Proceedings of the 6th International Conference on Education Innovation and Psychological Insights
DOI: 10.54254/2753-7048/2025.22826

Music and Sensory Integration

Yuqing Liu[1], Jie Tan[1*]

[1]Conservatory of Music, Sichuan Normal University, Sichuan, China
**Corresponding Author. Email: 18602851415@163.com*

Abstract: Currently, the increasing focus on sensory integration therapy has had a significant impact on the clinical practices of professionals in related health fields. Sensory integration involves the evaluation of the tactile, olfactory, gustatory, visual, auditory systems, as well as proprioception and the vestibular system. In recent years, music and sound have been used as therapeutic tools by occupational therapists, speech - language pathologists, and psychologists. Research has shown that music and music therapy positively affect sensory gating and sensory modulation. Additionally, music therapy has the potential to be integrated into multidisciplinary team interventions, providing multifaceted and personalized interventions tailored to the specific needs of individuals. This paper provides an overview of the concepts and operating mechanisms of sensory integration through a literature review on music, music therapy, sensory integration, and sensory processing disorders. It highlights sensory processing disorders and discusses the relationship between music and sensory integration by reviewing existing research on music therapy interventions for sensory integration/sensory processing disorders. Finally, the paper further explores the potential possibilities of music therapy interventions for sensory processing disorders. This research has found that music and music therapy demonstrate certain potential in the application to sensory processing disorders, making them worth further exploration.

Keywords: Music, Music Therapy, Sensory Integration, Sensory Processing Disorder

1. Introduction

Currently, sensory integration therapy has received significant attention, which has in turn promoted the clinical practices of professionals in related health fields [1]. Sensory integration involves the assessment of the tactile, olfactory, gustatory, visual, and auditory systems, as well as proprioception and the vestibular system [1]. In recent years, music and sound have been used as therapeutic tools by occupational therapists, speech pathologists, and psychologists [2]. Music and sensory systems are related to the nervous system, so children with sensory processing disorders are particularly suitable for music therapy. [3]. On the other hand, the research on the impact of music therapy on sensory integration and sensory processing disorders is limited. It is uncommon to see a study on this topic.

This paper is a literature review. Through reviewing and summarizing previous relevant studies, this paper finds that while research on music therapy and sensory integration/sensory processing disorders remains limited, some studies have demonstrated that music therapy and Therapeutic Listening are effective and hold significant potential for application in sensory integration/ sensory processing disorders.

DOI: 10.54254/2753-7048/2025.22826

This paper will introduce sensory integration and sensory processing disorders, and further explore the application of music therapy in sensory integration through literature review.

This paper aims to further promote the application of music therapy in the medical sensory field, integrate the development of sensory processing disorders and music therapy, explore the relationship between music and the sensory system/sensory integration, and discuss the potential application of music therapy in sensory integration/sensory processing disorders.

2. Sensory Integration

2.1. Core Concept

The first concepts of Sensory Integration are advanced by Ayres. Since Ayres's initial publications in the 1950s, numerous works have significantly advanced this theory, making it one of the most widely cited and utilized frameworks in the field of occupational therapy [4]. Sensory integration is a multimodal processing process, which supports the formation of the following information and the extraction of multi-sensory perception in the central nervous system. [5]. As Pollock says, "It is a neurological process that enables us to make sense of our world by receiving, registering, modulating, organizing, and interpreting information that comes to our brains from our senses [6]".

2.2. Mechanism of Operation

Sensory receptors capture external stimuli from the environment via sensory systems like touch, vision, and hearing, or they capture internal stimuli from the body through tactile, vestibular, or proprioceptive receptors [7]. These receptors transform the captured stimuli into sensory information, which is then transmitted to the brain for processing, ultimately resulting in specific motor and behavioral responses [7]. The processing and integration of sensory information within the brain is known as sensory integration (SI) [7]. Sensory integration is crucial as it enables effective responses to stimuli.

Some researchers have divided the SI process into four stages: registration, modulation, discrimination, and response [8]:

(1) Registration: The brain receives sensory information from sense organs [8].

(2) Modulation: Regulate the intensity of the received sensory information [8].

(3) Discrimination: Analyze and interpret the received information to determine its importance, unique attributes, and detailed characteristics [8].

(4) Response: The stage in which the brain integrates all processed stimuli to generate an appropriate response [8]. This response determines the specific behaviors and movements that follow, allowing the individual to perform coordinated and appropriate actions based on the interpreted stimuli.

