

## Chapter 64

# Clustering Finger Motion Data From Virtual Reality–Based Training to Analyze Patients With Mild Cognitive Impairment

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### ABSTRACT

*Research in virtual reality (VR) has resulted in the development of many applications in clinical settings in the areas of learning and therapy in psychology and neuropsychology because this technology can be flexible to the needs of the clinical application. VR technology has many implementations for cognitive training and as a screening tool for patients with mild cognitive impairment (MCI). The technology has been used in the screening, diagnosis, treatment and support of patients with MCI. This study found that*

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*the information recorded in VR-based learning software can be useful in analyzing individuals with MCI in order to characterize groups of participants. The authors implemented a time series clustering algorithm acting on finger motion data from nine healthy participants as a pilot study, then comprehensively reviewed the clustering result by comparing it with performance-based measures. The results indicate that the clusters formed by using the acceleration data is reasonably analogous to the performance measures (i.e., with respect to the type and number of errors that occurred).*

## **INTRODUCTION**

Cognition is the process behind human thinking and experience that involves “a process of identifying, selecting, interpreting, storing, and using information to make sense of and interact with the physical and social worlds, to conduct one’s everyday activities, and to plan and enact the course of one’s occupational life” (Kielhofner, 2009). Cognitive function often refers to various cognitive domains such as perception, attention, memory, language, executive function (initiating, planning, organizing, controlling, and evaluation of thinking and acting) and psychomotor speed (Johansson, 2015). Certain cognitive functions show at least a small decline with advanced age in many, but not all, healthy individuals.

While age is the primary risk factor for cognitive function impairment, several diseases can cause this in the elderly, such as depression, diabetes, cardiovascular diseases, stress-related diseases, neurodegenerative disease, such as Alzheimer disease, dementia, and Parkinson, or a combination of different diseases. Mild cognitive impairment (MCI) refers to a clinical syndrome with multiple etiologies and outcomes that range from normal cognitive aging to dementia (Fischer et al., 2007). In a prior study by (Winblad et al., 2004), the following criteria for MCI were determined: (1) the person is neither normal nor demented, (2) there is evidence of cognitive deterioration shown by either an objectively measured decline over time and/or a subjective report of decline by self and/or informant in conjunction with objective cognitive deficits; and (3) activities of daily living are preserved and complex instrumental functions are either intact or minimally impaired.

There is accumulating evidence that nearly one-third of individuals with MCI have difficulties with instrumental activities of daily living (IADL), especially in managing their finances, making decisions, and completing everyday tasks that rely heavily on memory and complex reasoning (Foloppe, Richard, Yamaguchi, Etcharry-Bouyx, & Allain, 2015). Familiar examples of routinely performed tasks of IADL are shopping and cooking. To help individuals with MCI maintain their everyday autonomy, it is common to have others perform the tasks instead of the MCI patients. Some previous studies mentioned the importance of MCI patients staying cognitively active, to prevent functional deterioration over time. To help overcome the progress of MCI, neuropsychologists commonly recommend that patients learn or relearn potentially useful instrumental activities of daily living, as this may increase the patients’ functional autonomy. This is supported by various earlier works showing that extensive training and repetition of everyday tasks improves performance on trained tasks, and that with memory intervention strategies, some level of relearning is possible.

Several learning methods have been successfully applied for cognitive rehabilitation in MCI cases, including a large number of methods that avoid or strongly reduce errors during the learning process. In the context of cognitive rehabilitation of IADLs in MCI, the activities to train are structured as a series of actions in order to obtain simple and concrete standardized instructions. There has been increasing

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