Exploring the Influence of Music Intervention on Social and Communication Development in Autism Spectrum Disorder

Pulaporn Sreewichian[1]
ปุลพร ศรีวิเชียร

Abstract

Deficits in social and communication skills are known as core problems in autism spectrum disorder. To improve the core deficits, music has been used in therapeutic and educational contexts to facilitate social and communication developments in autism individuals. The review on reports of music intervention, music therapy and non-music therapy approaches, demonstrates that music seems to facilitate the developments in social interaction skill and, both, verbal and non-verbal communication skills. By analysing the outcomes of the interventions along with the evidences from psychology and neuroimaging literatures, the analysis in this article suggests that the improvements may be facilitated from the use of music as a medium for communication within the intervention and the characteristics of the music intervention.

Keywords: Music intervention, Music Therapy, Autism Spectrum Disorder, Social, Communication.

[1] Graduated Master student in Psychology of Music, The University of Sheffield

Introduction

Individuals with autism spectrum disorder or ASD often experience everyday challenges from difficulties in socialising[2]. The difficulties are results of the main deficits of the disorder. According to American Psychiatric Association, ASD is a neurodevelopmental disorder with deficits in social and communication skills; for instance, lack of social responses, lack of understanding non-verbal communication and lack of social awareness. As a consequence of these deficits, individuals with the disorder have usually faced difficulties in interacting and establishing relationships with others from a very young age[3] and continued to have lifelong problems in social interaction and social communication skills[4].

To cope with these difficulties, music interventions have been used with young individuals with ASD in therapeutic and educational contexts for almost a century. An evidence can be found back in 1926 when music was used along with physical education in the special ASD curriculum designed by Sister Viktorine Zak at the Widerhofer Pavilion[5]. Later, from the 1940s, music has been therapeutically used with children with ASD in psychiatric hospitals, institutions and schools; afterward, many music therapy methods have been developed to meet the needs of the ASD deficits.[6] Furthermore, many non-music interventions for ASD have started applying music within their approaches.[7] Lately, music has also been used in adaptive intervention outside of the therapeutic and educational contexts; for example, in the Rhythmic Art Project[8] which is a program that uses music to promote well-being and social developmental needs. The growth in the use of music in the interventions for ASD over the nine decades demonstrates that more people are becoming aware of the influence of music in facilitating ASD social and communication development.

---

[2] John Markley, "Reflections on the School Experience of a Student with Autism Spectrum Disorders." In *Autism and Developmental Disabilities: Current Practices and Issues*, edited by Anthony F. Rotatori, Festus E. Obiakor and Sandra Burkhardt (Bingley: JAI Press, 2008. http://doi.org/10.1016/S0270-4013(08)18008-4), 157-162.

[3] Brenda Robson, *Pre-School Provision for Children with Special Needs* (London: Cassell, 1989), 51.

[4] Jill Boucher, The Autistic Spectrum: Characteristics, Causes and Practical Issues (Los Angeles: SAGE, 2009), 77- 79.

[5] Uta Frith, "Asperger and His Syndrome." In Autism and Asperger Syndrome, edited by Uta Frith (Cambridge: Cambridge University Press, 1991), 8-9.

[6] Alaine E. Reschke-Hernandez, "History Music Therapy Treatment Interventions for Children with Autism," *Journal of Music Therapy* 48, no. 2 (Summer, 2011): 172, http://doi.org/10.1093/jmt/48.2.169.

[7] Robert Accordino, Ronald Comer, and Wendy B. Heller, "Searching for Music's Potential: A Critical Examination of Research on Music Therapy with Individuals with Autism," *Research in Autism Spectrum Disorder* 1, no. 1(2007): 110-112, http://doi.org/10.1016/j.rasd.2006.08.002.

[8] Eddie Tuduri, "The Rhythmic Arts Project," *The Exceptional Parent* 36, no. 3 (March, 2006): 23, https://search-proquest-com.sheffield.idm.oclc.org/docview/223535380?accountid=13828.

The aim of this article is to examine the impact of music intervention, including music therapy and non-music therapy approaches, on social and communication development. The article is separated in to two sections. The first section is a brief review on reports of music interventions on the social and communication developments. The goal of this first part is to provide the readers a concise evidence of music intervention and its results on the improvements in individuals with the disorder. Then, the next section is an analysis how music intervention can influence on ASD's core deficits based on literature review, drawing evidence from music psychology and neuroscience studies. The section will start by analysing the impact music on individuals with ASD, as music is a core element used in the intervention, then, followed by the analysis on music intervention practice.

Reports of Music Interventions and the Social and Communication Developments

In the present day, many developed music interventions are used to improve social interaction, communication skills and other developmental needs of individuals with ASD. Some are methods from music therapy approaches, for instance, improvisational music therapy, musical interaction therapy, activity music therapy, etc.[9] Outside of music therapy practice, music has also been used in other intervention designs, for example, the auditory integration training (AIT), rhythmic intervention and integrated movement and music program.[10] Interestingly, many outcomes from interventions with music have been reported to affect social and communication improvement. This section presents examples of music intervention and its outcomes in social and communication skill improvement, including development of social interaction and non-verbal and verbal communication. Examples are from music and non-music therapy approaches, of which the non-music therapy is considered music intervention that is designed and conducted by non-music therapist.

Many studies support that music intervention influences social interaction improvement in ASD individuals. Social interaction impairment in people with ASD can be found as lack of joint attention, co-ordinate attention between interactive social partners, and lack of eye contact. While typical children have learnt social interaction through eye contact with their caregivers since their infancy stage; children with ASD tend to focus less on the eyes when interact with others. Interestingly, research reveals that these social interaction skills are

[9] Robert Accordino, Ronald Comer, and Wendy B. Heller, "Searching for Music's Potential: A Critical Examination of Research on Music Therapy with Individuals with Autism," *Research in Autism Spectrum Disorder* 1, no. 1(2007): 103-112, http://doi.org/10.1016/j.rasd.2006.08.002.