2.3. Sensory Processing Disorder (SPD)

Sensory Processing Disorder (SPD) is caused by alterations in neural sensory integration [7]. Also known as Sensory Modulation Disorder, Sensory Integration Dysfunction, or Sensory Dysfunction, SPD occurs when the brain fails to properly process sensory inputs. This impairment can affect learning, coordination, behavior, and language, resulting in inappropriate actions and motor responses [9]. Additionally, SPD can lead to stress, anxiety, and even depression [7].

Due to the heterogeneity of SPD, there are different classification models for SPD. The two most widely used classification models are those proposed by Miller and Schaaf [7]. Here, the article primarily introduces one of these two models—Dr. Lucy Jane Miller's model.

DOI: 10.54254/2753-7048/2025.22826

In Dr. Lucy Jane Miller's model, SPD can be categorized into three types: sensory modulation disorder (SMD), sensory-based movement disorder (SBMD), and sensory discrimination disorder (SDD) [10,11]. Moreover, these types can coexist in a variety of combinations [7].

SMD, troubling in regulating responses to sensory stimuli. It is then further divided into three subtypes or disorders. They are Sensory Over-Responsive (SOR), Sensory Under-Responsive (SUR), and Sensory Craving (SC).

SBMD, having trouble with balance, motor coordination, and performing complex motor tasks. It has two subtypes, Dyspraxia and Postural Disorder.

SDD, unable to interpreting specific characteristics of sensory stimuli properly, it may occur in any sensory system.

3. Music in Sensory Integration

3.1. Music-based Therapeutic Listening

Therapeutic listening is currently one of the most commonly used music therapies for sensory integration dysfunction/sensory processing disorder.

3.1.1. Therapeutic Listening (TL)

TL is a sound-based intervention program that combines diverse electronically modified music (sound stimulation) with different sensory activities. The music in TL programs has different musical styles, audio, wavelength, sound quality and enhancement levels. [12].

The Therapeutic Listening program was approved by the American Occupational Therapy Association for continuing education on July 25, 2003, and is considered a feasible intervention method. Therapeutic Listening is an individualized listening intervention that selects music and sensory activities based on each child's needs and therapeutic goals. It primarily provides sensory stimulation through sound stimuli and sensory activities to enhance the body and nervous system. The sound stimuli offer auditory input, while the sensory activities provide vestibular, proprioceptive, and other types of input [12].

3.1.2. Music-based Therapeutic Listening in Sensory Integration

In general, Sensory Integration Therapy (SI) is a component of therapy for children receiving occupational therapy [13].

Dr. Alfred Tomatis, a French physician, is the founder of sound-based therapy. In the mid-20th century, he developed this treatment method using electronically altered music to treat individuals with various conditions, including attention deficit disorder, developmental delays, autism, and multi-sensory processing disorders, both in adults and children. In his philosophy, the ear is considered the "integrator," responsible for promoting the organization of the nervous system at various levels [2,14].

Frick and Hacker clarified the clinical significance of this method of music modulation [15]:

"What appears to be created with the use of modulated music is an "exercising" effect of the muscles in the middle ear. The flexibility of these muscles is necessary to transmit sensory information to primary sensory processing centers that support sensory modulation. . . . Biomechanically, it is the function of the middle ear muscles to contract or focus on sounds and relax to monitor ambient environment [15]."

It is important to note that Therapeutic Listening is typically combined with other therapeutic methods/activities, such as sensory diets [2], as well as some daily sensory activities (e.g., joint compression therapy, toe walking, push-ups, and blowing and catching bubbles [12]). For example, in the study by Leah Hall and Jane Case-Smith, where Therapeutic Listening was combined with

DOI: 10.54254/2753-7048/2025.22826

sensory diets, the results demonstrated that the combination of Therapeutic Listening and sensory diets appears to be effective in improving behavioral issues [2].

4. Discussing the potential use of Music Therapy in Sensory Processing Disorder

This chapter will discuss the potential application of music therapy in sensory processing disorder based on existing research.

4.1. Sensory Gating and Attention

Abnormal sensory processing and attention deficits are common characteristics in children with Autism Spectrum Disorder (ASD) [16]. Dr. A. Blythe LaGasse and colleagues evaluated the feasibility and preliminary effects of an individualized music - therapy attention protocol on enhancing sensory processing and attention skills in children with ASD [16]. The study findings demonstrated that children with ASD had greater difference scores for the N100 component after music therapy, suggesting an improvement in sensory gating after the intervention [16].

This preliminary study results provide some positive evidence for the potential and effectiveness of music therapy in sensory gating and attention in children with autism, particularly in selective attention.

