ISSN: 2146 - 9466
www.ijtase.net
International Journal of New Trends in Arts, Sports & Science Education – 2024, volume 13, issue 2

EXPLORING THE SYNERGY OF MUSIC AND READING INTERVENTIONS FOR CHILDREN WITH READING DISABILITIES

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Received: January 14, 2024 **Accepted:** April 26, 2024 **Published:** April 30, 2024

Suggested Citation:
Kahveci, G. (2024). Exploring the synergy of music and reading interventions for children with reading disabilities. *International Journal of New Trends in Arts, Sports &Science Education (IJTASE), 13*(2), 132-142.

Abstract

Reading disorders (RD) are complex, brain-based difficulties that hinder the ability to read and interpret text, affecting a broad demographic. These disorders are characterized not by sensory impairments, low intelligence, or poor education but are a persistent challenge often extending into adulthood. Individuals with RD struggle with phonological and orthographic processing, and exhibit deficits in processing speed, rapid automatized naming, working memory, and executive functions, which are crucial for efficient reading. The effects of RD also permeate into areas beyond reading, such as music education, where these disorders can affect the processing of musical notation and rhythms. However, integrating music training with reading instruction shows potential for remediation. Music can enhance language-related skills due to the shared cognitive processes involved in both music and reading, particularly in improving auditory temporal processing abilities which are similar to those required for reading. Future research should continue to investigate this interdisciplinary approach, focusing on long-term studies to better understand and maximize the benefits of music for reading development. This exploration is vital as it could offer substantial improvements in the educational outcomes for children with reading disabilities.

Keywords: Reading disabilities, music, dyslexia, phonological processing, orthographic processing.

INTRODUCTION

Reading Disabilities

Reading disabilities or disorders, which are specific, brain-based challenges in learning to recognize and interpret printed words, affect a diverse range of individuals. Reading disability (RD) is defined as persistent difficulty with reading that is not due to sensory impairments, low intelligence, or insufficient educational opportunities. Despite ongoing remedial efforts and frequent interactions with text, individuals with RD often continue to struggle with reading into adulthood (Fletcher 2009). Those affected by RD typically face phonological and orthographic challenges (Share 2004) and exhibit problems with reading processing speed (Breznitz and Misra 2003), rapid/instant automatized naming (Wolf et al. 2000), working memory functions (Brosnan et al. 2002), and executive processes (Helland and Asbjornsen 2000; Brosnan et al. 2002). Recent research points to the critical role that executive functions play in managing these aspects of reading to achieve efficient and skilled reading performance (Booth et al. 2013; Horowitz-Kraus, 2014; Horowitz-Kraus & Breznitz 2009; Margolis, & Liu, 2023; Kieffer et al. 2014). Simply, reading disorders are characterized by specific, brain-based challenges in learning to recognize and decipher printed words (Church, Grigorenko, & Fletcher, 2023).

It's crucial to grasp the nature of these disorders to adequately assist students who suffer from them. Individuals with reading disorders typically experience difficulty in recognizing words that are already familiar to them and comprehending the text they read. Additionally, they may struggle with spelling. It's important to note that not all individuals with a reading disorder exhibit every symptom. A diagnosis of a reading disorder is generally made when a person finds it hard to decode or comprehend what they've read (Kieffer et al. 2014). Reading disorders arise when individuals face difficulties in reading words or understanding the content they read. These disorders are primarily caused by specific variations in how the brain processes written words and text. Typically, these differences are inherent from a young age. However, it is also possible for a person to develop a reading disorder due to a brain injury at any

age. These conditions underscore the complex interaction between brain function and reading abilities (Hoover & Gough, 1990).

Reading abilities are generally defined as the capability to interpret meaning from written symbols and are divided into two main parts: decoding and comprehension (Gough & Tunmer, 1986). Decoding involves converting written text into phonetic elements to access meaning at the word level, whereas comprehension is the skill of deriving meaning from these phonetically decoded words using language abilities (Hoover & Gough, 1990). It is often observed that students facing reading challenges predominantly have issues with the decoding aspect, which consequently affects their fluency and comprehension of the text (Siegel, 2006). Studies indicate that individuals with decoding difficulties tend to have deficiencies in phonological processing and face hurdles in mapping letters to sounds (Hulme & Snowling, 2016; Knoop-van Campen, Segers, & Verhoeven, 2018). The lack of speed and precision in this letter-sound conversion is recognized as a significant barrier to acquiring proficient orthographic and fluent reading abilities (Coltheart, 2006).

