Virtual Reality Therapy for Depression

Subjects: Clinical Neurology

Contributor: Marwa Abdelmonem

Virtual reality (VR) describes a family of technologies which immerse users in sensorily-stimulating virtual environments. Such technologies have increasingly found applications in the treatment of neurological and mental health disorders. Depression, anxiety, and other mood abnormalities are of concern in the growing older population—especially those who reside in long-term care facilities (LTCFs).

Keywords: depression ; virtual reality (VR) ; virtual reality therapy (VRT) ; long-term care facility (LTCF) ; mood disorder ; place attachment ; neuro-architecture

1.Introduction

Virtual reality (VR) is the use of various technologies to digitally simulate or recreate an environment in which an observer can realistically hear, see, and/or feel as though they are a part of the simulation [1]. This dynamic perceptualization is achieved through technologies such as wearable head-mounted displays (HMDs), noise cancellation headsets, and other multimodal stimuli to immerse the wearer in the virtual atmosphere [1]. While VR has been a critical training tool in the fields of aviation, military combat, and surgery, it has recently shifted towards clinical psychology and therapy [2]. In fact, with the decreasing costs and increasing accessibility of digital media, VR has significant potential in reconstructing conventional approaches to patient care [3].

VR is a popular topic in psychological research studies for its potential in treating various mental disorders such as schizophrenia, post-traumatic stress disorder (PTSD), anxiety, and depression. Psychotherapy experts rank VR as one of the top psychological interventions with an overall positive growth projection in the coming decades [4]. Rothbaum and colleagues first assessed the clinical effects of VR therapy (VRT) on acrophobic college students [5]. Their study established the efficacy of VRT for trauma and anxiety, and provided a basis for further studies on other psychiatric illnesses [6]. With its ability to continuously expose patients to traumatic experiences or threats on a regular basis, VR can train patients to cope with, and eventually eliminate, the fears and negative emotions associated with stressful experiences [6]. One particular demographic that could benefit from the psychological and therapeutic effects of VR is older individuals who reside in long-term care facilities (LTCFs).

An increasing number of older people prefer to age-in-place until they become unable to care for their needs [7]. The choice of moving to a LTCF, however, often becomes inevitable at a certain stage due to deteriorating health conditions. This inevitability, along with demographic changes due to continuous increases in life expectancy, has become a concern [8]. Scholars such as Schwarz and Brent, argue that the proportion of people aged 80 years or older is expected to triple by 2040 [7]. In the United States of America, the age structure of the overall population is projected to change tremendously in the next decade: from 13 percent of the population aged 65 and older in 2010 to around 20 percent in 2030 [9]. Hence, there is a need for social infrastructure to accommodate the physical and psychological needs of this growing population that may transition into LTCFs.

Transitioning into a LTCF may cause severe distress and amplify pre-existing mental health impairments, corresponding to a higher rate of depression of nursing home residents when compared to non-residents [10]. Furthermore, age-related cognitive decline and desires for a familiar environment can further an older individual's mental deterioration. As mental illnesses can exacerbate other underlying health conditions such as cardiovascular diseases, afflicted individuals may require more demanding and attentive care [11]. VR can serve as a tool to aid the adjustment of older people into new LTCF environments by immersing them in a familiar space to relieve stress, or by familiarizing them with their new surroundings with continuous exposure. VRT can, therefore, mitigate the negative mental health trends seen in individuals in care homes.

2. VR's Effect on Depression and Mood in Older People

The medical applications of VR have been extensively reviewed [12]. Applications span numerous disciplines—including medical education and training, robotic surgery, molecular biology, forensic pathology, and others [13][14]. We will focus primarily on the applications of VR in psychology, specifically as a therapeutic intervention for depression and mood in LTCFs. Given the limitations of behavioral therapy due to the complex psychological states of older individuals, the application of VR for mental health treatment is critical.

It is evident that depression is associated with increased stress levels related to place attachment and relocation. A number of studies investigated reminiscence therapy using digital media and new technologies, such as VR, as a treatment for memory loss in people with dementia [15]. In the cognitive and behavioral sciences, VR is defined as "*an advanced form of human–computer interface that allows the user to interact with and become immersed in a computer-generated environment in a naturalistic fashion*," meaning that patients can "live" the experience of being in completely different spaces during the VR session (telepresence) [16]. However, the use and implementation of the technology is debated amongst researchers and healthcare practitioners.

