



Musical enrichment for neurologically disordered children

A new study finds music therapy an effective addition to treatment for children with severe neurological disorders, enhancing the children's attentional and emotional capacities.

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This study used a two-armed parallel group design to test the effectiveness of a music therapy treatment for children with severe neurological disorders. The control group received only a standard neurorestoration program, while the experimental received an additional music therapy prior in addition to standard occupational and speech therapy. The purpose was to improve the social interactions by promoting changes in attention and emotional responses and to explore whether music therapy could be more broadly utilized for a range of disorders. The results showed improved attention and communication and changes in brain plasticity in the children, supporting the hypothesis that music therapy is an effective addition to the treatment regimen for the rehabilitation of patients across a wide range of disorders.

It is without question that music plays a major role in human life, an aspect of humanity that transcends borders and generations. Previous research indicates that people consider music an important aspect of their lives and listening to music is an activity commonly engaged in¹. Similar research also found that when people are asked why music is a part of their lives, the answer is because music induces and regulates emotion². The social-emotional nature of music is credited with the sustained prominence music has throughout human culture^{3,4}. Regarding music and the brain, there is plenty of research that confirms differences in brain structures between musicians and non-musician. For example, music training has been shown to affect the development of the planum temporale, a structure of the secondary auditory cortex, which is involved in the conciliation of verbal memory⁵. In addition, the processing of music has been associated with the limbic and paralimbic regions of the brain, including regions involved in reward pathways (Zald, 2011). The concept of music therapy is defined as the use of music to modify brain processes by engaging the attention and interest of the subject and by confirmation of this engagement effect and its consequences⁶. There appears to be few studies that have evaluated the effectiveness of music therapy in treating a broad range of neurological disorders using appropriate methods to gauge behavioral and physiological outcomes. Because of the extensive research supporting various effects of music on brain structures involving cognitive, sensorimotor, and emotional processing⁷, this study was geared toward exploring the benefits of music therapy in addition to standard neurorestoration therapy for children with severe neurological disorders.

A two-arm parallel group design in which an experimental music therapy group was compared to a control group, where both groups received a standard neurorestoration program but the experimental group received additional music therapy. All children who participated had significant problems in motor, cognitive, and in particular communication abilities. There were no differences in the neuropsychological impairments between both groups. The neurorestoration program involved seven hours of motor, language, occupational, physical stimulation and

neuropsychology therapies, with each lasting an hour. The music therapy protocol involved children listening to different musical excerpts and focusing their attention on specific aspects of the music, such as shifting melody dynamics and rhythmic patterns. Two basic procedures were designed to stimulate either sustained or selective attention. In the sustained attention procedure, the child was required to throw a ball to another child in synchrony with changes in musical cues, and in the selective attention procedure, the child was required to focus on one instrument and ignore the others. The protocol was designed to increase the levels of sustained and selective attention and verbal and nonverbal communication between children with various neurological disorders. The music therapy protocol was administered in ten-minute sessions directly before the standard speech and occupational therapies. In all cases a final ERP Mismatch Response (event-related potential) evaluation was carried out at the end of the therapy period in order to measure brain plasticity. ERP Mismatch Responses have been used in children to determine maturation of the brain and to study specific childhood neurological disorders⁸. Additionally, a questionnaire was administered that used a number of well-established procedures from previous works in order to examine a wide range of behavioral results on a 5-point scale, with 1 being the lowest possible and 5 as the highest possible score. The questionnaire, administered by the therapists, incorporated aspects of standard and validated behavioral questionnaires in order to gauge improvements in motor, social, emotional, and cognitive areas. The effectiveness of music therapy was measured using the ERP Mismatch Response evaluation and the behavioral questionnaire to assess the results from multiple perspectives.

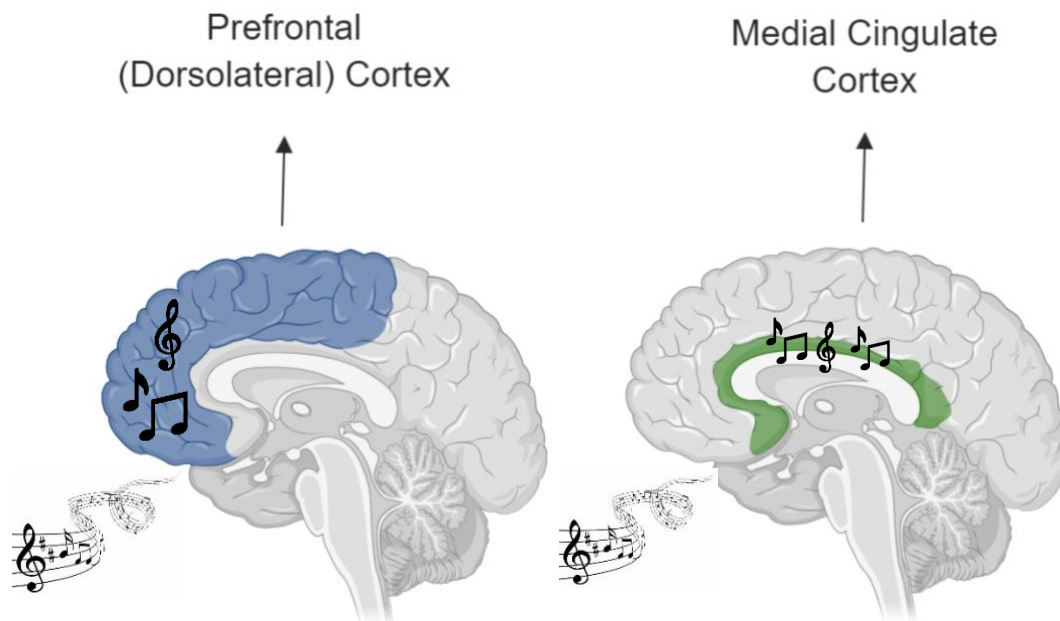


Figure 1

Overall, the results support the target questions: first, the effectiveness of MT in addition to standard neurorestoration therapy in real world situations, and second, the music therapy-specific changes in brain plasticity (Figure 1). The purpose of this protocol was to use the music therapy as a platform to train the children in other nonmusical areas, such as attention and communication. As opposed to previous works studying music therapy in relation to specific disorders, this study demonstrated music therapy's success across a mixed patient sample. Additionally, the program was also effective in enhancing the children's motivation and social behavior, which could account for the boosts in communication, cooperation and social awareness. An important note about the methodology is that the measurements were difficult to relate to the brain regions associated with

responses to the addition of music therapy. The median cingulate cortex and the prefrontal and dorsolateral cortex were identified with potential music therapy-induced effects. The ERP-LORETA analysis identified the medial cingulate cortex to be involved in the attentional network activated by cognitively demanding tasks, the processing and perception of pain, emotion, stimulus salience, action-reward associations, and premotor functions^{9,10,11}. The same analysis also identified the prefrontal cortical areas, which are largely associated with cognitive functions, and the dorsolateral prefrontal cortex, which is activated primarily during tasks requiring executive function¹².

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