A home-based feasibility study of Virtual Reality for Older Adults Living with Mild Cognitive Impairments

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Introduction

Mild Cognitive Impairment (MCI) refers to a condition that may cause minor impairments in attention, memory, language processing, reasoning, planning or problem-solving, and/or visual depth perception [1]. The individual may exacerbate behaviours that challenge, such as aggression, sadness, apathy, and loss of interest in oneself and others [2].

To delay the symptoms of MCI, several studies recommended that interventions for people with MCI should emphasize person-centred care and involve personalized formulations [3].

Over the last two decades, virtual reality (VR) has slowly begun to have a presence in the healthcare sector introducing innovative non-pharmacological person-centred care for people with MCI [4]. However, findings are still in its infancy and further evidence is needed to support the efficacy of VR for such purposes.

Methods

Participants

Twenty (males = 13, 61.9% and females = 8, 38.1%) with MCI, aged between 53 and 87 and a mean age of 68.45 years (SD = 11.07) participated in the study. Participants had no prior experience using VR. Additionally, 3 (male = 1, 33.3%, females = 2, 66.6%) with a mean age of 73.33 (SD = 11.93) refused to wear the headset due to material factors. All participants had normal or corrected vision and no history of severe motion sickness. Ethical approval was sought from the national health bioethics research committee.

Study Design and Procedure

The system design emerged from discussions with professionals in eldercare and eHealth and was informed by a systematic review [5] that examined the feasibility of VR for patients with neurological conditions and dementia (for a detailed explanation of the system design please refer to Matsangidou et al. [6]). The set-up took place at the personal space of the people with MCI (e.g., home). Before the VR session, we administered “pre-exposure" quantitative measures (i.e., VAS). Then, participants were given a "menu" of images of available virtual environments on an A3-sized sheet of paper.

Each participant could select up to three VR environments to be exposed to. A maximum total duration of 15 minutes of exposure was recommended to avoid side effects, such as dizziness, associated with VR usage. During the VR session, “during-exposure" quantitative measures (i.e., HR, VAS) were collected to capture the participants’ emotional state. Once the VR exposure session was completed, “post-exposure” measures (i.e., VAS, SUS) were collected. Each session lasted on average up to 45 minutes.

Figure 1 Snapshot of the environments which were used for the “Menu”.

Materials

- Heart Rate (HR) variability was collected in real-time using a Samsung Galaxy Active 2 smartwatch. Previous research has suggested that HR provides a valid and reliable measure of the psychophysiology of emotions [7].
- Visual Analogue Scale (VAS) [8]. VAS was used to record the self-assessed emotional state of participants during the session. The participants were asked to point to the emoji (0 = happy and 5 = sad) that matched their emotional state before and after the session. During the session, the participants were asked to refer to the emotion they were feeling again.
- Slater-Usoh-Steed Questionnaire (SUS) [9]. The scale assesses the level of presence and immersion using seven

questions on a 7-point Likert scale (e.g., 1 = being somewhere else and 7 = being in the VE) and was recorded after the session. The questionnaire can provide insights into the experience of participants during the session and the feasibility of the technology to "transfer" participants to different environments.

Results

Heart Rate

The results show that VR technology can influence the physiological responses of people with MCI. Most importantly, VR exposure demonstrated a decrease in people with MCI HR when they were exposed to VR environments that contained nature, and an increase in HR when they were exposed to VR environments that contained industrial elements (Figure 2). These findings were in line with previous studies that demonstrated the effect nature and urban environments can have on peoples' HR [10].

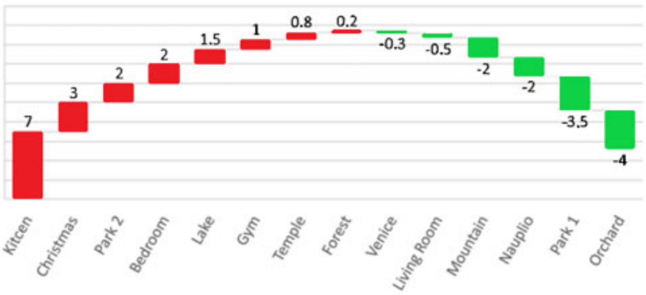

Figure 2 Heart Rate alteration during VR exposure in each environment.

Visual Analogue Scale (VAS)

In addition, Friedman test indicated that there was a significant reduction in the negative emotions between before, during, and after VR exposure, $\chi^2(2) = 33.778$, $p = 0.000$. Wilcoxon signed-rank tests revealed a significant decrease in negative emotions (and a significant increase in positive emotions) from before to after VR exposure $Z = -3.940$, $p = 0.000$ and from during to after VR exposure $Z = -3.936$, $p = 0.000$ (Figure 3).

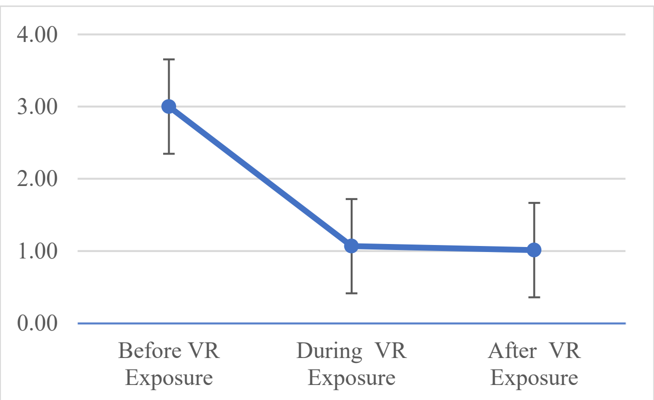

Figure 3. Emotions before, during, and after VR exposure using VAS.

System Presence (SUS)

High rates of presence (max score of 7) were reported by the people with MCI (M = 5.73, SD = .81). We consider this finding to be important as this is the first time a study explored the presence a group of people with MCI can sense in their own space.

Conclusion

In this proof-of-concept study, we explored how VR technology can enhance the emotional well-being of people with MCI residing in their own homes. Based on our findings, VR has the potential to improve the mental health of people with MCI by eliciting positive emotions and reducing negative ones. Overall, this study contributes to the growing body of research on digital technology for people living with MCI at home.

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