Describing the spectrum and limitations of VR technologies, Klein et al. write that "virtual reality worlds with a high level of interaction demands are often too hard to grasp for people with dementia in terms of cognitive elaboration and comprehension of the metaphors used. Nevertheless, there is indication that simulated locations and objects can have a positive impact for reminiscence therapy" [15]. Such positive effects of VR are demonstrated by a number of recent cognitive and psychological studies. For instance, Yang and colleagues examined the impact of VR technology on falls and depression among older individuals with mild depression, with their results showing that depression and internal stress scores were reduced after the intervention. They concluded that the VR exercise program exerted a positive effect on the psychological function of the aged and could be potentially utilized as a therapeutic intervention for reducing depression and internal stress among older people [17].

While literature of VRT as an intervention for depression are currently limited, numerous recent trials demonstrate the value of VRT in enhancing moods and cognition in older people (Table 1). These include several ambulatory studies. For instance, Chan et al. studied 236 healthy members (aged 60 and above) of community centers in Hong Kong. Members of the trial group were exposed to a VR-based tour of Hong Kong's landmark sites, which included both present-day and 20-year-old images. After a single exposure, they exhibited increases in overall positive emotions—including increased interest, enthusiasm, and excitement. They also exhibited decreases in overall negative affect and its components, such as distress, hostility, and guilt [18]. In another study, Graf et al. exposed 14 home-residing pensioners to a VR "forest walk" experience via the Oculus Go headset system. The experience included a virtual dog as a companion, and several cognitively stimulating mini-games. After the VR exercise, participants demonstrated an increased overall positive affect [19]. Moreover, Banos and colleagues exposed 18 Spanish Senior University participants (aged 58 to 79 years) to VR nature walks meant to elicit joy and/or relaxation. After one, two, or three exposures, both the joy-inducing and relaxation-inducing virtual environments (VE) increased perceived joy and relaxation, and reduced sadness and anxiety [20]. These trials underscore the ability of a single VRT session to influence mood among older individuals.

Other longer-term ambulatory studies also corroborate the potential of VRT to induce positive moods among older people. Barsasella et al. exposed 29 Taipei Medical University Aging Center patients (ages 60–94) to VR biweekly for six weeks (twelve total exposures). VR experiences were delivered through several applications on the High-Tech Computer Corporation's Vive platform. Notably, participants exhibited statistically significant increases in happiness, as measured through the Chinese Happiness Inventory, post-intervention [21]. Additionally, Gamito and colleagues exposed Portuguese senior daycare center users to biweekly VR interventions over the course of six weeks. The intervention was a city-based VR in which participants carried out everyday activities, such as household organization, shopping, and watching television. Intervention group members exhibited increases in general and visual memory as well as attention [22].

Similar results to those of the aforementioned trials were obtained from studies in LTCFs. Brimelow et al. exposed 13 Australian residential aged care facility (RACF) residents, aged 66–93 years, to relaxing scenes through the Samsung Galaxy S7 smartphone-Samsung Gear VR headset system. After a single exposure, participants exhibited decreased total apathy and increased levels of facial expression, eye contact, physical engagement, verbal tone, and verbal expression [23]. In another study by Saredakis and colleagues, 17 RACF residents were exposed twice to a wandering experience based on Google Street View. This VR intervention utilized the Wander application through YouTube VR and the Oculus Go headset. The investigators found correlations between decreased apathy after the VR experiences and increased semantic fluency [24]. Finally, D'Cunha et al. exposed 11 RACF residents to an immersive bicycling experience through

projected footage and stationary pedal exercisers. While no significant changes in mood or apathy were observed, the majority of participants enjoyed the experience, which allowed them to reminisce on cycling memories [25].

3. Concluding Remarks

Numerous studies substantiate the claim that VRT has clear potential in alleviating negative feelings while promoting improved cognitive ability and positive emotions in older patients. They indicate that VRT reduces overall negative feelings—such as apathy, distress, and anxiety—while increasing overall positive outlook compared to pre-exposed VRT patients [18][19][21]. It is worth noting here that, while anatomical and molecular factors such as NTs were not assessed in the reviewed studies, the described psychological findings suggest that VRT modulates the neurological mechanisms underlying mood and depression (Figure 1). Moreover, not only does VRT correlate with psychological relief, but evidence also suggests that VRT can improve both physical and cognitive functionality in older patients. As shown by Brimelow et al. and Saredakis et al., patients who underwent VRT exhibited improvements in visual memory, linguistic fluency and expression, and physical engagement [23][24]. These heightened abilities can alleviate the feelings of social exclusion felt by many LTCF residents, furthering the positive effects of VR on a patient's overall psychological well-being. In this light, VRT has the potential to improve mood and cognition, and mitigate the effects of depression—including those related to place attachment—in residents of care homes.

