

Music Therapy Promotes Resting-State Network Plasticity after Traumatic Brain Injury

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Introduction

Following a TBI, damage to the orbitofrontal cortex (OFC) frequently develops and can cause complicated behavioural abnormalities, including trouble focusing and paying attention. The networks of the OFC underwent considerable functional neuro-plastic changes as a result of our investigation into the impact of musical training on individuals with behavioural and cognitive abnormalities following a mild traumatic brain injury (mTBI). Neuropsychological test findings showed an improvement in cognitive function. Six out of the seven individuals in this group went back to work after the intervention, and they all reported an improvement in their social and emotional conduct. The functional alterations in the OFC after the music-supported intervention are examined in this study in relation to the connecting networks that might be in charge of improved social interaction. We also talk about the dopamine release during play as a component that may have an impact on the outcomes. The intervention involved two 30-minute lessons on the piano each week for eight weeks with a teacher. A minimum of 15 minutes of additional playing time each day was necessary at home [1].

During the intervention phase, participants reported spending an average of 3 hours per week playing the piano. Participants were divided into three groups: an mTBI group (n=7), two control groups made up of healthy individuals, one of which received music training (n=11), and a baseline group (n=12) without music training. The clinical group's participants had undergone standardised cognitive rehabilitation therapy while they were in the hospital, but they had not yet recovered from their impairments. Two years after the injury, the intervention was conducted. Prior to and after the intervention, all participants had neuropsychological testing as well as task- and resting-state functional magnetic resonance imaging (fMRI) evaluations. The findings supported fMRI findings that the orbitofrontal networks underwent functional alterations, showing a significant improvement on neuropsychological tests in the treatment group (OFC). Both a straightforward task fMRI and resting-state fMRI, which were both, examined using dynamic causal modelling, showed the same alterations (DCM). We postulated that practising the piano as instructed by the training procedure may enhance social interaction and general well-being. We propose that individuals with behavioural issues after a TBI may benefit clinically from the novelty of the intervention [1,2].

Description

The effects of traumatic brain injury (TBI) can be severe and alter a person's life. For individuals with head injuries, receiving the best care and rehabilitation

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can make the difference between disability and regular functioning. Few controlled studies have been done on the effects of long-term post-traumatic therapies despite the potential high significance for the practise and therapy of mild traumatic brain injury (mTBI). In a longitudinal study of patients with mTBI, Vikane came to the conclusion that multidisciplinary outpatient clinical care did not affect whether the patient returned to work (RTW) or remained on sick leave. These findings suggested that future intervention studies should take a different strategy to encourage RTW.

Complex behavioural alterations may emerge from damage to the orbitofrontal cortex (OFC) alone or in conjunction with damage to the temporal pole. The orbitofrontal networks are susceptible to trauma-induced rotational acceleration of the brain because they are situated so close to bony protrusions. Higher cognitive dysfunction and abnormal social behaviour have long been recognised as typical side effects of prefrontal brain injuries. In social interactions, emotional recognition is crucial because it enables people to comprehend intentions and hence direct conduct. The OFC is the highest integration centre for processing emotions as it gets information from the amygdala, temporal association cortex, and hypothalamus [2].

The approach to intervention that has been presented may fall under the umbrella of 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". The NMT technique is based on neuroscience concepts of how people perceive music and how music affects changes in brain regions unrelated to music. The current study does not, however, strictly adhere to one of the cognitive strategies described in NMT. There is a set curriculum used to structure the intervention programme [3].

Neuropsychological tests

In the sick group and the healthy control group with music intervention, the CVLT test revealed a significant impact of musical training on executive functions linked to attention, learning methods, and memory retrieval. To be more exact, the post-intervention examination showed that the sick group's performance had improved to the pre-intervention level of both control groups. However, the Stroop test revealed a major effect of repetition rather than any group-specific effects. Because there was a ceiling effect on all patients, the MMS test was not included in this investigation. The Stroop test, however, did not show any group-specific effects but rather a significant effect of repetition. The MMS test was excluded from this experiment because there was a ceiling impact on all subjects [4].

Discussion

The current findings show functional alterations in a number of parameters. The qualitative findings from semi-structured interviews, wherein six out of seven therapeutic group participants reported greater well-being and social contact along with a typical work environment, support the idea that increased social behaviour follows music intervention. Following music-supported intervention in the patient group, this was accompanied by functional neuroplasticity, which was primarily shown in the orbito- and prefrontal cortex, as concordantly seen in both task and resting-state fMRI [5].

Conclusion

In individuals with cognitive difficulties after mTBI, we have shown that

practising the piano can promote neuroplasticity and improve social interaction and wellbeing. Significant evidence for a causal link between music intervention and functional remodelling of brain networks in the OFC was found in the task and resting-state fMRI studies. An encouraging result of this intervention was the fact that six out of seven patients with chronic TBI went back to work once it was completed. The literature on neuroplastic changes in the brain during music training supports our hypothesis that neural activation during 8 weeks of intense and structured music intervention boosted social interaction and improved cognitive performance in the clinical group. To explore the impact of dopamine on social behaviour and how alterations in OFC brain networks affect it, future study should look into the amount of dopamine released when playing the piano. The small number of participants is a major drawback of the study. The absence of a patient control group is another drawback. A control patient group would give the results more relevance even if the patients in the patient group had previously received rehabilitation from the healthcare system and were in a chronic stage of post-concussion syndrome. There should be a patient control group in future trials. The novelty of this intervention may have clinical significance for people with social interaction issues, according to what we suggest as a conclusion.

Acknowledgement

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Conflict of Interest

None.

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