There exists a diverse array of reading disorders that individuals can encounter, making it essential to thoroughly evaluate all symptoms displayed by a child during the diagnosis phase. The American Speech-Language-Hearing Association recognizes several terms to categorize these reading challenges. These include dyslexia, which is perhaps the most widely known, along with reading disability, reading disorder, specific reading disorder, and specific reading comprehension deficit. Each label reflects different aspects and severities of reading difficulties, underscoring the importance of a detailed and comprehensive assessment to ensure that any diagnosis accurately reflects the full spectrum of a child's reading challenges. While the exact cause of reading disorders remains unknown, multiple factors can influence an individual's reading abilities. These factors highlight the complexity and individual variability in reading development and challenges (Karaca, 2023).

Reading disorders manifest when an individual struggles with reading words or comprehending what they read. These disorders often stem from unique differences in how the brain processes written text, which are typically present from an early age. However, it's also possible for someone to develop reading issues following brain injury at any stage of life. There are various types of reading disorders, including dyslexia, reading disability, and specific reading comprehension deficits. When diagnosing these disorders, it's vital to consider all the symptoms a child exhibits. Although the exact causes of reading disorders are not currently known, multiple factors can affect an individual's ability to read effectively (Sun et al., 2024). Reading disorders don't have a single pinpointed cause. Factors like early exposure to reading and classroom experiences significantly influence reading skill development. Moreover, genetics may also play a role in reading difficulties. Although preventing reading disabilities entirely isn't possible, early, and frequent reading activities can diminish the risk. It's essential to acknowledge that children with reading disabilities have normal intelligence; their challenges with word decoding and text comprehension are real and not a result of laziness (Sun et al., 2024). Furthermore, the impact of reading disabilities extends beyond the language arts classroom into subjects like music. Elementary music teachers in public schools often work with a varied student population, including those with reading disabilities. Recognizing that these disabilities affect learning across different subjects, including music, is important for effective education.

There are diverse opinions on the impact of reading disabilities on students' participation and success in music classes. Abramo (2012) points out that there might be an unexpected advantage, as he refers to neurological research suggesting that individuals with certain sensory impairments, like blindness, often demonstrate enhanced musical skills such as more precise pitch recognition and superior spatial awareness of sounds. Additionally, Abramo notes that individuals with autism are more frequently found to possess perfect pitch compared to the broader population. In contrast, Gleason provides an alternative viewpoint in his paper. He argues that disabilities tend to have a negative impact on students' musical experiences and performance.

These contrasting views highlight the complexity of understanding and addressing the needs of students with reading disabilities in music education, illustrating that the effects can vary significantly from one individual to another. There's a prevalent misconception in educational circles that can impact both

music teachers and their students. It's often wrongly assumed that if a student has a learning disability that negatively affects their academic performance, they must possess inherent musical or artistic talents. According to Gleason, this assumption is flawed because the skills required for music involve similar auditory and visual capabilities needed for reading and mathematics. Music, like written language and numbers, is highly symbolic. Despite the initial appearance of contradiction between the views that learning disabilities can both hinder and enhance musical abilities, these perspectives can actually be reconciled. Music engages multiple senses, and when students have disabilities in one area, such as reading, they may be forced to develop and rely more heavily on other sensory abilities. Consequently, a student with reading disabilities might struggle with reading music notation but could excel in performing music by ear, showcasing exceptional musical talent. This dual reality highlights the complex interplay between different cognitive abilities and the arts, emphasizing that challenges in one area can lead to compensatory development in another. Consequently, students with reading disabilities are entitled to personalized instruction tailored to their unique needs. This is typically provided through an Individualized Education Plan (IEP), which outlines specific strategies and accommodations to help each student succeed in the music classroom and beyond. The provision of such tailored educational plans ensures that all students, regardless of their disabilities, have the opportunity to engage with and benefit from their educational experiences.

