Integration between virtual-reality and video-based systems to deliver cognitive tele-rehabilitation; three case studies

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***Abstract*— The purpose of this paper is to describe implementation of VR-based and video- based cognitive telerehabilitation, as a part of a large clinical telerehabilitation service. Three clients in the chronic phase after an Acquired Brain Injury received cognitive tele-rehabilitation with a 3D sensor-based platform (VR-based system) and a video-based system. The therapy was provided on-line, once or twice a week. Each client set at least two functional goals using the Canadian Occupational Performance Measure. Improvement of at least one goal was seen in all clients. It seems that the use of the VR- based system together with the video-based system is feasible and may enhance adherence to treatment and generalization to daily activities.**

Keywords—cognitive telerehabilitation, metacognitive strategies, acquired brain injury

I. INTRODUCTION

The use of tele-rehabilitation has been growing in the past decade and its potential to provide high quality rehabilitation has been discussed in several systematic reviews and meta-analysis [e.g.1,2]. In addition, few studies showed the potential of using video-based systems to deliver cogniti9ABIve tele rehabilitation for people with acquired brain injury (ABI) [3,4]. However, the use of virtual-reality (VR) based tele rehabilitation in combination with video-based telerehabilitation to provide functional-based cognitive rehabilitation and metacognitive strategies training has not been described. The purpose of this paper is to describe implementation of VR-based and video- based cognitive telerehabilitation, as a part of a large clinical telerehabilitation service. This will be accomplished by presenting three case studies of people that were enrolled in the clinical service (i.e. a retrospective report).

II. METHODS

A. Participants

Three clients (two men) with an ABI, aged 37, 43 and 74 participated. Time since injury was 8.5, 4 and 2 years respectively.

B. Instruments

The ReAbility-Online 3D sensor based platform , a VR-based system (www.reabilityonline.com) was used in combination with a video based system. The 3D sensor-based system includes virtual games and functional activities that require the use of cognitive abilities such as attention and executive functions together with movements of the upper extremities and/or trunk, i.e. dual-task [5]. The video-based system enables sharing screens between the client and the clinician. Therapeutic activities include daily tasks that are created by the clinician such as scheduling weekly errands or using the web to train activities such as online-shopping. The primary outcome measure was the Canadian Occupational Performance Measure (COPM) [6] that queries about the perceived performance and satisfaction from performance of the client's meaningful daily activities on a scale of 1-10 (high performance and satisfaction). An improvement of two points is considered clinically significant.

C. Procedure

The therapy was provided on-line, once or twice a week, by trained clinicians (e.g. occupational therapists) and was tailored to each client according to his or her abilities and needs. Length of treatment varied between the clients as this is a retrospective report, and ranged between three to nine months. The focus of treatment was on achieving functional goals by training meta-cognitive strategies in various activities (e.g. using checklists to maintain sequence of

performance). In addition, clients were given exercises for self-training during the week.

III. RESULTS

Examples of goals set by the clients were ability to read a book, understand instructions given by other people, be able to deliver a message during a conversation and remember what other people said.

The change in scores of the COPM is presented in Fig 1. Client number three reported on improvement of his two goals and the other two clients reported on improvement of the first goal only (upper part of the figure). The goals that did not improve were socially-oriented. The decreased in perceived performance seen in client number one could be explained by an improvement noticed in his awareness of his cognitive deficits.

IV. CONCLUSIONS

The cognitive tele-rehabilitation described in this paper was based on cognitive models in occupational therapy [7]. It seems to be a promising paradigm for improving functional therapeutic goals in the chronic stage after an ABI. The combination of VR- based and video-based systems increased the variety of therapeutic activities and may enhance adherence to treatment and generalization to daily activities. These should be further studied in the future.

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Fig. 1. Change in COPM scores of goal one (upper part) and goal two (lower part)