Attitudes towards and Usability of Head-mounted Virtual Reality in Older Adults

Abstract
Virtual Reality (VR) is increasingly being used for the assessment and treatment of mental health disorders. The use of VR in mental health has recently been boosted by the development of (low-cost) commercially available VR headsets. Despite this promising evolution, surprisingly little is known about the response of vulnerable populations to head-mounted VR devices that use head tracking (H-VR). The feasibility of using H-VR may be particularly challenging for a frail and ageing population. The aim of the current study is to investigate the attitudes towards and the usability of this technology in older adults and to explore which characteristics of older adults affect the usability and attitudes.

Author Keywords
Elderly; Virtual Reality; Attitudes; Usability; User Experience; Ageing; Cognition.

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H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See http://acm.org/about/class/1998 for the full list of ACM classifiers. This section is required.
**Biography**

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**Introduction**

**Virtual Reality in Mental Health Care**

Virtual Reality (VR) allows us to develop immersive artificial and interactive environments [24]. This technology provides exciting opportunities to better understand, assess and treat a variety of mental health disorders [3]. For instance, the use of VR in exposure therapy has been shown to be equally or more effective than standard therapy for the treatment of phobias, post-traumatic stress and eating disorders [15,30]. VR has also proved to be useful for the rehabilitation of motor impairments in stroke, Parkinson’s disease and multiple sclerosis [1,10,17]. In addition, it is now being used for the assessment and rehabilitation of cognitive deficits in ADHD, autism, Alzheimer’s dementia, mild cognitive impairment (MCI) and stroke [12,13,14,27,28,29]. It has even been shown to improve activities of daily living in older adults with MCI or dementia [9]. All these studies suggest that VR can create better treatment and assessment protocols for a variety of mental health disorders.

**Head-mounted VR in Health Care**

Over the last decade, VR headsets such as the Oculus Rift, HTC Vive, and lower cost versions such as the Google Cardboard or Samsung Gear VR, have gained popularity. Recent advances in VR technology include the use of head-mounted devices with stereoscopic vision, stereophonic audio, and head position tracking to create an immersive experience - we will call this "H-VR". Recent VR systems also include controllers that can track hand movements such that feedback can be given about the user’s interactions with the environment. H-VR induces immersive experiences beyond what is offered via devices such as the Nintendo Wii or Xbox Kinect. H-VR is placed further on the Milgram continuum that distinguishes between augmented, mixed and virtual reality [24] on the basis of the extend of mediation taking place. Therefore, it comes as no surprise that the interest in these newer H-VR devices for mental health care applications has grown. However, little is known about their acceptance and usability in patients with mental health disorders, which may be particularly challenging when dealing with older adults [5].

**The Usability of VR in Older Adults**

Earlier studies indeed showed that the acceptance and usability of devices such as the Wii or Kinect can be problematic in older adults [7,25], e.g., nearly 40% of patients in a geriatric day hospital refused to participate in a study examining the Nintendo Wii. The authors suggested that the reduced cognitive status of the patients may have had a negative impact on their motivation to use this device [7]. Other studies reported more discomfort using a head-mounted device [23] and generally more dizziness in older adults [8]. These studies illustrate that the use of new technologies is not straightforward in older adults and highlight the need of usability and acceptability studies in this population.

To the best of our knowledge, no studies have been published concerning the attitudes towards and the usability of H-VR in an ageing or frail population. Noteworthy, studies bumping into issues of usability and acceptability of new technologies for mental health care (such as VR) may not always be published. These issues may thus be underrepresented in the literature (a known issue in eHealth [11]). A better understanding of the attitudes towards H-VR and of the usability of H-VR in older adults is therefore warranted.
Study objectives
To investigate the usability of H-VR in older adults we will study their attitude towards H-VR, their ability to use this technology and their response to a first experience with the Oculus Rift CV1. In addition, we will estimate the proportion of older adults in whom H-VR can be used based on the safety recommendations for this device and we will report on the prevalence of side effects of the experience. Furthermore, we will test whether the attitudes of older adults towards H-VR can be manipulated through a first user experience. Finally, we will assess which user characteristics (e.g., cognitive status, previous experience with computers, computer self-efficacy) influence the attitudes towards and the usability of H-VR. In summary, we aim to reveal important characteristics of older adults that must be taken into account when developing H-VR mental health care applications.

Methodology
Participants
We aim to test at least 40 older adults with no (H-)VR experience. We will recruit participants that represent a broad range of ages (55 to 90 years of age), education levels, socio-economic statuses and cognitive abilities. To avoid a recruitment bias towards participants who feel positive about new technologies, we will not mention the use of new technology during the recruitment process.

Research protocol
Our study will consist of two sessions (of 60-90 minutes each), administered with a maximum of 2 days in between the sessions (Figure 1).

Session 1
We will assess the general cognitive status of the participants, using the Montreal Cognitive Assessment (MoCA) [26] and measure praxis (the ability to plan and execute hand movements) using the praxis task of the Birmingham Cognitive Screen (BCoS) [18].

We will use questionnaires to measure computer self-efficacy (based on [2]), computer proficiency (based on [4]) and attitudes towards VR (based on [6]). We will also use the subscale “openness” of the NEO-FFI-3 to measure to what extent participants are open to new experiences [16].

Session 2
In the second session, we will instruct participants on the H-VR technology and the buttons needed to operate the application. Participants will then be exposed to the H-VR experience “Perfect” by nDreams [31]. In this application, participants will visit two realistic natural scenes. Participants will have the opportunity to freely explore the VR environment and, if needed, assistance will be provided to help them interact with objects using the Oculus Touch Controllers. To assess the skillfulness of the participants in interacting with the VR environment, screen and audio captures will be made and rated by two independent observers using a behavioral observation rating scale.

After the first VR experience, user experience will be measured using items of the Intrinsic Motivation Inventory [22], the Sense of Presence Inventory [21] and the Immersion questionnaire [19]. We will also re-administer the attitudes questionnaire and we will use the Simulator Sickness Questionnaire to measure potential side effects of the VR [20].
**Preliminary results**

*Attitudes*
We have already conducted a pilot study on 5 frail older adults residing in a nursing home (3M/2F, age range: 74-90). Both the initial attitudes and the attitudes after the VR experience varied greatly across participants.

*Skillfulness*
3/5 participants experienced difficulties in learning how to interact with the VR environment using the touch controllers. The participants either failed to find the correct buttons or could not discriminate between them. This observation suggests that touch controllers without visual feedback of a hand model may be difficult to use for older (cognitively vulnerable) adults.

*User Experience and Side effects*
The participants differed in their emotional responses to the H-VR experience. One participant was afraid to drown in a lake scene, which illustrates that the immersive nature of H-VR may limit its usability under certain circumstances. The other participants did not have negative experiences. Some of them even enjoyed it, and were grateful and proud that they could have experienced this new technology.

None of the participants reported headache, dizziness or nausea. There were only mild complaints of eye strain and some fatigue.

**Conclusion**
Our study will lead to a better understanding of the feasibility of H-VR in an ageing and frail population. We will be able to report on the attitudes of the older adults towards VR, as well as on the usability of this technology (including its safety). Furthermore, we will investigate the effect of a first user experience on the attitudes towards H-VR and the possible influence of user characteristics. A better understanding of the feasibility of using H-VR in older adults will help direct choices regarding what technology to use for new mental health applications in this frail population.
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