While VRT offers many benefits, there are various challenges involved in its large-scale implementation in mental rehabilitation and therapy (Figure 2). Current technologies are costly and bulky, limiting their applicability in care homes due to inadequate financial resources or physical space. Furthermore, adequate training for using the technologies is required for physicians and caretakers to maximize benefit from the treatments. VRT has been attributed to various side-effects, including dizziness, nausea, and eye-fatigue, effectively limiting the population who can participate in the treatments [26][27]. Given that older people already have decreased cognitive ability due to mental deterioration, VRT may cause further aggravation and discomfort. Moreover, lack of technological understanding and insufficient physical ability may also make older individuals apprehensive of VRT, making it harder to implement as a therapeutic intervention [28]. In addition to user concern, further research is necessary to consolidate the benefits of VRT so to make it a more accepted long-term intervention within the medical field [29]. In the context of broader future applications of VRT, as well as being a potential treatment for psychological ailments in older people, VRT can also be suggested for other age groups—including children, adolescents, and middle-aged individuals. A recent study by Mesa-Gresa and colleagues yielded positive results for the use of VR for autism and phobias in children and adolescents, exemplifying the extent to which VRT can aid in psychological rehabilitation in various populations [30]. This study found that VRT increased the emotional understanding and enhanced the communication skills of individuals on the autism spectrum. With this, prospects for the future application of VRT for psychological disorders are endless.

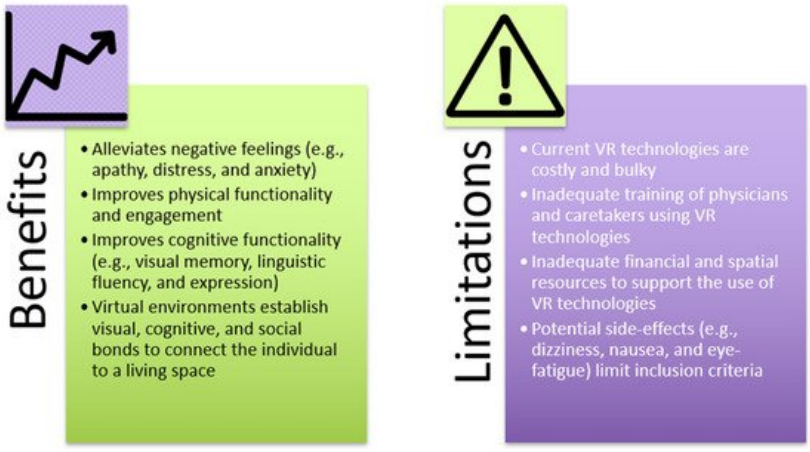

Figure 1. Potential benefits and limitations of the use of VRT in LTCFs.

Numerous studies support that VR provides an opportunity for LTCF residents to adapt to their new environments in a controlled atmosphere, ultimately alleviating distress and subsequent psychological turmoil, and instead promoting positive feelings and emotions. Virtual environments can elicit positive psychological responses due to their ability to establish the necessary visual, cognitive, and social bonds to connect the individual to the living space. The neuroscientific influences of these virtual environments that simulate real structural environments are profound. The National Human Activity Pattern Survey finds that approximately 90% of an individual's life is spent within a built system [31]. Built systems are necessary for one's social, mental, and physical development—ultimately influencing one's perception and psychological state. As the process of aging starts to deteriorate the cognitive mind, the ability to

emotionally connect to a new environment is also hindered, contributing to social exclusion and depression in older individuals. Hence, social planners, architects, neuroscientists, and psychologists must collaborate when designing infrastructures catered to older people due to the influence of these structured environments on psychological well-being [32]. To maximize the positive effects of VRT, proper infrastructure for VR equipment and adequate training of healthcare providers are necessary. Educational programs to destigmatize VR may also prove beneficial for establishing end user trust [28]. Finally, further quantitative and qualitative research is needed in the fields of environmental psychology and environmental neuroscience to explore and substantiate the potential of VR technology in emotional and mental health.

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