[10] Ibid., 103-112.

improved after having music therapy intervention.[11] Case studies from McTier demonstrate development in integration between ASD clients and a therapist through music therapy intervention sessions. Clients were reported as developing eye contact, instrumental sharing and integrating in music making activities with the therapist. Another example from Wimpory and Nash reports that client showed increasing lengthier events of eye contact and joint attention with parents after attending interactive music therapy sessions. Both studies report follow-up data showing that clients have maintained the skills and developed interest in seeking to interact with others beyond the sessions.

Development in joint attention is also found as a result in music intervention outside of the music therapy practice. In a study by Srinivasan et al., comparing outcomes of rhythmic intervention, using singing and rhythmic elements to engage children with ASD into a whole-body imitation game, with robotic intervention, result revealed that children who attended the rhythmic intervention group showed greater joint attention development than other groups. A technology mediated music-making intervention by Kossyvaki and Curran also observed positive outcomes of joint attention from children with ASD during the intervention. The interventions in both examples were designed and conducted by non-music therapist practitioners; nonetheless, the results of both studies have shown that some applied music activities could enhance development in joint attention in young individuals with ASD.

Music intervention is also reported to have a significant effect on developing of communication skill. In music therapy practice, the intervention is used as an expected medium for non-verbal and gestural communication outcomes. Many literatures have suggested that music therapy could be an effective practice for communication development for ASD individuals.[12] Studies report that individuals with ASD can be seen for developing to use music for self-expressing and communicating with therapists or researchers and gestural communication. [13]An example of the improvement can be seen in cases reviewed in Ockelford which clients developed to use musical instrument to interact with a therapist through musical conversations. The clients showed improvement in giving cues and taking turns in musical dialogues, indicating the development in using body movements and having awareness of oneself and others.

---

[11] Jennifer Whipple, "Music in Intervention for Children and Adolescents with Autism: A Meta-Analysis," *Journal of Music Therapy* 41, no.2 (July, 2004): 262, https://doi.org.sheffield.idm.oclc.org/10.1093/jmt/41.2.90, 102.

[12] Ibid., 102-103; Ibid., 106-112.

[13] Ian S. McTier, "Music therapy in a special school for children with autistic spectrum disorder, focusing particularly on the use of the double bass." In Music Therapy in Schools: Working with Children of all Ages in Mainstream and Special Education, edited by Jo Tomlinson, Philippa Derrington, and Amelia Oldfield (London: Jessica Kingsley, 2012), 156-161; Adam Ockelford, "Songs Without Words: Exploring How Music Can Serve as a Proxy Language in Social Interaction with Autistic Children," In Music, Health, & Wellbeing, edited by Raymond Macdonald, Gunter Kreutz, and Laura Mitchell (Oxford: Oxford University Press, 2012), 322.

Whilst music therapy is widely discussed on its effect on non-verbal communication skill development; however, there is not many literatures discussed on the effect of non-music therapy intervention on such development. Thus, the future research on music intervention outside of the music therapy practice could examine more into the influence of the intervention on this outcome.

Sometimes, music intervention also shows influence on verbal communication development in non-verbal ASD children. Research has shown that music therapy could affect verbal production in non-verbal children with ASD. A study by Lim, comparing improvement from music therapy technique called Developmental Speech and Language Training through Music (DSLM) and a regular speech training, found that both approaches influencing verbal production improvement. However, participants with low-functioning ASD were found to have greater verbal development after attending DSLM than the speech training. These studies have provided evidences that music has a potential to enhance verbal communication training for ASD individuals.

Similar results on verbal production development can be found in non-music therapy intervention. Sandiford, Mainess and Daher conducted a pilot study, comparing outcomes of melodic-based communication therapy (MBCT) and traditional therapy for eliciting speech. In MBCT, clinicians are to play pre-recorded instrumental and melody through a compact disc player while prompting children with ASD during the intervention.[14] Results revealed that MBCT showed faster rate of verbal production improvement and greater overall development in verbal attempt when compared to the traditional therapy. Influence in verbal development is also reported by music educators who gave individual music education intervention to children with ASD. A case study by Fong and Lee, giving an individual music lessons, involving singing, movement activities and musical games, to a young child with ASD who was reported to being unable to properly communicate verbally; observed that the child showed improvement in verbal communication in class and was able to give proper verbal answers to the teacher, indicating development in self-control over verbal interaction. Thus, these evidences have demonstrated that improvement in verbal communication can also be found in non-music therapy music interventions.

Whilst there are many positive reports of music interventions, both music and non-music therapy approaches, some approaches with passive music activities seem to be less promising. Reports with successful outcomes are mostly engaged with active music making activities, for instance, singing or playing music with therapists, practitioners or clinicians. In

[14] Givona A. Sandiford, Karen J. Mainess, and Noha S. Daher, "A Pilot Study on the Efficacy of Melodic Based Communication Therapy for Eliciting Speech in Nonverbal Children with Autism," Journal of Autism and Developmental Disorders 43, no.6 (June, 2013): 1300, https://doi.org/10.1007/s10803-012-1672-z.

contrast, a passive music approach such as AIT, involving listening to music only and usually excluded from music therapy practice, has shown controversial results in improving long-term communication skills[15]. Therefore, this has given one consideration that the more promising development on social communication development could possibly be found as a result of active music intervention more than the passive music approach.

How Music Intervention Can Help Improving Social and Communication in ASD

As the evidences have showed in the previous section, music intervention has been reported to have positive impacts on individuals with ASD. It is not surprising that the intervention is widely discussed as a tool which facilitates social and communication improvement[16]. This section will analyse how music, as a tool for communication, and music intervention can influence social and communication development in ASD individuals.