4.2. Sensory Modulation

Sensory modulation is the nervous system's ability to process sensory signals by filtering and inhibiting unnecessary incoming information. Individuals with sensory modulation issues may exhibit under-responsiveness, sensory dormancy, or over-responsiveness to stimuli [17].

Research has found that music has a calming effect on children with sensory sensitivities. The studies indicate that music with high repetition is more calming than no music, and high repetition music stimulates more interest and engagement compared to low repetition music [18].

In a multidisciplinary treatment plan, a music therapist designed a music therapy program tailored to the sensory issues of a specific case [17]. The case exhibited an excessive response to sensory stimuli and a delayed response to the vestibular and proprioceptive systems. In this context, the music therapist developed a music therapy plan to address these sensory issues. During each session, the therapist followed the activity plan and adjusted the musical environment to meet and challenge the sensory needs of the case (e.g., encouraging the use of different mallets to play a hand drum to fulfill proprioceptive needs), while creatively using music with the case. The results showed that the case responded very positively to both the movement and music therapy sessions. Additionally, when encouraging eye contact, the music therapy sessions were significantly more effective than the movement sessions.

5. Suggestions

5.1. Integration of Music Therapy with other Therapeutic Approaches

Currently, therapies related to sensory integration are primarily conducted by occupational therapists, and therapeutic listening is generally used and implemented by occupational therapists as well. However, music-based therapeutic listening shares similarities and even overlaps with some methods of Receptive Music Therapy, which can serve as a reference point for music therapists when intervening in cases of Sensory Processing Disorder or Sensory Integration Disorder.

In addition to being conducted as an independent therapy session, music therapy can also be integrated into a multidisciplinary team, contributing to the team’s overall intervention. Compared to pre-recorded music, the use of improvisation by music therapists during therapeutic interventions

DOI: 10.54254/2753-7048/2025.22826

allows for greater flexibility and diversity in the application of music, providing richer support for the multidisciplinary team's treatment efforts.

For example, in the study by Hooper, McManus and McIntyre, the music therapist not only provided individual music therapy sessions but also participated as a member of the multidisciplinary team in the client's movement sessions [17]. During the movement activities, music therapy supports the client's interaction with the physical therapist and occupational therapist by playing keyboard music. [17]. Throughout the entire project collaboration, the other therapists did not consider the music therapist to be dispensable, and they thought Pre-recorded music cannot replace the live improvisational performance of the music therapists [17].

As the music therapist involved in the project said, "Because of our grounding in improvisation techniques, we, as music therapists, can provide sensitive and flexible music that makes a unique contribution to multi-disciplinary work [17]."

5.2. Personalized and Multi-dimensional Interventions for Individuals and Populations

SPD is often present in individuals with ASD and Attention Deficit Hyperactivity Disorder (ADHD), and some studies suggest that difficulties in sensory processing may be a key underlying factor of core autistic traits [18]. These individuals may exhibit unusual processing behaviors that can lead to stigma, which in turn negatively affects their social participation. Music therapy for this population, particularly children, can serve not only as an intervention for Sensory Processing Disorder itself, but also as a means to support social development and attention.

In addition to the previously mentioned content, the field of music therapy is filled with concepts that can be integrated into sensory integration theory [1]. Mark R. James points out, "By applying current music therapy practice to sensory integration theory, therapists may enhance their success within such areas as mental retardation, psychiatry, and learning disabilities [1]."

Overall, the potential for the use of music and music therapy in Sensory Processing Disorder is positive. Moreover, this not only benefits the patients but also further promotes the development of music therapy.

6. Conclusion

This paper provides a review of literature on music therapy, sensory integration, and sensory processing disorders, outlining the relevant concepts of sensory integration and sensory processing disorders. It introduces therapeutic listening, which is currently the most commonly used music-related therapeutic approach for sensory processing disorders, and further explores the potential applications of music therapy in sensory processing disorders.

Currently, the focus on sensory integration therapy has significantly influenced the clinical practices of professionals in related health fields. In recent years, music and sound have been utilized as therapeutic tools by occupational therapists, speech pathologists, and psychologists. Since music and the sensory systems are both connected to the nervous system, music therapy is particularly suitable for children with sensory processing disorders. Research has shown that music and music therapy have positive effects on sensory gating and sensory modulation. Moreover, music therapy has the potential to be integrated into multidisciplinary team interventions alongside other therapeutic approaches, as well as to provide multifaceted and personalized interventions tailored to the specific needs of individuals.

