portugal: Translation and	CHILDREN From 2 to 8 years	Temporal stability was analysed using test-retest reproducibility, which was calculated using Cohen's kappa and CCI of 12 cases. Cohen's kappa coefficient revealed a low concordance in only 2 of the 109 items of the 3 subscales, a slight concordance in 16 items, a considerable concordance in 57 items, a moderate concordance in 29 items, and a substantial concordance in 5 items, according to the criteria of Landis and Koch (1977).

		psychometric evidence		
Reiter e et al. 2024	USA	Telehealth in arts therapies for neurodevelopment and neurological disorders: a scoping review	ADULTS From 4 to 87 years	The new frontier of telemedicine has shown that art therapy has the potential to improve the social, emotional, and cognitive aspects of people with ASD. Furthermore, telemedicine, being at a distance, is indispensable for people unable to travel for health reasons or due to distance.
William s et al. 2024	USA	Improved motor skills in autistic children after three weeks of neurological music therapy via telehealth: a pilot study	CHILDREN 5 to 10 years	The pilot study reports that children with ASD improved motor skills after just nine sessions. Even the professionals themselves claim to have implemented their intervention strategies, given the remarkable results obtained.
William s et al. 2024	CANADA	Auditory feedback decreases timing variability for discontinuous and continuous motor tasks in autistic adults	ADULTS From 17 to 27 years	Autistic adults have greater difficulty with split-time tasks than with continuous-time tasks. Autistic adults can exploit augmented auditory feedback without a concomitant rhythmic auditory signal to reduce movement variability to a precise level for continuous and discontinuous time tasks. This article supports the potential of music-based motor rehabilitation techniques involving augmented auditory feedback to reduce motor variability in persons with autism. Further research is needed to ascertain the clinical potential of auditory feedback in improving various movement parameters to a degree that is meaningful to people's everyday life experiences and needs autistic.

Zou et al. 2024	CHINA	Analysis of the moderating effect of music therapy on autism in the context of big data	CHILDREN 11 years	The attention and concentration of children with ASD who underwent the music therapy intervention improved significantly. The data extrapolated from the research confirm how effective this practice is in improving the quality of life of the subjects taken in consideration.
Kanzari et al. 2025	SWITZERLAND	The Impact of a Music and Movement-Based Intervention on Motor Competence, Social Engagement, and Behavior in Children with Autism Spectrum Disorder	CHILDREN From 5 to 13 years	Intervention with music, physical activity, and play improves social behaviour, motivation, and motor skills in children with ASD. This study highlights the educational aspect of such pedagogical action.
Ragone et al. 2025	ITALY	Supporting and understanding autistic children's non-verbal interactions through OSMoSIS, a motion-based sonic system	CHILDREN 5 to 11 years	The study reveals that the reactions of children with ASD when the 'Sounds On' or 'Sounds Off' conditions were activated were significantly more favourable when interacting with others. Musical stimuli encourage imitation of body language, and systems such as OSMoSIS also encourage physical activity. This aspect is still to be investigated, but there are indications of a concrete validity.
Yu et al. 2025	USA	Protocol for evaluating the effects of integrating music with taekwondo training in children with autism spectrum disorder: A randomised controlled trial	CHILDREN 7 to 9 years	The results of this study will provide an additional option for managing children with ASD and evidence-based strategies that can improve children's active participation in training sessions. The results will be helpful in the educational work and offer potential practical suggestions for teachers and caregivers to improve the effectiveness of teaching and training in children with ASD.

Discussions

Neurobiological and behavioral foundations

Music, with its rhythmic and melodic structure, can involve the motor and auditory systems, can overcome barriers, open channels of expression and communication and induce significant changes in the mind and body, considering that some individuals with autism show a musical predisposition.

Distinction between music education and music therapy

Music education in the context of autism focuses on developing an understanding of musical content, while music therapy works through music and its elements to intervene in various contexts (medical, educational, every day) to optimise quality of life and improve general well-being.

