

5-1-2022

## Effectiveness of Physical Therapy and/or Music Therapy On Enhancing Motor Skills in Children With ASD: A Systematic Review

Julia Reagan  
*The University of Texas at El Paso*

Lauren Zoller  
*The University of Texas at El Paso*

Michelle Brown  
*The University of Texas at El Paso*

Follow this and additional works at: [https://scholarworks.utep.edu/dpt\\_cap](https://scholarworks.utep.edu/dpt_cap)



Part of the [Physical Therapy Commons](#)

---

### Recommended Citation

Reagan, Julia; Zoller, Lauren; and Brown, Michelle, "Effectiveness of Physical Therapy and/or Music Therapy On Enhancing Motor Skills in Children With ASD: A Systematic Review" (2022). *DPT Capstones*. 10.

[https://scholarworks.utep.edu/dpt\\_cap/10](https://scholarworks.utep.edu/dpt_cap/10)

This DPT Project is brought to you for free and open access by the Physical Therapy and Movement Sciences at ScholarWorks@UTEP. It has been accepted for inclusion in DPT Capstones by an authorized administrator of ScholarWorks@UTEP. For more information, please contact [lweber@utep.edu](mailto:lweber@utep.edu).

**EFFECTIVENESS OF PHYSICAL THERAPY AND/OR MUSIC THERAPY ON  
ENHANCING MOTOR SKILLS IN CHILDREN WITH ASD: A SYSTEMATIC  
REVIEW**

**By**

**JULIA REAGAN, SPT  
LAUREN ZOLLER, SPT  
MICHELLE BROWN, SPT**

**Capstone Advisor: Rhonda Manning, DPT**

**Presented to the Faculty of the Doctor of Physical Therapy Program of**

**The University of Texas at El Paso**

**in partial fulfillment of the requirements for the degree of**

**DOCTOR OF PHYSICAL THERAPY**

**THE UNIVERSITY OF TEXAS AT EL PASO**

**MAY 2022**

## **Abstract**

**Objective:** Autism spectrum disorder (ASD) is a diagnosis that encompasses several developmental disorders which present with neurological impairments, developmental delays, and correlates to increased motor dysfunction. Research to date has shown success with the use of music therapy and physical therapy treatment in the ASD population. However, further investigation needs to be conducted to determine which of these treatment options is most effective. The purpose of this systematic review is to explore if music therapy alone, physical therapy alone, or a combination of music therapy and physical therapy elicits the greatest benefit to enhance gross motor skills in children with ASD.

**Methods:** Searches were performed utilizing PubMed, Google Scholar, and EBSCO Medline between September 2020 to August 2021. Inclusion criteria for potential articles included access to full-text and published in a peer-reviewed journal article within the last 10 years. Ten articles were included in this systematic review.

**Results:** Studies regarding music therapy found that there are benefits for children with ASD to improve different aspects of motor performance and enhance neural connectivity between motor regions of the brain. Research involving physical therapy found an increase in gross motor skills such as: motor proficiency, executive functioning, locomotion, control of objects, gross motor quotient, and proprioception. Articles that examined the impact of both music and physical therapy found greater benefits are achieved in combination rather than one intervention alone.

**Conclusions:** A combination of music and physical therapy in children with ASD outweighs either type of therapy individually when assessing motor skill improvements. However, research combining the two forms of interventions is scarce.

**Impact Statement:** This systematic review outlines current literature pertaining to physical therapy treatment interventions utilized in the ASD patient population and provides information on the combination of physical therapy and music therapy interventions that have shown promise thus far.