Music and /or special education teachers have a crucial role in supporting students with disabilities by adhering to the guidelines set forth in each student's IEP. These IEPs are designed to provide necessary accommodations and modifications to ensure that students with reading disabilities, and other impairments, can successfully participate in music education. It is vital to acknowledge that a reading disability does not affect a person's overall intelligence. Students with reading disabilities have the capability to comprehend and participate effectively in musical activities. Abramo (2012) emphasizes that individuals are not disabled but rather impaired, and it is often society's failure to provide adequate accommodations that restricts their abilities. For example, a person who uses a wheelchair is not disabled by their impaired legs as long as appropriate accommodations like ramps, elevators, and wide entrances are available. However, without these accommodations, architectural barriers effectively disable the individual from accessing certain spaces. Thus, the purpose of IEPs in music education, similar to other accommodations in public spaces, is to remove barriers that might prevent students from accessing and fully participating in learning experiences. By adhering to IEPs and implementing required adaptations, music educators can guarantee that every student, no matter their disabilities, receives equal chances to thrive and appreciate their experience in music. Despite existing regulations aimed at ensuring students with reading disabilities have equal educational opportunities, inequalities can still occur. It is essential for teachers to actively prevent discrimination against students with reading disabilities in their classrooms. Teachers should engage in self-reflection to identify if their own practices might be creating barriers and should also be vigilant about barriers imposed by others, including those inherent in materials or events, advocating for their students when necessary.

A significant case comes from Frederick W. Moss Jr.'s book, which highlighted that students with visual impairments were often excluded from music auditions due to the requirement of sight-reading. This requirement inadvertently discriminates against those with visual impairments, potentially transforming a manageable impairment into a significant disability. This example underscores the need for flexibility in teaching practices and assessment criteria to accommodate diverse needs without compromising educational objectives.

Furthermore, as McCord, & Fitzgerald, discusses, the lack of adequate support and adaptations in the music classroom can lead to learned helplessness, frustration, and apathy among students with disabilities. These negative outcomes can stifle creativity and discourage students from participating in musical composition or improvisation. Learned helplessness might manifest as resistance to tasks, behavior problems to avoid challenging activities, or a reliance on others for answers rather than engaging creatively (McCord, & Fitzgerald, 2006).

Teachers must be proactive in recognizing signs of learned helplessness and ready to provide necessary support to prevent students from becoming overly frustrated or disengaged. Offering multiple examples

of composing and improvisation can build confidence and encourage independent efforts among students with learning disabilities. Ensuring that accommodations outlined in IEPs are effectively implemented is crucial for helping each student to succeed and fully participate in the music education process (Ritter-Cantesanu, 2014).

Reading disabilities can present significant challenges for students in music classes, affecting their ability to read music, process rhythms, sing correct pitches, and more. Beyond these technical aspects, such challenges can also impact a student's motivation and creativity, potentially leading to learned helplessness and reducing their overall success in music.