Role of the movement

Movement is a form of learning based on the neurological stages of development. Movement activities can improve perception and functional use of the body, motor coordination and neurological maturity.

Pedagogical approaches and methodologies

Music-Centred Improvisational Music Therapy, Nordoff Robbins Scales (NR), Music Education with Psychomotor Enfoque, Rhythmic Auditory Stimulation (RAS®), Ludomusic Activities.

Table 3. Comparative Table of Methodologies

Methodology	**Primary Focus**	**Role of the Movement**	**Pedagogical/Therapeutic Objectives Primary**
Music therapy	Music and its elements as a professional intervention	It can be a means of expression and interaction	Improvement: communication, socialisation, behaviour, physical, emotional well-being, cognitive and social
Adapted Music Education	Teaching and understanding of musical content	An influential element in the learning process	Development of musical understanding, cognitive skills, body, and adaptation to specific difficulties
Neurologic Music Therapy	Music for dysfunctions cognitive, sensory and motor	Rhythm drives the cortical plasticity for movement	Improvement of motor, sensory, and cognitive functions based on neuroscientific models
Dance Movement Therapy	Expressive movement	Primary means of expression and interaction	Emotional, social, cognitive, and physical integration
Orff and Jaques-Dalcroze	Rhythm, movement and musical improvisation	Central elements of musical learning	Musical learning through bodily experience, rhythm and creativity

Movement Sonification	Sounds generated by movement	Basis for interaction and sound feedback	Increased imitation, interaural synchronisation, involvement and positive affectivity

Pedagogical Objectives and Outcomes

The pedagogical objectives include the improvement of cognitive skills, motor and psychomotor skills, and body-scheme knowledge and awareness, communication and socialisation, the acquisition of musical content, and potential improvement of language skills, motor imitation, and general development