**Manuscript Word Count:** 1887

## **Introduction**

### *Autism Spectrum Disorder*

In 2013, the Diagnostic and Statistical Manual of Mental Disorders - Version V (DSM-V) created an umbrella term to replace Autistic Disorder and other developmental disorders with Autism Spectrum Disorder (ASD).<sup>1,2</sup> Although the DSM-V criteria for ASD does not describe motor dysfunction, research has suggested that there may be a correlation between neurologic impairment and atypical movements in this population.<sup>3</sup> Additional studies support this speculation through data that demonstrates individuals with ASD have increased motor impairments compared to neurotypical counterparts.<sup>4,5</sup> Therefore, early intervention should address the deficits in motor skills to promote functional independence in individuals diagnosed with ASD. Further investigation needs to be conducted to determine which treatment is the most effective in promoting optimal motor skills in this population.

### *Motor Skills*

Motor skills are essential for participation in physical activity and enhance developmental skills necessary to complete activities of daily living.<sup>6</sup> Skills such as locomotion, object control, gross motor, and fine motor movements can all be included under motor skill interventions to address delays and impairments that are pre-existing in the ASD population.<sup>6</sup> The motor impairments seen in children with ASD have been linked to various factors including impairments in postural control, motor planning, motor imitation and sensory processing differences.<sup>7</sup>

### *Music Therapy and Autism Spectrum Disorder*

Music therapy is a therapeutic intervention used by credentialed individuals which includes an extensive variety of techniques utilizing temporal and rhythmic based activities to help patients accomplish their goals.<sup>8</sup> Individuals diagnosed with ASD possess impaired rhythm that can be addressed with music in an attempt to synchronize movement patterns.<sup>8</sup> Interestingly, cortical areas in the brain responsible for movement are targeted during musical training to improve and promote functional and structural connectivity throughout the brain.<sup>8</sup> Using music as a therapeutic intervention has the potential to reorganize sensorimotor cerebrocerebellar circuits, and improve plasticity of the brain, which has a positive effect on motor control and repetitive actions.<sup>8</sup>

Initially, treatment for children with ASD utilized music therapy to improve the cognitive, social, and communication aspects of the ASD diagnosis.<sup>3</sup> More recent studies have investigated the impact music therapy has on motor skills in patients with ASD; however, research in this area is still limited.<sup>3</sup> There is evidence of individuals with cerebellar ataxia who benefited from the use of rhythmic interventions for motor improvements.<sup>3</sup> This information establishes the theoretical basis on how utilizing music and rhythm during treatment may be beneficial for normalizing movement in individuals with impaired motor performance, including individuals diagnosed with ASD.<sup>3</sup>

### *Physical Therapy and Autism Spectrum Disorder*

Physical therapists are a vital part of the healthcare team as they are equipped to assess and treat children at risk of not reaching or are delayed in achievement of developmental

milestones, which is often an early indication of ASD.<sup>9,10</sup> Physical therapists are qualified to individualize treatment plans for each patient based on the limitations and impairments that are most evident.<sup>11</sup> Traditionally, physical therapy has been aimed at improving coordination, motor tasks, motor planning, balance, fine and gross motor skills, posture skills, and addressing gait abnormalities, as these are common impairments seen in individuals with ASD.<sup>3,11</sup> Current literature supports that therapy most effectively addresses impairments in motor skills by including instructions and strategies to organize their practice, and by giving direct feedback to the patient.<sup>7</sup> Evidence is expanding and has shown improvements in the area of motor intervention strategies conducted by physical therapists and their impact on the International Classification of Functioning, Disability, and Health impairments in children with ASD.<sup>7</sup> Physical therapists play a distinctive role in introducing interventions aimed at addressing functional limitations to improve movement and function in children with ASD.<sup>9,10</sup>

### *Physical Therapy, Music Therapy, and Autism Spectrum Disorder*

Research exploring physical therapy in conjunction with music therapy interventions in the ASD population has only recently been undertaken. Published studies have found that music therapy combined with traditional physical therapy interventions to address motor impairments such as coordination, running speed, balance, agility, and strength have shown increased benefit over one treatment intervention alone.<sup>12,13</sup> Unfortunately, there is a limited amount of research available in this area; however, this may eventually prove to be a beneficial addition to the current treatment plans commonly utilized for individuals with ASD.

