Chapter 63
Cognitive Exercising for Patients With MCI Using Serious Games:
Design of a Pilot Study

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ABSTRACT

In this chapter we demonstrate how older adults can benefit from novel technologies. One hundred and fourteen patients with MCI according to the revised Petersen criteria (Petersen, 2006), aged between 65 and 88 years, were recruited to participate in a Serious Game training (SG) and an Active Control group (AC). They benefited from neuropsychological testing and electroencephalography before and after the intervention. Our results showed that the SG group improved performance in specific cognitive functions such as working memory, dual task performance and visual conjunction search. The performance improvement was also supported only at the SG group by increased amplitude of the Event Related Potentials extracted from the electroencephalography measures. The results from our study suggest that older adults do not need to be technologically savvy to benefit from virtual reality training.

INTRODUCTION

Virtual Reality (VR) and Augmented Reality (AR) are some of the most promising and at the same time challenging applications of computer graphics. Virtual Reality (VR) is stimulating the user's senses in such a way that a computer generated world is experienced as real. In order to get a true illusion of real-

ity, it is essential for the user to have influence on this virtual environment. All that has to be done in order to raise the illusion of being in or acting upon a virtual world or virtual environment, is providing a simulation of the interaction between human being and this environment. This simulation is -at least-partly attained by means of Virtual Reality interfaces connected to a computer. When considering VEs for context-sensitive rehabilitation, it is important to first evaluate the limitations and potential of the underlying VR technology.

Over the past decades VR technology has been used in many different domains such as education (Virvou et al, 2008), simulation for expert training (Lewis et al, 2011) and therapy. Looking at medical uses in particular, Rizzo and Kim (2005) and Rizzo, Schultheis, Kerns and Mateer (2004) discuss the advantages and disadvantages of VR systems in a therapeutic context. Even though both reviews have been conducted six and seven years ago respectively, most of what the authors discuss still appears to be of relevance. In Rizzo and Kim's overview the following aspects were among the key characteristics for VR systems and therefore should be taken into account when developing VEs for individualized rehabilitation. In this chapter we are going to present the benefits of using a particular type of virtual reality interface, named the VR-SG Museum. The VR Museum was used as an intervention tool for patients with Amnestic-type Mild Cognitive Impairment (aMCI) in order to see if it can improve the task domains of navigation, spatial orientation and spatial memory. Those tasks were chosen for their relevance for patient with aMCI for whom it is essential to be spatially oriented in order to live independently (Hort et al, 2007).

Firstly we are going to focus on MCI and the basic characteristics of aMCI patients. It is essential to define the exact cognitive profile of those patients in order to understand the difficulties that non-invasive methods of intervention may encounter. We are also going to describe related attempts to address those patients with virtual reality.

On the second part we will describe the VR Museum, the clinical protocol, the research methodology and the final results. At the end of the chapter, we will sum up our findings with general conclusions and implications on the use of VR Museum as an intervention tool.

INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT

The concept of Mild Cognitive Impairment (MCI) was derived from milder cases of dementia and not Alzheimer's disease (AD). MCI encompasses patients with and without memory impairment. Of those with memory loss, some have memory impairment as their only deficit [amnestic MCI single domain (aMCIs)], whereas others have impairments of memory loss plus changes in other cognitive domains [amnestic MCI multiple domain (aMCImd) (Petersen et al., 1999). Multiple-domain MCI is more common than pure amnestic type MCI and is characterized by slight impairment in more than one cognitive domain but of insufficient severity to constitute dementia (Gauthier et al., 2006). Of those without any memory loss, some patients have deficits in one domain only, such as executive functions, apraxia or aphasia. Or they may have deficits in several domains, excluding memory (Petersen, 2004). These prodromal states may progress to non-AD dementias, such as vascular dementia, frontotemporal dementia, Lewy body dementia, primary progressive aphasia, or corticobasal degeneration (Winblad et al., 2004).

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