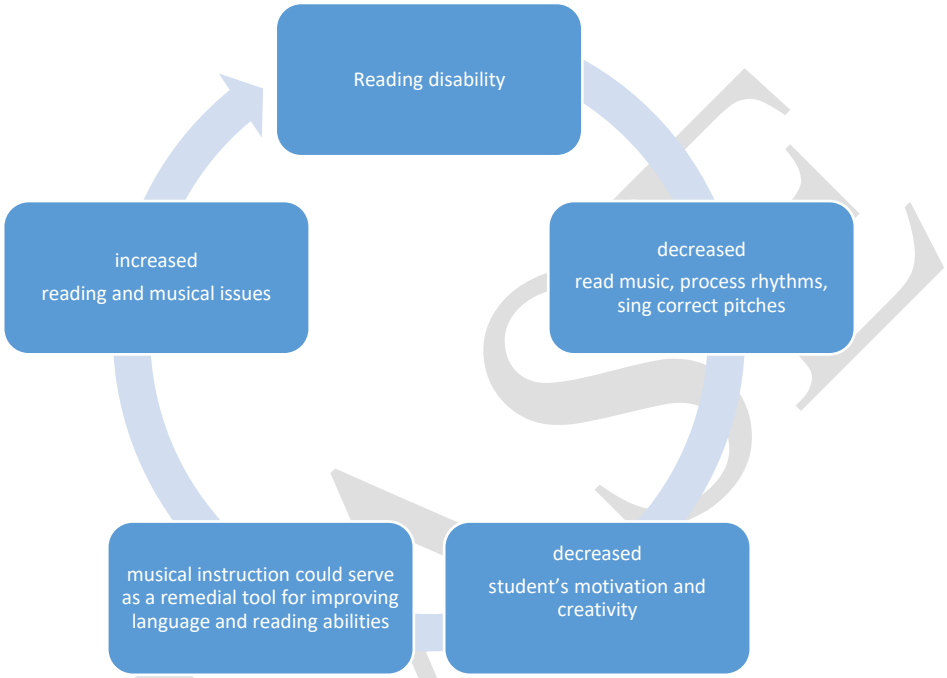

Figure 1. Contrary to seeming like part of the problem where a student's reading difficulty negatively affects music-related subjects, supporting reading via music-related reading activities can actually facilitate positive development in solving reading and music related problems.

The relationship between music and reading skills is complex yet often underexplored in educational strategies aimed at assisting students with reading disabilities. Research has suggested that musical instruction could serve as a remedial tool for improving language and reading abilities among these students. A notable series of studies conducted by Forgeard, Schlaug, Norton, Rosam, Iyengar, and Winner, (2008) explored this potential connection. The first study examined whether skills in phonological processing correlate with musical processing skills, such as pitch and rhythm, particularly among children who have undergone music training. The hypothesis suggested a stronger correlation for children with musical training. The second study extended this to examine the correlation between reading abilities and musical skills, again hypothesizing a stronger relationship for musically trained children. The third study focused on whether deficits in phonological processing and reading commonly observed in children with dyslexia also predict difficulties in processing musical pitch and rhythm. The fourth study compared children with dyslexia to their normal-reading peers, both with and without musical training, to further test the hypothesis regarding deficits in music processing.

These studies collectively indicate that music training might not only enhance related auditory processing skills but also provide significant benefits in reading and language skills for children with reading disabilities. This suggests that integrating music education into the curriculum for students with reading disabilities could be a valuable strategy for supporting their overall academic development.

Before conducting their in-depth studies, researchers investigated the connections between music and language skills. Previous research indicated a relationship between these skills in both typically developing children and those with dyslexia. Forgeard and colleagues found that "a strong relationship

between musical discrimination abilities and language-related skills" exists, particularly emphasized in students who received musical instruction (Forgeard, p. 383). Their findings highlighted that a student's musical abilities could potentially predict their performance in reading tasks, and that musical interventions could help address language deficits.

The comprehensive results from Forgeard et al.'s studies, particularly studies 1 through 4, confirm that auditory musical discrimination abilities are closely linked to language-related skills. In children who read normally, the ability to discriminate melodic elements was found to predict both phonological and reading skills, while the ability to discriminate rhythmic elements was linked only to reading skills. These relationships were more pronounced in children who had undergone music training compared to those who hadn't, suggesting that music training can play a crucial role in developing language-related skills (2008).

While music has shown promising benefits for students with reading disabilities in enhancing their language skills, it hasn't been proven to outperform traditional methods of remediation. Experimental studies that have looked into using music interventions to boost reading skills in typically developing children have yielded inconsistent results. Additionally, while some research has noted positive effects of music training on reading abilities, no studies have yet demonstrated that music interventions are as effective or more effective than other types of non-musical auditory training.

Despite the current lack of evidence for music's superiority over other methods, its benefits for children with reading disabilities are undeniable and should not be overlooked. Forgeard remains hopeful, suggesting that "a general instrumental or singing-based music intervention may help children with language-based learning disabilities recover normal language and music skills" (Forgeard, p.388). Thus, music instruction continues to be a valuable tool in helping students with reading disabilities improve their language and reading skills, supporting their overall educational development. Moyer (2020), an experienced researcher and music educator, has consistently observed the remarkable benefits of music education for students with various learning disabilities. Over time, Moyer has discovered that customized music lessons can effectively address learning disabilities in ways that are unexpected and not yet fully understood. Moyer holds the view that music education is not merely for enrichment but is crucial for developing essential skills, particularly beneficial for children with learning disabilities who can greatly benefit from the unique capabilities music instruction provides. Moyer asserts that focusing music education on the needs of these children has proven to be an effective strategy, even if the precise mechanisms behind this success are still unknown to the researcher.