Music as a Medium for Communication

Music is a non-verbal and complex sound whose structure can possibly be perceived by ASD individuals despite their lack of ability to process other verbal communication or languages. Examples of musical structure perceived by ASD individuals can be seen in man studies. For instant, a study by Quintin, Bhatara, Poissant, Fombonne and Levitin shows that individuals with high-functioning ASD have the ability to process musical structure in a global level. Similarly, Lim found that non-verbal and low-functioning ASD children show intact ability to perceive and imitate musical patterns, illustrating that complex sound structure processing ability also appears in ASD individuals with the lack of language understanding. This aptitude of musical structure processing may be a trait from early childhood development of shared music and language neutral processing mechanisms[17]. Proven by evidences from

---

[15] Accordino, Comer, and Heller, "Searching for Music's Potential: A Critical Examination of Research on Music Therapy with Individuals with Autism," 110-112.

[16] Andrea Caria, Paola Venuti, and Simona de Falco. "Function and dysfunction brain circuits underlying emotional process of music in autism spectrum disorders," Cerebral Cortex 21, no. 12 (December, 2011): 2845-2846, http://doi.org/10.1093/cencor/bhr084.; Kate Simpson, and Deb Keen. "Music Interventions for Children with Autism: Narrative Review of the Literature," Journal of Autism and Developmental Disorder 41, no.11 (November, 2011): 1507-1508, http://dx.doi.org/10.1007/s10803-010-1172-y.; Eve-Marie Quintin, Anjali Bhatara, Hélène Poissant, Eric Fombonne, and Daniel J. Levitin, "Emotion Perception in Music in High-Functioning Adolescents with Autism Spectrum Disorders," Journal of Autism and Developmental Disorders 41, no.9 (September, 2011): 1251, http://doi.org/10.1007/s10803-010-1146-0.

[17] Erin McMullen, and Jenny R. Saffran. "Music and Language: A Developmental Comparison, " Music Perception: An Interdisciplinary Journal 21, no.3 (Spring, 2004): 303, https://doi.org/10.1525/mp.2004.21.3.289.; Hayoung A. Lim, "Effect of Developmental Speech and Language Training Through Music" on Speech Production in Children with Autism Spectrum Disorders," Journal of Mussic Therapy 47, no.1 (Spring, 2010): 19-20, https://doi.org/10.1093/jmt/47.1.2.)

neuroimaging using a functional magnetic resonance imaging (fRMI), an experiment done by Caria et al. demonstrated that music activated brain areas of ASD individuals which involve syntactic, temporal, rhythmic, and pitch information processing. Some of the activated areas are known to be involved in language structure processing, such as the left supramarginal gyrus and the superior temporal gyrus[18]. Whilst ASD involving developmental impairments resulting in dysfunctionality in complex verbal processing[19] and usually showing difficulties in verbal communication skills[20], interestingly, the ability to perceive and develop understanding in musical structure is preserved.

With the aptitude to perceive musical structure and the overlapping musical and language processing mechanisms, music can be a promising medium for verbal training in ASD individuals who possess non-verbal and low-verbal skills. From the example from the research of Lim, non-verbal ASD participants gradually increased their understanding, imitated the given musical patterns, and, finally, developed to functional speech producing. The results from his research suggest that ASD children can transform musical patterns into speech patterns. This language development procession may be advantaged from predicable characteristics of musical repertoire inside the intervention. Music as a medium for verbal producing allows individuals with ASD to train pitch and rhythmic of words[21]. By repeating the same practice over the time, the music patterns will be more predicable for ASD individuals to imitate[22] and produce speech sound from emulating pitch and rhythm. The idea of imitating pitch and rhythmic training is also discussed that the particular training for non-verbal ASD individuals may increase their abilities to recognise pitch and rhythmic information from words in real life context[23]. However, there is lack of research evidence focusing on musical pattern perceiving aptitude and improving of speech sound produced in ASD individuals with non-verbal or low-verbal skills. Thus, this suggests that more research in this area should be conducted to provide more evidence and

---

[18] Edith Kaan, and Tamara Y. Swaab. "The Brain Circuitry of Syntactic Comprehension," TRENDS in Cognitive Sciences 6, no.8 (August, 2002): 352, http://doi.org/10.1016/S1364-6613(02)01947-2.

[19] Nathalie Boddaert, Nadia Chabane, Pascal Belin, Marie Bourgeois, Vincent Royer, Catherine Barthelemy, Marie-Christine Mouren-Simeoni, Anne Philippe, Francis Brunelle, Yves Samson, and Mônica Zilbovicius, "Perception of Complex sound in Autism: Abnormal Auditory Cortical Processing in Children." *American Journal of Psychiatry 161*, no.11 (November, 2004): 2119, https://doi.org/10.1176/appi.ajp.161.11.2117.

[20] Jill Boucher, The Autistic Spectrum: Characteristics, *Causes and Practical Issues*, 93.

[21] Givona Sandiford, Karen Mainess, and Noha Daher, "A Pilot Study on the Efficacy of Melodic Based Communication Therapy for Eliciting Speech in Nonverbal Children with Autism," *Journal of Autism and Developmental Disorders*43, no. 6 (June 2013): 1304.

[22] Adam Ockelford, "Songs Without Words: Exploring How Music Can Serve as a Proxy Language in Social Interaction with Autistic Children," 322.

[23] Sandiford, Mainess, and Daher, "A Pilot Study on the Efficacy of Melodic Based Communication Therapy for Eliciting Speech in Nonverbal Children with Autism," 1303-1304.

analysis for the intervention.