Rhythm is a key factor in music; it embodies timekeeping characteristics that are essential in amalgamating the use of music and therapeutic motor activities.<sup>3</sup> Physical therapy has been the traditional standard of care to address motor impairments in children with ASD; however, it is crucial that other treatment strategies be investigated to ensure these patients receive high-quality, evidence-based care.

The purpose of this systematic review is to explore different interventions (music therapy alone, physical therapy alone, or a combination of music therapy and physical therapy) to determine which treatment strategy elicits the greatest benefits for enhancing motor performance in children with ASD.

## **Methods**

### *Data Sources and Searches*

Searches were conducted between the months of September 2020 and August 2021 using three search engines: PubMed, Google Scholar, and EBSCO Medline. All searches were limited to research that was conducted between the years of 2010 and 2020. Six different search terms were used in all databases. *Category 1* search terms included: ‘autism physical therapy music’ and ‘ASD AND rhythm AND active’. The *Category 2* search term includes ‘motor skill intervention AND autism spectrum disorder’. Lastly, search terms for *Category 3* included: ‘autism physical music motor skills,’ ‘music, autism, child, motor,’ and ‘physical therapy motor skills autism spectrum disorder’.

### *Data Extraction and Quality Assessment*



Inclusion criteria for the searches required full article access that was published in a peer-reviewed journal and published within the 10 year period from 2010-2020. Articles regarding diagnoses other than ASD or compared ASD to other diagnoses were excluded from our search. Additionally, articles were excluded that implemented music therapy intervention or physical therapy intervention but failed to analyze the different interventions' impact on a motor component in children with ASD. A total of 10 articles were obtained and analyzed for relevant content. See Appendix 1 for a summary of relevant information from each article and article quality assessment.

#### *Role of Funding Source*

This paper did not receive any financial support from federal, public, or other recognized sectors. Conflict of Interest: none declared.

## **Results**

#### *Category 1: ASD and Music Therapy*

In this category, a total of five sources were reviewed for this systematic review pertaining to the diagnosis of ASD and the impact music intervention has on motor performance in these individuals. The music therapy component used in these studies included the use of rhythmic auditory cues, activities with use of music, and instrument play. All five studies found that music therapy benefits children with ASD and improves different aspects of motor performance such as gross motor,<sup>14</sup> motor planning,<sup>15</sup> coordination,<sup>16,17</sup> balance,<sup>16</sup> and

imitation.<sup>14,17</sup> Further, one study in this category found music intervention enhances neural connectivity between motor regions of the brain.<sup>18</sup>