In the specialized area of reading disabilities, with a particular focus on Developmental Dyslexia (DD), there have been significant strides in the development of diagnostic tools that have refined our understanding of the fundamental causes of this condition. Recent advancements in neurophysiological and cognitive research have posited that auditory and musical training may play a beneficial role in addressing phonological and reading challenges by bolstering auditory temporal processing capabilities, which are frequently found to be deficient in children diagnosed with DD, a notion supported by the compilations of research from Hämäläinen et al. (2013). Furthermore, findings from Lallier et al. (2017) and Cantiani et al. (2019) have highlighted that erratic oscillations in neural activity within the auditory cortex could potentially interfere with the operations of the reading networks situated in the left hemisphere of the brain, which in turn could impede the development of phonological and reading skills, a conclusion that is in line with observations made by Goswami et al. (2011) and Giraud and Ramus (2013).

The Temporal Sampling (TS) Theory, initially introduced by Goswami in 2011 and subsequently elaborated upon by Goswami and colleagues in 2014, elucidates the connection between these atypical neural oscillations and the challenges encountered in recognizing and differentiating the rise times within the amplitude envelope of sounds, which are the initial fluctuations in sound modulation. These rise times play a pivotal role in articulating the rhythmic structures inherent in both speech and music. Particularly in speech, these elements are vital as they clearly mark the rhythm and prosodic patterns, playing a critical role in the segmentation of the acoustic signals into distinct syllables and words. The capability to effectively process these rhythms is indispensable for the development of language skills

(Curtin, 2010), as it lays down a phonological framework that is essential for the expansion of vocabulary (Leong et al., 2014), which, in turn, crucially supports the enhancement of reading abilities (Ziegler et al., 2014). Studies have established a correlation between difficulties in auditory processing of speech signals and the ability to manage rhythms in non-speech contexts among individuals with Developmental Dyslexia (DD), as evident in musical exercises that evaluate one's responsiveness to the rhythmic patterns of sounds (Huss et al., 2011; Goswami et al., 2013; Flaugnacco et al., 2014). The capacity to distinguish different rhythms is not only a strong indicator of phonological awareness and the development of reading skills in children but also a consistent predictor of their future reading abilities (Huss et al., 2011; Flaugnacco et al., 2014; Ozernov-Palchik et al., 2018). Based on these findings, it has been suggested that musical training focused on improving temporal alignment could be an effective method to alleviate phonological and reading difficulties in children with DD (Overy, 2003; Tallal and Gaab, 2006; Patel, 2012). However, research into the effectiveness of music training on reading skills has yielded varying outcomes (Antonietti, 2022).

Integrating Music and Reading Instruction

Combining music and reading training can be a highly effective educational approach, particularly for enhancing language skills. This method integrates music activities such as listening, singing, playing instruments, and movement with traditional reading and language tasks. This integration helps reinforce learning by engaging different sensory modalities, which can improve phonological awareness, reading fluency, and comprehension.When implemented, the curriculum typically involves regular sessions where students participate in both musical and reading activities. These could be structured around themes or particular skills that align both musically and linguistically. For example, a session might involve singing songs that have repetitive, rhyming lyrics to help with phonemic awareness, followed by reading activities that focus on the phonics concepts introduced in the song. The rationale behind this approach is that music naturally involves many of the auditory processing skills that are critical to reading, such as the ability to discern pitch, pace, tone, and rhythm. Music can stimulate the brain's language centers, thereby providing a potent medium to enhance learning in students, especially those struggling with reading difficulties. Additionally, engaging with music can increase motivation and reduce anxiety around reading tasks, making the learning environment more enjoyable and effective.