Another unique essential of music that makes it a promising medium for communication is that music can be perceived emotionally by people with ASD. It is important to underline that deficient in emotional processing is one of the common characteristics in ASD population[24]. This is caused from the impairment in developmental state which affects the development of secondary emotion and facial expression[25], and comorbid condition of type two alexithymia that causes difficulties in naming and verbally expressing emotions, and identifying emotion expressed by others[26]. Allen, Davis, and Hill using skin conductance method (GSR), revealed that participants with ASD have physiological response to music in the same way found in individuals with typical development. This indicates that individuals with the disorder also experience arousal from listening to music. However, in the study, participants with ASD are shown to have problems describing and imagining emotions from musical listening. Due to the lack of emotional describing to the music of the participants and emotional deficient of the disorders, Zangwill (2013, 1-3) had discussed based on results of Allen et al. Zangwill raised three hypotheses: a) that music uniquely triggered normal emotion cognition of ASD individuals, b) that ASD individuals could be aroused by music as a kind of sound, not as music itself, and c) that ASD individuals may be aroused from the rhythm existed in music. Nevertheless, there are evidences answering these hypotheses and supporting the abilities to process music emotion of individuals with ASD. First, an explanation for the first hypothesis can be seen in Quintin et al., the work found that ASD individuals can report basic, sad, happy, and other specific emotions perceived from listening to music which are known to be secondary emotions, such as peaceful and scary. These results show that music can trigger complex emotion which is likely to be defected in ASD individuals. Secondly, to suggest an answer for the second hypothesis, music is allegedly used as a medium for different moods altering by most of the ASD participants in the qualitative study by Allen, Hill, and Heaton. This indicates that ASD individuals experience emotional arousal and have conscious awareness of such arousal they perceive from music listening. Lastly, the rhythmic factor suggested in the third hypothesis may not be the main factor for musical emotion arousal in individuals with ASD. As previously stated regarding the ability to process musical structure and imitate its patterns, people with ASD are capable of processing and being aware of elements in music. Moreover, characteristics of rhythm and tempo in music preferred by ASD individuals are different depending on their

[24] American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders (DSM-V)*, (Washington DC: American Psychiatric Press, 2013), 53.

[25] Eve-Marie Quintin et al., "Emotion Perception in Music in High-Functioning Adolescents with Autism Spectrum Disorders," *Journal of Autism and Developmental Disorders*41, no. 9 (September 2011): 1241.

[26] Sylvie Berthoz, and Elisabeth L. Hill, "The Validity of Using Self-Reports to Assess Emotion Regulation Abilities in Adults with Autism Spectrum Disorder," *European Psychiatry* 20, no.3 (2005): 294-297, http://doi.org/10.1016/j.eurpsy.2004.06.013.

personal preferences. Some individuals with ASD prefer slow and quiet music to produce sense of calmness, while others may not prefer music with slow pace[27]. Hence, individuals with the disorder experience and are conscious of emotion arousal from music despite their emotional understanding deficits.

The characteristic of music as a non-verbal sound may be a beneficial factor of music emotion processing for individuals with ASD. This suggestion is raised from considering the co-morbidity with type two alexithymia in ASD population. Alexithymia is described as having difficulties in perceiving and expressing emotions in symbolized communication[28]. As mentioned in Berthoz and Hill, many individuals with ASD have similar cognitive impairments of type two alexithymia. By considering these suggestions, the characteristics of type two alexithymia may associate with the difficulties in processing and understanding emotion based on verbal communication, such as naming, describing, and thinking of emotions. However, an evidence from neuroimaging shows that brain areas of individuals with ASD which are used to process emotions and perceive emotional states are activated when listening to music[29]. The activations in areas which are known for understanding and being conscious of emotion to music sound might be related to their attribute that does not contain verbal meaning. Without conveying verbal content, music emotion may possibly be directly processed without the need for verbal interpretation.

Another interesting theory from neuroscience and music psychology is that the influence of music on emotional understanding in ASD might also be associated with the mirror neuron system or MNS. This neuron system is involved in action and emotional understanding of others.[30] Thus, MNS is also believed to be associated with social cognition, imitation learning, language development and emotional empathy.[31] Because of its association with the mentioned social and communication skills, some scholars have questioned that the core deficits of ASD might be affected by the dysfunction of MNS. Whilst some pieces of evidence from a neuroimaging

---

[27] Rory Allen, Elisabeth Hill, and Pamela Heaton, "The Subjective Experience of Music in Autism Spectrum Disorder," *Annuals of the New York Academy of Science* 11691, no.1 (July, 2009): 328, http://doi.org/10.1111/j.1749-6632.2009.04772.x.

[28] Thomas M. Roedema and Robert F. Simons, "Emotion-Processing Deficit in Alexithymia," *Psychophysiology* 36, no.3 (March, 1999): 379, http://doi.org/10.1017/S0048577299980290.

[29] Andrea Caria, Paola Venuti, and Simona de Falco, "Function and dysfunction brain circuits underlying emotional process of music in autism spectrum disorders," *Cerebral Cortex* 21, no. 12 (December, 2011): 2841, http://doi.org/10.1093/cencor/bhr084.

[30] Giacomo Rizzolatti and Laila Craighero. "The Mirror-Neuron System," *Annual Review of Neuroscience* 27 (2004):174-278, http://doi.org/10.1146 /annurev.neuro.27.070203.144230; Leonardo Fogassi, "The Mirror Neuron System: How Cognitive Functions Emerge from Motor Organization," *Journal of Economic Behavior & Organization* 77, no.1 (January, 2009): 70.