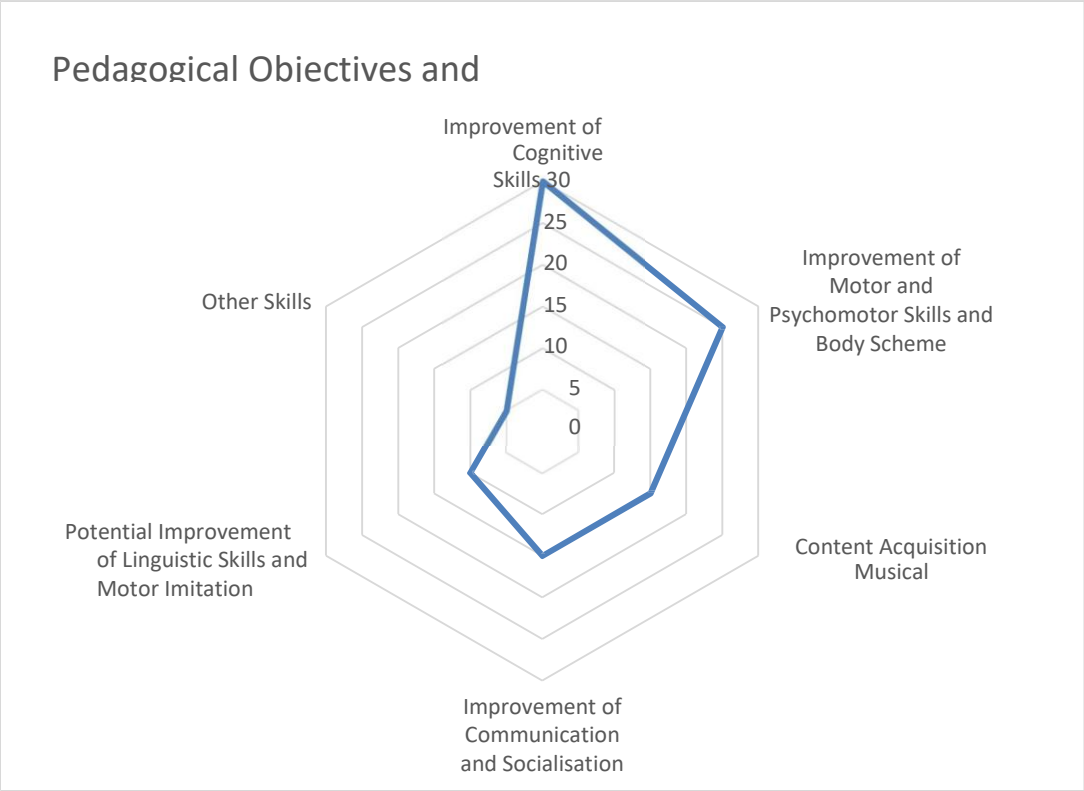

Figure 2. ***(****source: own elaboration)*

The sources presented by the different countries show how attention to the topic is now spread all over the planet.

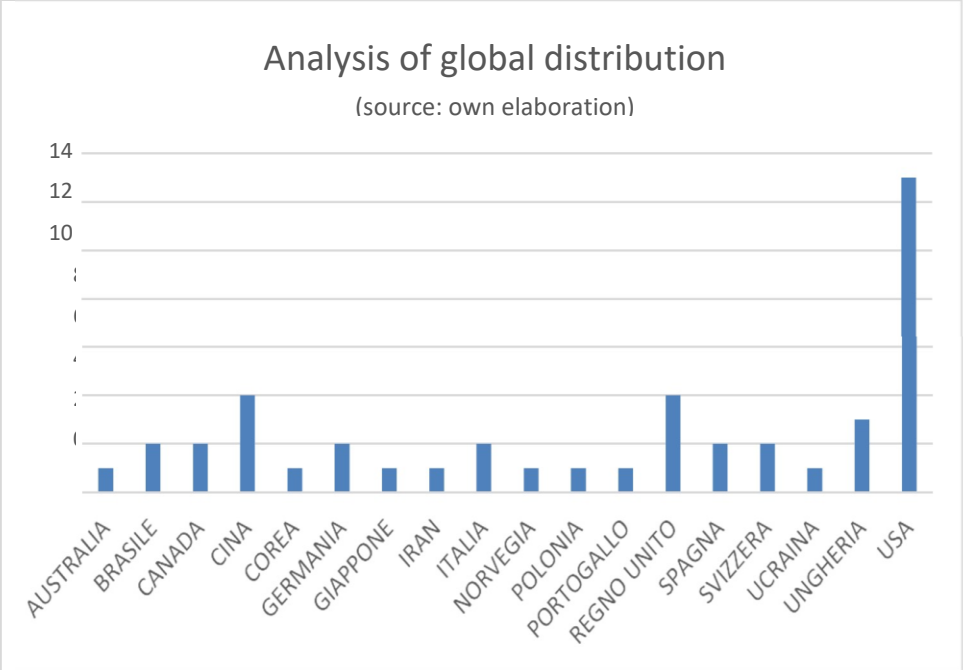

Figure 3. (*source: own elaboration)*

Conclusion

According to the data, the rate of children manifesting ASD increases every year, and it is therefore imperative that studies for more effective and efficient management of the phenomenon be increased. The present work identifies the desire to expand the literature on this topic by analysing the educational potential of the factors considered and attesting to the validity of using these alternative communication channels. It emerges that music and movement represent valid and potentially effective pedagogical tools to support the learning and development of individuals with ASD. Research indicates improved communication, socialisation, motor, and cognitive skills through targeted interventions. The holistic approach proved extremely powerful, considering not only the human network (educators, family, school, caregivers) but also specific screening tools, art therapy, and telemedicine, to name a few.

Specific assessment tools such as the *Nordoff Robbins Scales* and the others mentioned above make estimating progress more concrete and objective. Exploring which techniques and expedients are instrumental in obtaining answers in the treatment of persons with ASD underlines the need not to stop study and research in this specific field. Neuroscientific knowledge integrated with pedagogy will be the new frontiers to achieve even more personalised and targeted interventions, considering the diversity and complexity with which it manifests itself, aimed at guaranteeing anyone with this disorder a better quality of life.

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