Usability evaluation of cognitive training with the NeuroAIreh@b platform: preliminary results of an ongoing pilot study

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ABSTRACT

We present the preliminary results on the usability of four tablet-based cognitive training tasks of the NeuroAIreh@b platform. These tasks address the training of activities of daily living and have been designed involving professionals of various disciplines following human-computer interaction methods. After an iterative development process accompanied by testing sessions with healthy participants, we started a pilot study with stroke and traumatic brain injury patients. To date, ten participants have gone through a 4-week cognitive training program in a clinical setting, using the developed tasks. Results from the System Usability Scale and the satisfaction section of the Usefulness, Satisfaction and Ease of use questionnaire show acceptable levels of usability and satisfaction.

1. INTRODUCTION

Virtual Reality and digital applications that simulate the training of activities of daily living have shown benefits for patients with cognitive impairments (Faria et al., 2016). Such technologies are practical since they allow content customization and difficulty setting enabling them to be adapted to different profiles (Paulino et al., 2019). During the design process of rehabilitation technologies it is important to involve stakeholders from both the technology and healthcare domains (How et al., 2017). The digital prototypes presented in this document went through a series of workshops, brainstorming and co-design sessions prior to their implementation. Engineers, designers, neuropsychologists, and rehabilitation experts participated in those sessions, contributing to the design of the digital tasks and the main system's User Interface. These digital tasks are to be integrated into an intelligent system, the NeuroAIreh@b platform, which aims to provide cognitive telerehabilitation. Here we present preliminary usability results of an ongoing pilot study that aims to assess the feasibility of the initial set of digital tasks with patients with acquired brain injuries.

2. METHODS

The pilot study examines the efficacy of an intervention consisting of 8 sessions of tablet-based cognitive training in patients with acquired brain injury, recruited in the Madeira Health Service. Sessions have a duration of 45 minutes and are administered twice a week. The sessions are conducted by a health professional (HP), a psychologist, who manually sets the tasks' parameters at the beginning of each session and during the following intervention sessions. This manual process and the performance analysis will help inform the algorithms that will set the rules for personalization and adaptation. Besides a pre and post cognitive assessment with validated instruments, both patients and HPs assess the system at the end of the program in terms of usability and satisfaction using the System Usability Scale (SUS) (Lewis & Sauro, 2018), the satisfaction section of the Usefulness, Satisfaction and Ease of use questionnaire (USE) (Dantas et al., 2017), and a custom qualitative questionnaire that the HP answered according to her perspective and observations.

The initial set of cognitive training tasks of the NeuroAIreh@b consists of four digital tasks whose content can be fully customizable in a universal form. They were designed such that the scenarios and objects, which are interchangeable, are loaded externally from a common container of 3D objects, named the Daily Life Library. Two of the tasks are presented in 2D format due to their characteristics, but their content is also fully customizable. The four digital tasks, namely the Reh@Org, Reh@Pay, Reh@Search, and Reh@Cat, are based on traditional cognitive training tasks, specifically, action sequencing, calculation, cancellation, and categorization, respectively (Figure 1). The tasks have been contextualized in environments related to the performance of activities of daily living (e.g., the kitchen and the supermarket). All tasks have their own specific set of parameters which allow setting different difficulty levels.

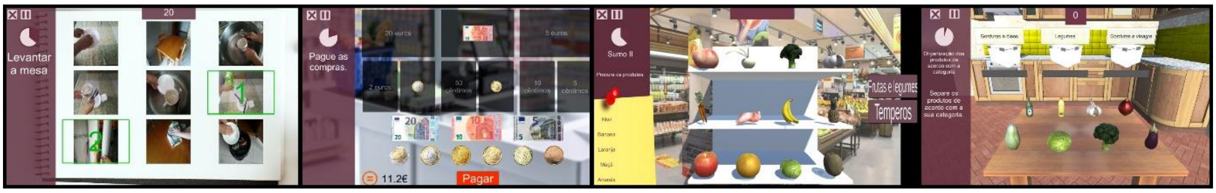

Figure 1. *The four cognitive training tasks (from left to right): Reh@Org, Reh@Pay, Reh@Search, Reh@Cat.*

3. RESULTS

We report on the results of ten participants (Stroke = 9; TBI = 1; Female = 5; Male = 5; Age = Mean 58 (SD = 6.68) that have already finished the cognitive training program (MoCA test median and interquartile range at baseline 18(7.25), and post-intervention 20.5(6.25)). Data from the SUS were normalized, producing an overall score of 66.8 (SD = 15.9), which compared with SUS norms falls into the 41-59 percentile range with a C grade. This score can be considered an acceptable level of usability. The satisfaction section from the USE was analysed considering that each item is rated with a 7-point Likert scale (1 – “Strongly disagree”; 7 – “Strongly agree”) including a N/A option. The mean of the participants was 5.7 (SD = 0.5), which can be considered a high level of satisfaction. The HP answered the full USE questionnaire which resulted in an overall score of 4.34 (SD = 0.89) with higher impact on the ease of learning section (Mean = 6.25, SD = 0.5).

4. CONCLUSIONS

Our preliminary findings suggest that the initial set of tasks provides a reasonable level of usability and high level of satisfaction with space for more improvement. From the analysed data, we gathered many insights and future improvements to apply to the subsequent iterations of the prototypes. These and other data, for instance, performance data and parameters choices, will be used to improve the digital prototypes and inform an integrative system in terms of artificial intelligence rules for automatic personalization and recommendation of activities tailored to patients’ cognitive profile.

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