[31] Leonardo Fogassi, "The Mirror Neuron System: How Cognitive Functions Emerge from Motor Organization," *Journal of Economic Behavior and Organization*77, no.1 (January, 2011): 70.

study seemed to agree that there is an abnormal activation in the brain area related to MNS[32] found in persons with ASD[33]; some neuroimaging results revealed that brain regions associated with MNS of individuals with ASD and typical development are similarly activated in response to music listening. This contradiction has led to discussions on the effect of music on MNS in ASD.[34] As the activation in MNS influence skills underlines emotional understanding, and also social interaction and communication, there are suggestions that music could be an effective therapeutic tool for ASD. However, the general hypothesis on the dysfunction MNS of ASD has still been controversially discussed, which lead to an ambiguity to conclude the impact of music on MNS. On this account, there is still a need for researchers to understand more about the general relationship between the disorder and MNS before any music psychologist can draw a conclusion about the influence of music on this neuron system.

Music Intervention, an Opportunity to Develop Social and Communication

First thing that should be underlined when discussing about music intervention is that the intervention includes music as a medium or a tool to enhance development in individuals with ASD. One benefit of using music is that it provides an opportunity to express and communicate with others through music. Whilst social communication skill deficits are the common characteristic of the disorder which affects ASD individuals from a young age; people with the disorder still have needs for sense of belonging and being able to communicate with others.[35] With the benefit as a non-verbal sound that can be perceived structurally and emotionally, as suggested above, music can possibly be a medium for ASD individuals despite their lack of ability to communicate with others through verbal communication in daily life. Music intervention provides an opportunity for people with ASD to express themselves and interact with others using a medium that they can comprehend. Music intervention involving music making activity helps them create, take control and share the non-verbal communication

---

[32] Justin H. G. Williams, Andrew Whiten, Thomas Suddendorf, and David I. Perrett, "Imitation, Mirror Neurons and Autism," *Neuroscience & Biobehavioral Review* 25, no. 4 (June, 2001): 290-291, http://doi.org/10.1016/s0149-7634(01)00014-8.

[33] Nouchine Hadjikhani, Robert M. Joseph, Josh Snyder, and Helen Tager-Flusberg,"Anatomical Differences in the Mirror Neuro System and Social Cognition Network in Autism," Cerebral Cortex 16, no.9 (September): 1518, http://doi.org/10.1093/cercor/bhj069.

[34] Katie Overy, and Istvan Molnar-Szakacs, "Being Together in Time: Musical Experience and the Mirror Neuron System," *An Interdisciplinary Journal 26*, no.5 (June, 2009): 93, http://doi.org/10.1525/mp.2009.26.5.489; Catherine Y. Wan, Krystal Demaine, Lauryn Zipse, Andrea Norton, and Gottfried Schlaug,"From Music Making to Speaking: Engaging the Mirror Neuron System in Autism," Brain Research Bulletin 82, no.3-4 (May, 2010): 165, http://doi.org/110.1016/j.brainresbull.2010.04.010.

[35] Luke Jackson, *Freaks, Geeks and Asperger Syndrome: A User Guide to Adolescence* (London: Jessica Kingsley Publishers, 2002), 163-166.

dialogue with others,[36] and strengthen communication skills[37], such as, developing understanding in turn-taking, cue-giving and awareness of others' actions.

Using music in the intervention may also be beneficial for emotion and social learning for individuals with the disorder. As previously discussed, individuals with ASD possess problems with emotion recognition which could be related to type two Alexithymia and abnormality of MNS. This could be related to the lack of social and communication skills in ASD because abilities to understand and control self-emotion is associated with social competence and engagement. However, as discussed above, the ability to recognise musical emotion seems to be preserved in individuals with ASD. Therefore, using music intervention might be a promising approach for emotion awareness training for individuals with ASD. Previous research has suggested that music activity and music sharing during the intervention help create emotional attunement between individuals and the therapists.[38] Moreover, development of self-emotion awareness can also be influence by some interventions which do not include music making activity. As suggested by Gold et al., music listening in a session might involve interactive process and self-reflection in people with ASD. This suggests that using music as a tool in music intervention is not only providing the opportunity to communicate and express through music, but also a chance to train emotion awareness and understanding of others.

Using music interventions also facilitate more attention than other interventions. As stated in Simpson, Keen and Lamb's work, the lack of attention engagement to the given tasks will decreases learning opportunity in individuals with ASD. Musical intervention can be a promising approach for the attention development, considering the reports from many studies showing that the intervention increases joint attention of the ASD participants. In the research comparing different interventions, it also found that individuals with ASD increased more attention during music related interventions. These reports of the higher attention might be influenced from music making activity; as reviewed by De Vries, Beck, Stacey, Winslow and Meines that interventions which involve music making activity were reported with improvement in joint attention, such as increasing eye contact and engagement to tasks. Similarly, Guzic, Tonkin, Roberts and Demuth reported that ASD children showed more attention to a given task when using percussion instruments. However, active music making may not be the only

---

[36] Adam Ockelford, "Songs Without Words: Exploring How Music Can Serve as a Proxy Language in Social Interaction with Autistic Children," 307.

[37] Karin Mössler, Christian Gold, Jörg Aßmus, Karin Schumacher, Claudine Calvet, Silke Reimer, Gun Iversen, and Wolfgang Schmid,"The Therapeutic Relationship as redictor of Change in Music Therapy with Young Children with Autism Spectrum Disorder," *Journal of Autism and Developmental Disorder* (September, 2017): 12, http://doi.org/10.1007/s10803-017-3306-y.

[38] Monika Geretsegger, Ulla Holck, John A. Carpente, Cochavit Elefant, Jinah Kim, and Christian Gold. "Common Characteristics of Improvisational Approaches in Music Therapy for Children with Autism Spectrum Disorder: Developing Treatment Guidelines," *Journal of Music Therapy* 52, no.2 (July, 2015): 270-271, http://doi.org/10.1093/jmt/thv005.

factor of the attention enhancement. Reports from intervention involving no music making activity also observed the improvement in the attention to tasks. This might be due to the character of music as a perceivable sound for ASD which can be consciously processed and paid attention to.

