

# Chapter 74

## Significance of Virtual Reality–Based Rehabilitation in Acquired Brain Injury

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### ABSTRACT

*Recent research has shown the potential of Virtual Reality (VR) in the field of rehabilitation, namely neurocognitive rehabilitation. This technology will certainly revolutionize the rehabilitation of the future. Its advantages include greater ecological validity than conventional rehabilitation methods, provision of safe contexts for learning/training, the possibility of programs to be contingent on patient performance, with increasing levels of task difficulty and provision of immediate feedback, and the use of a “game factor” that promotes motivation for participation. These are important aspects in the rehabilitation of patients with acquired brain injury. Patients with this and other types of neurological injuries endure cognitive deficits that cause difficulties in independent functioning and daily-life activities. Their rehabilitation calls for systematic intervention programs that are theoretically grounded and use innovative approaches to their advantage. In this paper we present a review about the advantages of VR in the generalization*

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*of acquired skills to real-life contexts, to promote patients' functionality and quality of life, and propose an innovative program of neurocognitive rehabilitation. Research in the field shows positive effects of VR programs, but urges progress in terms of the development of techniques (e.g., facial synthesis and of more research on the impact of these interventions. Future studies should also explore the existence of neuro-anatomical correlates of behavioral changes, contributing to the investigation of the relationship between neural plasticity and behavior and providing evidence for clinical practice.*

## **ACQUIRED BRAIN INJURY**

Acquired Brain Injury (ABI) is a broad concept that can result from traumatic incidents (e.g., brain concussions resulting from traffic accidents, work accidents, falls, incidents with firearms and violence) as well as from non-traumatic episodes (such as infectious diseases or strokes). A neurologically intact person can acquire a (traumatic or non-traumatic) brain injury at a certain point of his or her life (Greenwald, Burnett, & Miller, 2003). A traumatic brain injury (TBI) can be defined as a chronic neurological condition associated with profound neuropsychological damage. TBI is the main cause of death and disability in Portugal, as well as in other industrialized countries (Coronado, Thurman, Greenspan, & Weissman, 2009; Coronado et al., 2011; Santos, de Sousa, & Castro-Caldas, 2003; WHO, 2002). Traffic accidents are the main causes of death and of moderate-to-severe TBI in children and teenagers between the ages of 15 and 25, and of disability in people over 40 years old (Mckinlay et al., 2008).

ABI's most common consequences include neuropsychological, social, vocational and functional changes that reflect damaged brain mechanisms (Lannoo, Brusselmans, Eynde, Laere, & Stevens, 2004). Cognitive deficits in the areas of perception, memory and language or executive functions often affect the person's ability to solve routine problems and perform the most basic activities of everyday life (Lewis, Babbage, & Leathem, 2011). These deficits can lead to a significant decrease in the quality of life of patients and their families, interfering greatly in their community integration (Cernich, Kurtz, Mordecai, & Ryan, 2010; Chevignard, Brooks, & Truelle, 2010; Matheson, 2010).

## **COGNITIVE REHABILITATION: CHARACTERISTICS AND CHALLENGES**

Cognitive rehabilitation refers to the "therapeutic process of increasing or improving an individual's capacity to process and use incoming information so as to allow increased functioning in everyday life." (Sohlberg & Mateer, 2001, p. 3). It should desirably be part of a more extensive neuropsychological rehabilitation process that simultaneously includes the person's cognitive, social and emotional dimensions (Ben-Yishay, 1978; Prigatano, 1986). Consequently, its main goal is the improvement of the person's quality of life (Prigatano, 1999; Sohlberg & Mateer, 2001).

Zangwill (1947) defined three possible objectives of cognitive rehabilitation, namely (1) to intervene at the level of the disability, stimulating and improving the altered functions by acting directly upon them with training (restoration); (2) to promote the use of alternative brain mechanisms or preserved skills (substitution); or (3) to promote the use of internal and external strategies (e.g., electronic agendas) which help to minimize the problems resulting from the dysfunction (compensation). The rehabilitation

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