### *Category 2: ASD and Physical Therapy*

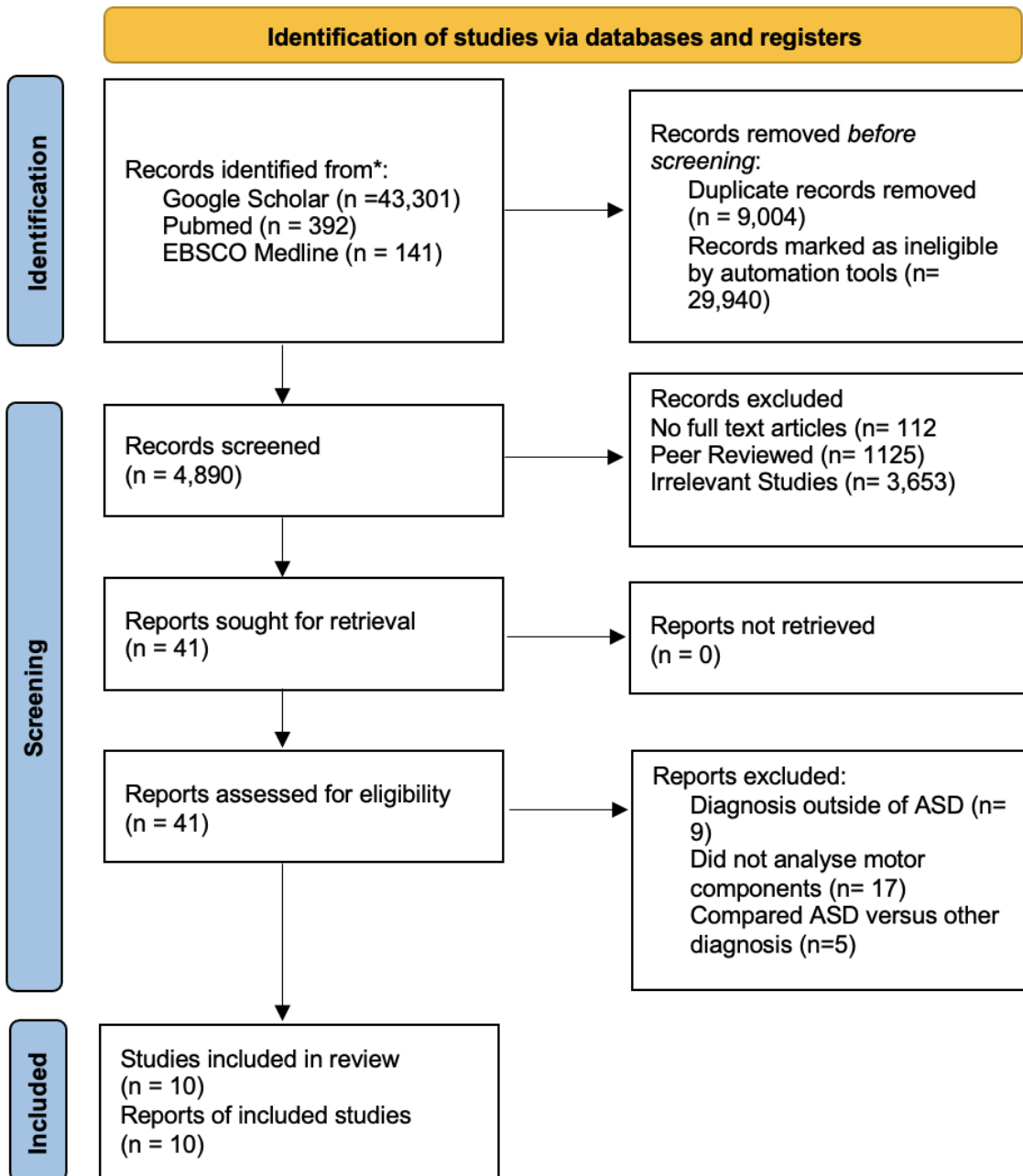
This category included two articles that specifically describe the motor performance benefit of physical therapy for children diagnosed with ASD and discuss the improvement of motor proficiency after physical therapy intervention. While other benefits were seen, such as executive functioning and social skills, both articles focus on the influence physical therapy has on motor skills. Specifically one article found statistically significant improvement in locomotion, control of objects and gross motor quotient in the physical therapy intervention group versus the control group who did not receive any intervention.<sup>19</sup> The second article in this category found that yoga intervention delivered by physical therapists resulted in improved gross motor performance assessed with the BOT-2 when compared to academic based intervention.<sup>20</sup> Additionally, the authors discussed the possibility of how an improvement in proprioception may be a contributing factor for the enhancement of gross motor skills.<sup>20</sup>

### *Category 3: ASD and Music Therapy and Physical Therapy*

Three articles were included in the review of this category that assessed the impact of combining music therapy and physical therapy on the motor skills of individuals with ASD. One article used a combination of music therapy and physical therapy,<sup>12</sup> while the other two articles focused on gait training with the use of auditory rhythmic cueing.<sup>13,21</sup> Although the methods of these studies varied, a common theme was discovered throughout all sources identified in this

category; when combining music therapy with traditional standard physical therapy, greater benefits are achieved in comparison to one intervention alone.

