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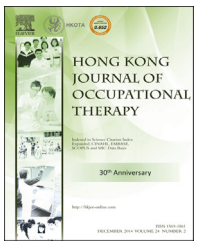

ORIGINAL ARTICLE

Flow Experience During Attentional Training Improves Cognitive Functions in Patients with Traumatic Brain Injury: An Exploratory Case Study

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traumatic brain injury

Summary *Objective/Background:* Flow is the holistic experience that occurs when an individual acts with total involvement. The objective of this study was to examine the effects of attention training that induces flow experience for patients with attention-deficit disorder after traumatic brain injury (TBI).
Methods: A two-patient case report with a within-subject AB design was conducted. Two patients with attention deficit after TBI were recruited for attention training. Two types of video game tasks for attention training were created, one inducing flow (flow task) and the other not (control task). Patient A performed the flow task for 14 days after receiving general occupational therapy (OT) for 11 days. Patient B performed the flow task for 15 days after performing

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the control task for 10 days. We examined training effects using neuropsychological tests. The Flow State Scale for Occupational Tasks was administered to identify the patient's flow state. To evaluate the training effect, we used visual analysis, the two-standard deviation band method, and effect-size analyses.
Results: Both Patient A and Patient B showed improvement on the Continuous Performance Test, Symbol Digit Modalities Test, and Moss Attention Rating Scale after the flow task. Patient B also showed improvement on the Trail Making Test.
Conclusion: The results for Patient A suggested that the flow task was more effective than general OT for improving attention deficits. Moreover, the results for Patient B suggested that the flow task was more effective than the control task. Attention training inducing flow experience may thus facilitate improvement of attention.

Introduction

Patients with traumatic brain injury (TBI) show diverse higher brain dysfunctions such as attention deficit, memory disorder, and executive dysfunction (Millis et al., 2001). Many young patients have severe problems in relation to a return to work or school (Schmitter-Edgecombe, 2006). Attentional deficits have high priority for treatment because they are common following TBI and have great adverse impact on patients' daily and social lives.

The most common current approach to attentional training is direct intervention that trains the impaired specific attentional component repeatedly, such as attention process training (Galbiati et al., 2009; Pero, Incoccia, Caracciolo, Zoccolotti, & Formisano, 2006; Serino et al., 2007; Vallat-Azouvi, Pradat-Diehl, & Azouvi, 2009). However, this approach only produces small effects and does not generalize to new situations, even if the trained component improves (Rohling, Faust, Beverly, & Demakis, 2009). In addition, because specific direct intervention approaches require high endurance, patients with TBI who fatigue easily as a result of decreased information processing, anxiety symptoms, and depression (Ponsford et al., 2012) may find it difficult both to concentrate on the tasks and to sufficiently exert their ability. Danzl, Etter, Andreatta, and Kitzman (2012) reported that the principles of engagement have the potential to facilitate the effect of neurorehabilitation; however, to the best of our knowledge, this is yet to be confirmed by another study.

Alternatively, flow-inducing tasks may be effective for treating attention deficit in TBI. Flow is the holistic experience that occurs when an individual acts with total involvement (Csikszentmihalyi, 1975). When in flow, an individual operates at full capacity (Nakamura & Csikszentmihalyi, 2002). Flow is a psychological state characterized by a high level of attention with a low sense of effort, low self-awareness, and a feeling of control and enjoyment; it occurs during the performance of tasks that are challenging, but matched in difficulty to the skill level of the individual (Csikszentmihalyi & Csikszentmihalyi, 1988; Csikszentmihalyi & Nakamura, 2010). Flow most clearly represents an absorbed state.

The neural correlates of flow experiences have been investigated by several functional brain imaging studies, and reward-related structure, including the striatum, had been reported to be associated with flow experience (de Manzano et al., 2013; Klasen, Weber, Kircher, Mathiak, & Mathiak 2012; Ulrich, Keller, Hoenig, Waller, & Grön, 2014). In addition, recent findings indicate a possibility that the reward system optimizes neurocognitive functions such as visual selective attention and visual search (Chelazzi, Perlato, Santandrea, & Della Libera, 2013). It is presumed that the flow experience influences these neurocognitive functions; however, it remains unclear whether flow experience can be used as a therapeutic approach to facilitate cognitive training.

The objective of this study was to examine whether flow experience facilitates the effects of attention training. We used computer video game tasks to induce flow experience for two patients with attention deficits after TBI and examined the resulting effects on their neuropsychological performance.

Methods

Participants

Two adult patients with attention deficits after TBI were recruited from Hokkaido University Hospital.

Patient A was a 47-year-old right-handed female with a diagnosis of TBI. Magnetic resonance imaging (MRI) revealed bilateral frontal lobe lesions and diffusional axonal injury (DAI). At the time of enrolment, it had been 948 days since injury; at the time of injury, the Glasgow Coma Scale (GCS) was 11 (moderate). She had 12 years of education. Her baseline digit span was five, and her achievement rate on the Symbol Digit Modalities Test (SDMT; Smith, 1968) was 48.2% before intervention (Table 1). These results indicate notable impairment on common neuropsychological tests.

Patient B was a 41-year-old right-handed male with diagnoses of brain contusion, acute subdural haematoma, and traumatic subarachnoid haemorrhage. MRI revealed a left frontal lobe lesion and DAI. The GCS was 9 (moderate) at the time of injury. The postinjury period was 228 days. He had 16 years of education. His achievement rate on the SDMT was 30.6%, and his preintervention performance on Trail Making Test A (TMT-A) (Reitan, 1958) was significantly worse compared with healthy adults of the same age (Table 1).