Another special character of many music interventions is that the interventions provide secure and enjoyable environment for individuals with ASD. Music intervention is a child-led approach with unstructured curriculum. The approach is adaptable for each subject depending on their individual needs.[39] Therapists will pay attention to each subject within the intervention and develop activities to match their personalities and needs. Furthermore, the approach allows individuals with ASD to express and communicate in a flexible way through the non-verbal musical communication.[40] Considering these factors, music intervention creates the environment that the individuals can express themselves and feel accepted from the others. This benefit of the environment within the intervention is also stated by renowned music therapists, Robbin and Nordoff, cited in Reschke-Hernández, that ASD clients experienced music as a nonthreatening medium and, thus, clients seemed to develop engagement to the musical intervention than in the other environments.

Moreover, a characteristic of music intervention, especially in music therapy, that should be underlined is the shared history between ASD individuals and therapists. This is first suggested by Geretsegger et al., pointing out that shared experience in music repertoires and interaction themes over the time of sessions may develop interaction between therapists and ASD clients. Shared history is developed together with music learning during sessions. From the beginning of the intervention, the individuals have to learn new music and tasks which they have not learnt before. Developing activity progress and achievement help clients to create a share memory with therapists over a theme of each music. When moving to a new song or activity, they will develop more shared history.[41] This enhances more interaction and communication theme for ASD clients. However, this involves developing progress and achievement together with the therapist. This development in the shared history may be difficult to be observed in the intervention which excludes an active music activity.

---

[39] Jill Boucher, *The Autistic Spectrum: Characteristics, Causes and Practical Issues*, 301.

[40] Mössler, Gold, Aßmus, Schumacher, Calvet, Reimer, Iversen, and Schmid,"The Therapeutic Relationship as redictor of Change in Music Therapy with Young Children with Autism Spectrum Disorder," 11.

[41] Geretsegger, Holck, Carpente, Elefant, Kim, and Gold. "Common Characteristics of Improvisational Approaches in Music Therapy for Children with Autism Spectrum Disorder: Developing Treatment Guidelines," 272-273.

Conclusion

Reports have shown that music interventions have the beneficial effects for social interaction and communication skills development in people with ASD. These effects have been reported from many music interventions, including music therapy and non-music therapy approaches. The review in this article suggests that these positive outcomes may be the results of the influence of using music as a tool in the method and the nature of the intervention. Music, a non-verbal sound which can be perceived structurally and emotionally by ASD people; can be used as a tool for individuals with ASD to express themselves and interact with others despite their deficits in verbal or non-verbal communications. By involving in music activity, music intervention provides the opportunity for individuals with ASD to communicate and engage with others with the medium that they can express and understand. Thus, music intervention furnishes a safe and joyful environment for the individuals which they can develop their social communication skills with other people. These special characteristics of music intervention maybe a reason why the approach have been used widely to support the needs of people with ASD. However, this article also suggests that more research should be conducted to provide more evidence and theoretical background on why music intervention can help social and communication development in people with ASD.

Bibliography

Accordino, Robert, Ronald Comer, and Wendy B. Heller. "Searching for Music's Potential: A Critical Examination of Research on Music Therapy with Individuals with Autism." *Research in Autism Spectrum Disorder* 1, no. 1(2007): 101-115. http://doi.org/10.1016/j.rasd.2006.08.002.

Allen, Rory, Elisabeth Hill, and Pamela Heaton. "The Subjective Experience of Music in Autism Spectrum Disorder." *Annuals of the New York Academy of Science* 11691, no.1 (July, 2009): 326-331. http://doi.org/10.1111/j.17496632.2009. 04772.x.

Allen, Rory, Rob Davis, and Elisabeth Hill. "The Effect of Autism and Alexithymia on Physiological and Verbal Responsiveness to Music." *Journal of Autism and Developmental Disorders* 43, no.2 (February, 2013): 432-444. http://doi.org/10.1007/s10803-012-1587-8.

American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-V)*. Washington DC: American Psychiatric Press, 2013.

Berthoz, Sylvie, and Elisabeth L. Hill. "The Validity of Using Self-Reports to Assess Emotion Regulation Abilities in Adults with Autism Spectrum Disorder." *European Psychiatry* 20, no.3 (2005): 291-298. http://doi.org/10.1016/j.eurpsy. 2004.06.013.

Boddaert, Nathalie, Nadia Chabane, Pascal Belin, Marie Bourgeois, Vincent Royer, Catherine Barthelemy, Marie-Christine Mouren-Simeoni, Anne Philippe,

Francis Brunelle, Yves Samson, and Mônica Zilbovicius. "Perception of Complex sound in Autism: Abnormal Auditory Cortical Processing inChildren." *American Journal of Psychiatry* 161, no.11 (November, 2004): 2117-2120. https://doi.org/10.1176/appi.ajp.161.11.2117.

Boucher, Jill. *The Autistic Spectrum: Characteristics, Causes and Practical Issues*. Los Angeles: SAGE, 2009.

Caria, Andrea, Paola Venuti, and Simona de Falco. "Function and dysfunction brain circuits underlying emotional process of music in autism spectrum disorders." Cerebral Cortex 21, no. 12 (December, 2011): 2838-2849. http://doi.org/10.1093/ cencor/bhr084.

Cattaneo, Luigi, and Giacomo Rizzolatti. "The Mirror Neuron System." *Archives of Neurology* 66, no. 5 (May, 2009): 557-560.http://doi.org/10.1001/archneurol. 2009.41.

De Vries, Dawn, Teresa Beck, Bethany Stacey, Katelyn Winslow, and Kristyn Meines. "Music as a Therapeutic Intervention with Autism: A Systematic Review of the Literature." *Therapeutic Recreation Journal* 49, no.3 (Third Quarter, 2015): 220- 237. https://search-proquestcom.sheffield.idm.oclc.org/docview/1704374693?accountid=13828.