PRISMA Diagram<sup>22</sup>



## **Discussion**

The primary findings of this research has shown the positive impact physical therapy and music therapy have on children with ASD for improving motor performance. Music therapy has been shown to improve a wide variety of motor skills, which allows the authors of this review to conclude there is a large benefit when engaging in rhythmic related movements for children with ASD. This not only enables the child to improve motor performance, but also works on mastering new skills such as playing instruments, learning to keep rhythm and increasing the ability to respond to cues. This is important to enable children with ASD to participate with their peers at school in activities and games that involve higher level motor abilities.

Many children with ASD have difficulty using internal cueing when preparing to coordinate a movement.<sup>13</sup> Music provides an external cueing source that the child could rely on to substitute for their deficient internal cueing.<sup>13</sup> However, without physical therapy interventions to help facilitate correct motor movements during the music therapy sessions, the child could potentially develop dysfunctional movement patterns that may be detrimental to development. Acknowledging the validity of the proposed theories enabled the authors to come to an agreement that the combination of music and physical therapy would allow this population of children to have the greatest outcomes.

### *Limitations*

This systematic review encountered several limitations. One of these limitations being a lack of literature available for review. Additionally, several articles investigated the impact of physical therapy, or music therapy on motor performance, but failed to investigate the potential

impact combining these two interventions can have on motor performance. A majority of the articles reviewed for inclusion in this paper focused on investigating the social behaviors in this population but failed to incorporate research around the motor deficits. Therefore, we decided to limit this review to strictly the impact music has on motor performance. While there are many limitations, this systematic review is the only available evidence that has compiled previous research investigating the different interventions addressing the deficient motor skills in children with ASD. This implicates a need for future research to explore the motor deficits associated with this population in order to determine what type of therapy intervention would result in maximal benefit.

### *Conclusion*

The aim of this study was to explore three different interventions to determine the treatment strategy that elicits the greatest benefits for enhancing motor performance in children with ASD. These interventions include music therapy, physical therapy, or a combination of the two. Previous research has demonstrated that motor performance improvements can be obtained with each of the three interventions individually. However, this systematic review synthesizes the most recent data and provides insight to the promising impact music therapy in combination with physical therapy has on improving motor performance in individuals diagnosed with ASD. Overall, the research findings show that providing both music and physical therapy to children with ASD outweighs either type of therapy individually when assessing motor skill improvements.

## References:

1. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. American Psychiatric Publishing; 2013.
2. Asperger's syndrome. Autism-society.org. Accessed March 21, 2020. <https://www.autism-society.org/what-is/aspergers-syndrome/>.
3. Hardy M, LaGasse A. Rhythm, movement, and autism: using rhythmic rehabilitation research as a model for autism. *Front Integr Neurosci*. 2013;7:1-9. doi:10.3389/fnint.2013.00019.
4. Green D, Charman T, Pickles A, et al. Impairment in movement skills in children with autistic spectrum disorders. *Dev Med Child Neurol*. 2009;51:311-316. doi:10.1111/j.1469-8749.2008.03242.x.
5. Hilton C, Wente L, LaVesser P, Ito M, Reed C, Herzberg G. Relationship between motor skill impairment and severity in children with asperger syndrome. *Res Autism Spectr Disord*. 2007;1:339-349. doi:10.1016/j.rasd.2006.12.003.
6. Pan C, Chu C, Tsai C, Sung M, Huang C, Ma W. The impacts of physical activity intervention on physical and cognitive outcomes in children with autism spectrum disorder. *Autism*. 2017;21:190-202. doi:10.1177/1362361316633562.
7. Ruggeri A, Dancel A, Johnson R, Sargent B. The effect of motor and physical activity intervention on motor outcomes of children with autism spectrum disorder: a systematic review. *Autism*. 2020;24:544-568. doi:10.1177/1362361319885215.
8. Bharathi G, Jayaramayya K, Balasubramanian V, Vellingiri B. The potential role of rhythmic entrainment and music therapy intervention for individuals with autism spectrum disorders. *J Exerc Rehabil*. 2019;15(2):180-186. doi:10.12965/jer.1836578.289.
9. Ben-Sasson A, Atun-Einy O, Yahav-Jonas G, Lev-On S, Gev T. Training physical therapists in early ASD screening. *J Autism Dev Disord*. 2018;48:3926-3938. doi:10.1007/s10803-018-3668-9.
10. Downey R, Rapport M. Motor activity in children with autism: a review of current literature. *Pediatr Phys Ther*. 2012;24:2-20. doi:10.1097/PEP.0b013e31823db95f.
11. Bhat A, Landa R, Galloway J. Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorders. *Phys Ther*. 2011;91(7):1116-1129. doi:10.2522/ptj.20100294.
12. Imankhah F, Khanzadeh A, Hasirchaman A. The effectiveness of combined music therapy and physical activity on motor coordination in children with autism. *Iran Rehabil. J*. 2018;16(4):405-412. doi:10.32598/irj.16.4.405.
13. Shemy S, El-Sayed M. The impact of auditory rhythmic cueing on gross motor skills in children with autism. *J Phys Ther Sci*. 2018;30:1063-1068. doi:10.1589/jpts.30.1063.
14. Srinivasan S, Kaur M, Park I, Gifford T, Marsh K, Bhat A. The effects of rhythm and robotic interventions on the limitation/praxis, interpersonal synchrony, and motor performance of children with autism spectrum disorder (ASD): a pilot randomized controlled trial. *Autism Res Treat*. 2015:1-18. doi:10.1155/2015/736516.