Integrating music in learning environment has shown promising results in various studies, where students who participated in combined music and reading programs often showed improvements not just in specific language-related skills, but also in broader academic performance metrics. Register et al. (2007) created a specialized music program, known as the Register Music/Reading curriculum, aimed at enhancing word reading, passage comprehension, and vocabulary. The program consisted of training sessions held three times a week over a four-week period. These sessions integrated music activities such as listening to music, singing, playing instruments, and moving, with reading and language tasks, supported by visual aids and printed academic materials. To assess the effectiveness of this program, a group of eight second-grade students with specific reading impairments and 33 of their typically-reading classmates were divided into two groups: a treatment group of 25 students who received both the music-reading program and the standard reading curriculum, and a control group of 16 students who received only the standard curriculum. All students with developmental dyslexia were placed in the treatment group. Standardized tests measured reading skills, passage comprehension, and vocabulary before and after the intervention. Post-intervention, the students with developmental dyslexia showed significant improvements in all measured areas. While both groups showed significant enhancement in reading and vocabulary, improvements in passage comprehension were not observed. Notably, the vocabulary improvements were significantly greater in the treatment group compared to the control group. Thus, when considering both students with Developmental Dyslexia (DD) and those who are typical readers, the In a study by Flaugnacco et al. (2015) conducted in Italy, researchers investigated the impact of music training, which included at-home reading activities, on children with Developmental Dyslexia (DD). This program, inspired by the Kodaly and Orff pedagogies, focused on enhancing rhythm and temporal processing through percussion, rhythmic movements, sensorimotor synchronization, and rhythmic chanting. As a comparative measure, a control group participated in a painting training program aimed at developing visual-spatial abilities, manual skills, and creativity. The study involved

46 primary school children aged 8 to 10, with 24 attending the music classes and 22 attending the painting classes. Both groups met for 60 minutes twice a week over approximately seven months and performed 20 minutes of daily reading exercises at home under parental supervision.

Pre- and post-intervention evaluations assessed various cognitive and perceptual abilities, including reading skills (covering word, pseudo-word, and text reading), phonological awareness, verbal working memory, auditory attention, and temporal processing capabilities, such as rhythm reproduction and musical meter discrimination. Self-esteem levels were also measured. Results showed general improvements in reading abilities across both groups, yet the children in the music group exhibited more substantial gains in reading pseudo-words and texts accurately. Additionally, the music group showed greater progress in phonological tasks like pseudo-word repetition and phonemic blending, working memory, auditory attention, and identifying irregular timing in sounds. Meanwhile, the painting group made more pronounced improvements in visual-spatial skills. There was no noticeable difference in self-esteem between the two groups after the interventions. music-reading curriculum added to regular school activities did not alter reading outcomes.

The array of research reviewed here indicates that musical and auditory-focused interventions, aimed at addressing phonological deficits associated with Developmental Dyslexia (DD), have had a positive impact on reading skills to varying degrees. Comparisons between these musical/auditory training programs and traditional language-only remediation approaches typically showed similar levels of effectiveness. Additionally, studies focusing primarily on phonological awareness as an outcome consistently reported significant enhancements in these skills compared to control groups. Auditory processing abilities also saw improvements through most of the interventions examined in this review. Concurrently, a separate study in Italy by Bonacina et al. (2015), discussed in further detail by Antonietti (2017) and subsequent publications by Cancer et al. (2016, 2019, 2020, 2021, 2022), assessed a computer-based program called Rhythmic Reading Training (RRT). This program employs beat-synchronized reading tasks that prompt children to synchronize their reading with a steady beat. This method focuses on enhancing the segmentation of spoken language into phonological units such as syllables and onset-rimes, thereby enhancing the overall efficacy of the reading intervention. The RRT program specifically targets various reading subprocesses, including syllabic blending, and both sublexical and lexical reading strategies.

In another study (Bonacina et al., 2015), 28 junior high school students diagnosed with DD, aged 11 to 14, were divided into two matched groups. One group underwent RRT through nine 30-minute biweekly sessions, conducted individually and supervised by a specialized trainer, while the other group did not receive any intervention. Reading performance was evaluated before and after the training using a set of standardized Italian reading tests that measured reading accuracy and speed for texts, words, and pseudo-words. Rhythm perception was also tested through a rhythm reproduction task. The comparison of pre- and post-training outcomes demonstrated significant improvements in reading abilities for the RRT group, particularly in reading speed for short and long pseudo-words, reading accuracy for high-frequency long words, and text reading accuracy, indicating that RRT led to more pronounced enhancements in reading skills compared to natural reading development.