Dieringer, Shannnon T., Kimberly Zoder-Martell, David L. Porretta, Angela Bricker, and Jaclyn Kabazie. "Increasing Physical Activity in Children with Autism through Music, Prompting, and Modeling." *Psychology in the Schools* 54, no.4 (February, 2017): 421-432. https://doi.org/10.1002/pits.22003.

Enticott, Peter G., Hayley A. Kennedy, Nicole J. Rinehart, Bruce J. Tonge, John L. Bradshaw, John R. Taffe, Zafiris J. Daskalakis, and Paul B. Fitzgerald. "Mirror Neuron Activity Associated with Social Impairments but not Age in Autism Spectrum Disorder." *Biological Psychiatry* 71, no. 5 (March, 2012): 427-433. http://doi.org/10.1016/j.biopsych.2011.09.001.

Fan, Yang-Teng, Jean Decety, Chia-Yen Yang, Ji-Lin Liu, and Yawei Cheng. "Unbroken Mirror Neurons in Autism Spectrum Disorders." *Journal of Child Psychology and Psychiatry* 51, no.9 (September, 2010): 981-988. http://doi.org/10.1111/j.1469-7610.02269.x.

Frith, Uta. "Asperger and His Syndrome." In *Autism and Asperger Syndrome*, edited by Uta Frith, 1-36. Cambridge: Cambridge University Press, 1991.

Fogassi, Leonardo. "The Mirror Neuron System: How Cognitive Functions Emerge from Motor Organization." *Journal of Economic Behavior & Organization* 77, no.1 (January, 2009): 66-75. http://doi.org/10.1016/j.jebo.2010.04.009.

Geretsegger, Monika, Ulla Holck, John A. Carpente, Cochavit Elefant, Jinah Kim, and Christian Gold. "Common Characteristics of Improvisational Approaches in Music Therapy for Children with Autism Spectrum Disorder: Developing Treatment Guidelines." *Journal of Music Therapy* 52, no.2 (July, 2015): 258-281. http://doi.org/10.1093/jmt/thv005.

Guzic, Brenda, Kent Tonkin, Jay B. Roberts, and Barbara R. Demuth. "Using Percussion to Improve Attention-to Tasks in Children with Autism." *The Exceptional Parent (online)* 41, no.3 (March, 2011): 18-20. https://search.proquest.com/docview/867093439?accountid=13828.

Hadjikhani, Nouchine, Robert M. Joseph, Josh Snyder, and Helen Tager-Flusberg. "Anatomical Differences in the Mirror Neuro System and Social Cognition Network in Autism." *Cerebral Cortex* 16, no.9 (September): 1276-1282. http://doi.org/10.1093/cercor/bhj069.

Jackson, Luke. *Freaks, Geeks and Asperger Syndrome: A User Guide to Adolescence*. London: Jessica Kingsley Publishers, 2002.

James, Ruth, Jeff Sigafoos, Vanessa A. Green, Giulio E. Lancioni, Mark F. O'Reilly, Russell Lang, Tonya Davis, Amarie Carnett, Donna Achmadi, Cindy Gevarter, and Peter B. Marschik. "Music Therapy for Individuals with Autism Spectrum Disorder: a Systematic Review." *Review Journal of Autism and Developmental Disorders* 2, no.1 (March, 2015): 39-54. https://doi.org/10.1007/s40489-014-0035-4.

Kaan, Edith, and Tamara Y. Swaab. "The Brain Circuitry of Syntactic Comprehension." *TRENDS in Cognitive Sciences* 6, no.8 (August, 2002): 350-356. http://doi.org/10.1016/S1364-6613(02)01947-2.

Kim, Jinah, Tony Wigram, and Christian Gold. "The Effects of Improvisational Music Therapy on Joint Attention Behaviours in Autistic Children: A Randomized Controlled Study." *Journal of Autism and Developmental Disorders* 38, no.9 (October, 2008): 1758-1766. http://doi.org/10.1007/s10803- 0566-6.

Lim, Hayoung A. "Effect of "Developmental Speech and Language Training Through Music" on Speech Production in Children with Autism Spectrum Disorders." *Journal of Mussic Therapy* 47, no.1 (Spring, 2010): 2-26. https://doi.org/10.1093/jmt/47.1.2.

Marsh, Lauren E., and Antonia F. de C. Hamilton. "Dissociation of Mirroring and Mentalising Systems in Autism." *NeuroImage* 56, no.3 (June, 2011): 1511-1519. http://doi.org/10.1016/j.neuroimage.2011.02.003.

Markley, John. "Reflections on the School Experience of a Student with Autism Spectrum Disorders." In *Autism and Developmental Disabilities: Current Practices and Issues*, edited by Anthony F. Rotatori, Festus E. Obiakor and Sandra Burkhardt. Bingley: JAI Press, 2008. http://doi.org/10.1016 /S0270-4013(08)18008-4.

McTier, Ian S. "Music therapy in a special school for children with autistic spectrum disorder, focusing particularly on the use of the double bass." In *Music Therapy in Schools: Working with Children of all Ages in Mainstream and Special Education*, edited by Jo Tomlinson, Philippa Derrington, and Amelia Oldfield, 151-164. London: Jessica Kingsley, 2012.

McMullen, Erin, and Jenny R. Saffran. "Music and Language: A Developmental Comparison." *Music Perception: An Interdisciplinary Journal* 21, no.3 (Spring, 2004): 289-311. https://doi.org/10.1525/mp.2004.21.3.289.

Miller, Shifra B., and Jan M. Toca. "Adapted Melodic Intonation Therapy: A Case Study of an Experiment Language Program for an Autism Child." *The Journal of Clinical Psychiatry* 40, no. 4 (April, 1979): 201-203.