However, current research and clinical evidence on music therapy and sensory integration dysfunction/sensory processing disorder remain limited. While the available research suggests that music and music therapy hold the potential to address sensory processing disorders, further studies are needed to provide more data and clinical evidence. Existing studies not only face limitations such

DOI: 10.54254/2753-7048/2025.22826

as small sample sizes and a lack of sufficient research, but also issues such as inconsistent definitions of professional terms and the frequent grouping of SPD research with ADHD and ASD studies, resulting in a lack of targeted research on SPD. Nevertheless, music and music therapy demonstrate certain potential in the application to sensory processing disorders, making them worth further exploration.

This paper cites a limited number of references and does not include empirical research. It relies solely on the current literature to discuss the potential applications of music therapy in sensory processing disorders. A brighter future could be led by deepening expand the possibility in the fields that connection of music and managing and interpreting sensory stimuli, and influence of music on processing or integration of sensory information, as well as presenting data and clinical validation. As a result, individuals can maximize the use of music, enhancing both music practices and music therapy.

References

[1] *James, M. R. (1984). Sensory integration: A theory for therapy and research. Journal of Music therapy, 21(2), 79-88.*

[2] *Hall, L., & Case-Smith, J. (2007). The effect of sound-based intervention on children with sensory processing disorders and visual–motor delays. The American Journal of Occupational Therapy, 61(2), 209-215.*

[3] *Simhon, V., Elefant, C., & Orkibi, H. (2019). Associations between music and the sensory system: An integrative review for child therapy. The Arts in Psychotherapy, 64, 26-33.*

[4] *Mulligan, S. (2002). Advances in sensory integration research. Sensory integration: Theory and practice, 2, 397-411.*

[5] *Smith Roley, S., Mailloux, Z., Miller-Kuhaneck, H., & Glennon, T. J. (2007). Understanding Ayres' sensory integration.*

[6] *Pollock, N. (2009). Sensory integration: A review of the current state of the evidence. Occupational therapy now, 11(5), 6-10.*

[7] *Galiana-Simal, A., Vela-Romero, M., Romero-Vela, V. M., Oliver-Tercero, N., García-Olmo, V., Benito-Castellanos, P. J., ... & Beato-Fernandez, L. (2020). Sensory processing disorder: Key points of a frequent alteration in neurodevelopmental disorders. Cogent Medicine, 7(1), 1736829.*

[8] *del Moral Orro, G., Montaño, M. Á. P., & Valer, P. S. (2013). Del marco teórico de integración sensorial al modelo clínico de intervención. Revista electrónica de terapia ocupacional Galicia, TOG, (17), 18.*

[9] *Galiana-Simal, A., Muñoz-Martinez, V., & Beato-Fernandez, L. (2017). Connecting eating disorders and sensory processing disorder: A sensory eating disorder hypothesis. psychopathology, 37(8), 1077-1087.*

[10] *Miller, L. J., Anzalone, M. E., Lane, S. J., Cermak, S. A., & Osten, E. T. (2007). Concept evolution in sensory integration: A proposed nosology for diagnosis. The American Journal of Occupational Therapy, 61(2), 135-140.*

[11] *Miller, L. J., Nielsen, D. M., Schoen, S. A., & Brett-Green, B. A. (2009). Perspectives on sensory processing disorder: a call for translational research. Frontiers in Integrative Neuroscience, 3, 597.*

[12] *Chiu, E. C., & Li, C. P. (2017). A sound-based intervention for children with sensory processing disorders in Taiwan. Neuropsychiatry, 7(5), 759-765.*

[13] *Preto, S., Malloy, A., & Luong, B. (2017). Efficacy of Therapeutic Listening® Quickshifts in Children with Sensory Processing Difficulties.*

[14] *Thompson, B. M., & Andrews, S. R. (2000). An historical commentary on the physiological effects of music: Tomatis, Mozart and neuropsychology. Integrative physiological and behavioral science, 35, 174-188.*

[15] *Frick, S. M., & Hacker, C. (2001). Listening with the whole body. Vital Links.*

[16] *LaGasse, A. B., Manning, R. C., Crasta, J. E., Gavin, W. J., & Davies, P. L. (2019). Assessing the impact of music therapy on sensory gating and attention in children with autism: a pilot and feasibility study. Journal of music therapy, 56(3), 287-314.*

[17] *Hooper, J., McManus, A., & McIntyre, A. (2004). Exploring the link between music therapy and sensory integration: an individual case study. British Journal of Music Therapy, 18(1), 15-23.*

[18] *Kim, G. (2022). Calming effects of repetition in music for children with sensory sensitivities.*