15. Bharathi G, Jayaramayya K, Balasubramanian V, Vellingiri B. The potential role of rhythmic entrainment and music therapy intervention for individuals with autism spectrum disorders. *J Exerc Rehabil.* 2019;15(2):180-186. doi:10.12965/jer.1836578.289.
16. Atrigh A, Akbarfahimi M, Zarei M. The effect of movement activities in synchronization with music on motor proficiency of children with autism. *JAMSAT.* 2017;3:61-68. doi:10.18869/2Fnrip.jamsat.3.2.61.
17. Proffitt M. A survey of current music therapy practices addressing motor goals in children with autism spectrum disorder. The University of Kentucky; 2015. doi:10.13023/ETD.2016.005.
18. Sharda M, Tuerk C, Chowdhury R, Jamey K, Foster N, Custo-Blanch M, Tan M, Nadig A, Hyde K. Music improves social communication and auditory–motor connectivity in children with autism. *Transl. Psychiatry.* 2018;8:1-13. doi:10.1038/s41398-018-0287-3.
19. Ketcheson L, Hauck J, Ulrich D. The effects of an early motor skill intervention on motor skills, levels of physical activity, and socialization in young children with autism spectrum disorder: a pilot study. *Autism.* 2017;21:481–492. doi:10.1177/1362361316650611.
20. Kaur M, Bhat A. Creative yoga intervention improves motor and imitation skills of children with autism spectrum disorder. *Phys Ther.* 2019;99:1520–1534. doi:10.1093/ptj/pzz115.
21. Yin C, Yin T. A review on the efficacy of physical therapy intervention on motor skills of children with autism spectrum disorder. *ASSEHR.* 2019;388:39-43. Published December 2019. Accessed March 28, 2020. <https://www.atlantis-press.com/proceedings/icse-19/125928886>.
22. Page M, McKenzie J, Bossuyt P, Boutron I, Hoffmann T, Mulrow C, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi:10.1136/bmj.n71.