Mössler, Karin, Christian Gold, Jörg Aßmus, Karin Schumacher, Claudine Calvet, Silke Reimer, Gun Iversen, and Wolfgang Schmid. "The Therapeutic Relationship as Predictor of Change in Music Therapy with Young Children with Autism Spectrum Disorder." *Journal of Autism and Developmental Disorder*, (September, 2017): 1-15. http://doi.org/10.1007/s10803-017-3306-y.

Mundy, Peter, Marian Sigman, Judy Ungerer, and Tracy Sherman. "Defining the Social Deficits of Autism: The Contribution of Non-Verbal Communication Measures." *Journal of Child Psychology and Psychiatry* 27, no.5 (September, 1986): 657-669. http://doi.org/10.1111/j.1469-7610.1986.tb00190.x.

Ockelford, Adam. "Songs Without Words: Exploring How Music Can Serve as a Proxy Language in Social Interaction with Autistic Children." In *Music, Health, & Wellbeing*, edited by Raymond Macdonald, Gunter Kreutz, and Laura Mitchell, 289-323. Oxford: Oxford University Press, 2012.

Overy, Katie, and Istvan Molnar-Szakacs. "Being Together in Time: Musical Experience and the Mirror Neuron System." *An Interdisciplinary Journal* 26, no. 5 (June, 2009): 489-504. http://doi.org/10.1525/mp.2009.26.5.489.

Quintin, Eve-Marie, Anjali Bhatara, Hélène Poissant, Eric Fombonne, and Daniel J. Levitin. "Emotion Perception in Music in High-Functioning Adolescents with Autism Spectrum Disorders." *Journal of Autism and Developmental Disorders* 41, no.9 (September, 2011): 1240-1255. http://doi.org/10.1007/s10803- 010-1146-0.

Quintin, Eve-Marie, Anjali Bhatara, Hélène Poissant, Eric Fombonne, and Daniel J. Levitin. "Processing of Musical Structure by High-Functioning Adolescents with Autism Spectrum Disorders." *Child Neuropsychology* 19, no.3 (May, 2013): 250-275. http://doi.org/10.1080/09297049.2011.653540.

Reschke-Hernandez, Alaine E. "History Music Therapy Treatment Interventions for Children with Autism." *Journal of Music Therapy* 48, no. 2 (Summer, 2011): 169-207. http://doi.org/10.1093/jmt/48.2.169.

Rizzolatti, Giacomo, and Laila Craighero. "The Mirror-Neuron System." *Annual Review of Neuroscience* 27(2004):169-192. http://doi.org/10.1146/annurev.neuro. 27.070203.144230.

Roedema, Thomas M., and Robert F. Simons. "Emotion-Processing Deficit in Alexithymia." *Psychophysiology* 36, no.3 (March, 1999): 379-387. http://doi.org/10.1017/ S0048577299980290.

Robson, Brenda. *Pre-School Provision for Children with Special Needs*. London: Cassell, 1989.

Sandiford, Givona A., Karen J. Mainess, and Noha S. Daher. "A Pilot Study on the Efficacy of Melodic Based Communication Therapy for Eliciting Speech In Nonverbal Children with Autism." *Journal of Autism and Developmental Disorders* 43, no.6 (June, 2013): 1298-1307. https://doi.org/10.1007/s10803-012- 1672-z.

Simpson, Kate, and Deb Keen. "Music Interventions for Children with Autism: Narrative Review of the Literature." *Journal of Autism and Developmental Disorder* 41, no.11 (November, 2011): 1507-1514. http://dx.doi.org/10.1007/s10803-010-1172-y.

Simpson, Kate, Deb Keen, and Janeen Lamb. "The Use of Music to Engage Children with Autism in a Receptive Labelling Task." *Research in Autism Spectrum Disorder* 7, no.12 (December, 2013): 1489-1496. http://doi.org/10.1016/j.rasd. 2013.08.013.

Tuduri, Eddie. "The Rhythmic Arts Project." *The Exceptional Parent* 36, no. 3 (March, 2006): 20-23. https://search-proquest-com.sheffield.idm.oclc.org/docview/223535380?accountid=13828.

Wan, Catherine Y., Krystal Demaine, Lauryn Zipse, Andrea Norton, and Gottfried Schlaug. "From Music Making to Speaking: Engaging the Mirror Neuron System in Autism." *Brain Research Bulletin* 82, no.3-4 (May, 2010):161-168. http://doi.org/110.1016/j.brainresbull.2010.04.010.

Whipple, Jennifer. "Music in Intervention for Children and Adolescents with Autism: A Meta-Analysis." *Journal of Music Therapy* 41, no.2 (July, 2004): 90- 106. https://doi-org.sheffield.idm.oclc.org/10.1093/jmt/41.2.90.

Williams, Justin H. G., Andrew Whiten, Thomas Suddendorf, and David I. Perrett. "Imitation, Mirror Neurons and Autism." *Neuroscience & Biobehavioral Review* 25, no. 4 (June, 2001): 287-295. http://doi.org/10.1016/s0149-7634(01)00014-8.

Wimpory, Dawn C., and Susan Nash. "Musical Interaction Therapy – Therapeutic Play for Children with Autism." *Child Language Teaching and Therapy* 15, no.1 (February, 1999): 17-28. https://doi-org.sheffield.idm.oclc.org/10.1177/ 026565909901500103.

Worth, Tammy. "Eye Contact and Autism." *American Journal of Nursing* 108, no.11 (November, 2008): 21. http://doi.org/10.1097/01.NAJ.0000339147.55867.ce.

Zangwill, Nick. "Music, Autism, and Emotion." *Frontiers in Psychology* 4, 890 (December, 2013): 1-3. http://doi.org/10.3389/fpsyg.2013.00890.