In a related investigation by Cancer and team (2020), the effectiveness of Rhythmic Reading Training (RRT) was compared with a dual approach involving Visual Hemisphere-Specific Stimulation (VHSS) by Lorusso et al. (2006) and Action Video Game Training (AVG) by Franceschini et al. (2013). The study involved 24 students with Developmental Dyslexia (DD), aged between 8 and 14. They were divided into two groups, each consisting of 12 students. One group underwent the RRT while the other received a combined treatment of VHSS and AVG. Each participant attended eighteen 45-minute sessions over three weeks, totaling 13 hours of intervention. The findings showed that both methods notably improved reading skills and phonological awareness. However, RRT stood out particularly in accelerating pseudo-word reading speed. These advancements were also linked to enhanced phonological awareness, underlining the critical role of phonological processes in the effectiveness of RRT in boosting reading skills.

Support for the notion that better music perception skills might lead to improved language abilities comes from various experimental (e.g., Schon et al., 2004) and theoretical (e.g., Besson et al., 2011) research. Initially proposed by Overy in 2003 and further developed by Tallal and Gaab in 2006, the theory suggests that musical training could particularly enhance the processing of rapid temporal acoustic signals, supporting language development. This precise analysis of speech sounds' temporal elements is essential for developing phonological representations of words and the phoneme-grapheme connections crucial for reading. Nonetheless, some studies reviewed indicated that while interventions improved phonological and auditory processing, these enhancements did not always translate into better reading skills. This could be because the extent to which phonological and auditory abilities contribute to reading may vary based on the type and severity of each individual's reading impairment. We propose that in cases of reading difficulties not rooted in phonological issues, other unaddressed impaired processes (e.g., visuo-attentional deficits) might hinder the influence of enhanced phonological and auditory processing on reading. Although there is currently no agreed-upon classification of reading problem subtypes, the variation in clinical presentations might suggest distinct underlying impaired subprocesses. For instance, a deficit in word reading might arise from a dysfunction in the lexical route, which relies on visual word recognition (Coltheart et al., 2001); whereas difficulties in pseudo-word reading could stem from issues in the phonological route and grapheme-phoneme mappings (Coltheart, 1993).

It can be theorized that different reading profiles might most benefit from interventions that target their specific impaired subprocesses, particularly those with phonological deficits potentially gaining the most from musical/auditory training. Future studies should investigate this idea by examining the unique effects of music/auditory interventions on different types of readers. Another hypothesis to consider is that the full impact of music/auditory training on reading skills might require a long-term perspective. I suggest that future research should employ longitudinal studies to assess potential delayed effects on reading prompted by improved phonological abilities.

Conclusion

I theorize that different reading profiles might most benefit from interventions that target their specific impaired subprocesses, particularly those with phonological deficits potentially gaining the most from musical/auditory training. Future studies should investigate this idea by examining the unique effects of music/auditory interventions on different types of readers. Many researchers advocate that musical interventions be used in conjunction with traditional remedial strategies. Considering the complex neurobiological (Richlan, 2014) and behavioral (Menghini et al., 2010) aspects of DD, I believe that interventions focusing on music and auditory processing should also incorporate phonological and reading tasks. Integrating decoding exercises within music/auditory-based activities could potentially enhance their positive effects on reading performance.

Another hypothesis to consider is that the full impact of music/auditory training on reading skills might require a long-term perspective. I suggest that future research should employ longitudinal studies to assess potential delayed effects on reading prompted by improved phonological abilities.

The cognitive processes involved in both reading and music are driven by shared neural mechanisms, emphasizing how intertwined these skills are. This connection suggests that difficulties experienced in musical activities by high-risk readers mirror their broader challenges, indicating that enhancements in one domain could positively influence the other. The critical role of reading in both lifelong learning and everyday activities necessitates that educators, particularly those teaching reading and music, prioritize developing reading fluency. Music and special education teachers should be equipped to offer the necessary accommodations and modifications to students with reading disabilities. Such support not only helps these students fully engage in music classes but may also improve their reading skills through musical activities. Engaging students in music serves to stimulate the same brain processes involved in reading, providing a creative and effective method to bolster essential academic abilities. Ultimately, it is evident that musical education offers significant benefits beyond its inherent value, serving as a crucial educational resource for students with reading disabilities by enhancing their language and reading skills in substantial and impactful ways.

Ethics and Conflict of Interest

The author declare that the study has not unethical issues and that research and publication ethics have been considered carefully.

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