## Appendix 1: Evidence Table

Category	Author	Design	Intervention	Measure	Appraisal Tool and Score	Conclusion
Category 1: ASD and Music Therapy <sup>8,14,16,17,18</sup>	Srinivasan S, Kaur M, Park I, Gifford T, Marsh K, Bhat A	Pilot RCT	Rhythmic group- children with ASD complete simple and complex imitation set to music. Robotic group- children with ASD complete dual and multi-limb imitation games	- BOT-2 - Training-specific changes in imitation/praxis - Interpersonal synchrony	Pedro: 8/11	All three groups showed improvements regarding imitation/praxis and in interpersonal synchrony from the beginning to end sessions in the rhythm and robot groups. The BOT-2 test showed improvements in gross motor performance in the intervention groups and improvements in fine motor performance in the control group.
	Bharathi G, Jayaramayya K, Balasubramanian V, Vellingiri B	Literature Review	N/A	N/A	SANRA: 8/12	Use of rhythmic auditory cueing can be beneficial to steady movement patterns and streamline motor planning for individuals with ASD. Using rhythm as a therapeutic intervention may improve motor, language and personal skills.
	Atrigh A, Akbarfahimi M, Zarei M	RCT	Movement activities with music	BOTMP	Pedro: 8/11	For children with ASD, the combination of music with typical sensory motor tasks resulted in improvement of balance and bilateral upper extremity coordination compared to only motor tasks.
	Sharda M, Tuerk C, Chowdhury R, Jamey K, Foster N, Custo-Blanch M, Tan M, Nadig A, Hyde K	RCT	Use of improvisational approaches through song and rhythm to target social communication	- Social communication battery consisting of the ccc-2 - SRS-II - PPVT-4	Pedro: 9/11	Benefits in social communication, family quality of life, and intrinsic brain connectivity were seen for the music intervention group when compared to non-music intervention in individuals with ASD.



	Proffitt M	Qualitative Research (THESIS)	N/A	Survey	JBI Critical Appraisal for Qualitative Research: 8/10	This survey found that 62.8% of music therapists worked with children with ASD. Their programs most commonly worked on motor skills of imitation, upper/lower extremity and hand/eye coordination, compliance, praxis, and grasping. Interventions utilized included instrument play, movement activities, dancing, manipulatives, and task-oriented music games. Of the participants, 96% stated that their patients received treatment for their motor goals by other professionals and many had co-treated with physical therapists.
Category 2: ASD and Physical Therapy <sup>19,20</sup>	Kaur M, Bhat A	RCT	Yoga group- participated in yoga activities (breathing, contact and looking, poses, relaxation). Academic group- participated in reading, building activities, arts and crafts, and clean up	- BOT-2 - Training-specific imitation test - Exit Questionnaire	Pedro: 6/11	The authors found that following an 8-week yoga intervention there were improvements in proprioception leading to improvements in gross motor skills in children with ASD.
	Ketcheson L, Hauck J Ulrich D	Pilot RCT	Consisting of motor skill instruction	- MSEL - VABS-2 - ADOS-2 - TGMD-2 - POPE	Pedro: 6/11	This study found that high intensity, direct therapy interventions focused on targeted motor skills can lead to positive, significant results in children with ASD.
	Imankhah F, Khanzadeh A, Hasirchaman A	RCT	Physical therapy and music therapy	- AQ-Child - Oseretsky's motor development scale	Pedro: 7/11	Music therapy in combination with physical therapy significantly increases motor skills, due to increased understanding of rhythm and performance adaption in body movements, when compared to receiving no form of treatment in children with ASD.

Category 3: ASD and Music Therapy and Physical Therapy <sup>12,13,21</sup>	Shemy S, El-Sayedm M	RCT	Physical therapy program with the addition of gait training with rhythmic auditory stimulation	BOT-2	Pedro: 8/11	Gait training in combination with rhythmic auditory cueing and physical therapy will provide the greatest benefits in gross motor skills such as bilateral coordination, running speed, balance, agility and strength in children with ASD.
	Yin C, Yin T	Systematic Review	N/A	- BOT-2 - TGMD-2 - SFA	AMSTAR completed, no score applicable but article deemed to have moderate confidence in results	Children with ASD may have improvement in coordination bilaterally, balance, running speed, agility, strength, throwing accuracy and decrease of imitation/praxis error when participating in various physical therapy interventions.