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After Traumatic Brain Injury, Music Therapy Aids in the Plasticity of Resting-State Networks

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Introduction

Damage to the orbitofrontal cortex (OFC) frequently develops following a TBI and can result in complex behavioral abnormalities, such as difficulty focusing and paying attention. As a result of our investigation into the effect of musical training on individuals with behavioral and cognitive abnormalities following a mild traumatic brain injury (mTBI), the OFC networks underwent significant functional neuro-plastic changes. The results of a neuropsychological test showed that cognitive function had improved. After the intervention, six of the seven people in this group went back to work, and they all said that their social and emotional behavior had changed. This study examines the connecting networks that may be responsible for improved social interaction in relation to the functional changes in the OFC that occurred following the music-supported intervention. We also talk about the release of dopamine during play as a factor that could affect the results. For eight weeks, the intervention consisted of two 30-minute piano lessons with a teacher. At home, additional playtime of at least 15 minutes per day was required [1].

Participants reported spending an average of three hours per week playing the piano during the intervention phase. There were three groups of people in the group: an mTBI group (n = 7), two healthy control groups (n = 11), one of which received music training and a baseline group (n = 12) that did not receive any music training. While in the hospital, the participants in the clinical group had received standardised cognitive rehabilitation therapy, but they had not yet recovered from their impairments. The intervention was carried out two years after the injury occurred. All participants underwent task- and resting-state functional magnetic resonance imaging (fMRI) evaluations before and after the intervention. The treatment group (OFC) showed a significant improvement on neuropsychological tests, which supported the fMRI findings of functional changes in the orbitofrontal networks. The same changes were observed in both resting-state fMRI and simple task fMRI when dynamic causal modeling was used to examine them. We hypothesized that practicing the piano in accordance with the instruction may improve social interaction and overall well-being. We propose that the novelty of the intervention may benefit clinically individuals with behavioral issues following a TBI [1,2].

Description

Traumatic brain injury (TBI) can have profound effects that alter a person's life. Getting the best treatment and rehabilitation for a head injury can mean the difference between being disabled and able to function normally. Despite their potential significance for the treatment and practice of mild traumatic brain injury (mTBI), few controlled studies have been conducted on the effects of long-term post-traumatic therapies. Vikane concluded that multidisciplinary outpatient clinical care had no effect on whether a patient returned to work (RTW) or remained on sick leave in a longitudinal study of mTBI patients. These results suggested that RTW promotion should be approached in a different way in future intervention studies.

Damage to the orbitofrontal cortex (OFC) on its own or in conjunction with damage to the temporal pole can lead to complex behavioral changes. Due to their proximity to bony protrusions, the orbitofrontal networks are susceptible to trauma-induced rotational acceleration of the brain. Prefrontal brain injuries typically result in higher cognitive dysfunction as well as abnormal social behavior. Emotional recognition is essential in social interactions because it enables people to comprehend intentions and, as a result, direct behavior. Since it receives information from the amygdala, temporal association cortex, and hypothalamus, the OFC is the highest integration center for processing emotions [2].

Neurologic music therapy (NMT), which is defined as "the therapeutic application of music to cognitive, sensory, and motor dysfunction due to neurologic illness of the human nervous system," may encompass the intervention strategy that has been presented. The neuroscience of how people perceive music and how music affects changes in brain regions unrelated to music is the foundation of the NMT method. However, the current study does not strictly adhere to one of the NMT-described cognitive strategies. The intervention program is organized according to a predetermined curriculum [3].

Neuropsychological tests

The CVLT test demonstrated that musical training had a significant impact on executive functions related to attention, learning strategies, and memory retrieval in both the sick group and the healthy control group that received music intervention. To be more specific, the post-intervention examination revealed that the performance of the sick group had returned to the level it had been prior to the intervention in both of the control groups. However, the Strop test demonstrated that repetition had a significant effect rather than any group-specific effects. The MMS test was not part of this investigation because there was a ceiling effect on all patients. However, the Strop test revealed a significant effect of repetition rather than any group-specific effects. Due to the fact that there was a ceiling impact on all subjects, the MMS test was not included in this experiment [4].

Discussion

A number of parameters have undergone functional changes as a result of the current findings. The idea that music intervention results in increased social behavior is supported by the qualitative findings from semi-structured interviews, which revealed that six out of seven participants in the therapeutic group reported greater well-being, increased social contact, and a typical work environment. Functional neuroplasticity was observed in the

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orbito- and prefrontal cortex primarily following music-supported intervention in the patient group. This was consistent with findings from both task and resting-state functional magnetic resonance imaging (fMRI) [5].

Conclusion

We have demonstrated that practicing the piano can boost neuroplasticity, improve social interaction, and improve well-being in people who have cognitive difficulties following mTBI. The task and resting-state fMRI studies provided significant evidence for a causal link between the music intervention and the functional remodelling of brain networks in the OFC. Six out of seven patients with chronic TBI returned to work after this intervention was completed, which is encouraging. Our hypothesis that neural activation during eight weeks of intense, structured music intervention enhanced social interaction and improved cognitive performance in the clinical group is supported by the literature on neuroplastic changes in the brain during music training. Future research ought to investigate the amount of dopamine released when playing the piano in order to investigate the effect of dopamine on social behavior and the effects of changes in OFC brain networks. The study suffers greatly from the insufficient number of participants. Another limitation is the absence of a patient control group. Even if the patients in the control group had previously received rehabilitation from the healthcare system and were in a chronic stage of post-concussion syndrome, the results would still be more relevant in a control group. In future trials, there ought to be a patient control group. According to our conclusion, the novelty of this intervention may have clinical significance for people who struggle with social interaction.

Acknowledgement

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Conflict of Interest

None.

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