



A New Approach to Depression Intervention: Virtual Reality Paradigm

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Abstract. Due to the increased rate of depression during the pandemic, developing a new advanced approach for depression intervention is imperative. Virtual reality (VR) is a simulated artificial experience that delivers different sensory cues to individuals and renders them immersed in a particular scenario. Meanwhile, current studies have shifted focus on implementing VR from treatments of phobias and post-traumatic stress disorder (PTSD) to depression. Before transferring the VR intervention to a real-life scenario, it is necessary to discuss the effectiveness of VR paradigms for depression. In the present article, VR applications in clinical practice, basic mechanisms of depression intervention, and current studies on VR intervention for depression are discussed. It was demonstrated that VR intervention is effective at reducing depression-related symptoms. However, replications with a cleaner experimental design are still needed to illustrate the effect of VR intervention. Finally, future directions regarding the VR experience design and longitudinal follow-up are insightfully discussed.

Keywords: Virtual Reality · Depression · Mental health · Psychological intervention

1 Introduction

During the pandemic period, the prevalence of depression has significantly increased to 25% [1]. Individuals with depression may experience the symptoms of losing interest in daily activity, poor concentration, loss of appetite, insomnia, or even recurrent thoughts of suicide [2]. Given that depression could have various tragic consequences, it is imperative to develop an effective intervention for depression. Fortunately, several depression interventions were effective in reducing depressive symptoms. In particular, it was found that self-criticism is a common characteristic among depressed patients [3], and thus current intervention for depression aims to deliver the self-compassion technique that specifically tackles the self-criticism issue. Positive outcomes indicated that self-compassion is effective at reducing depressive symptoms [4, 5]. Self-compassion renders people to accept the positive and negative sides of their lives and be kinder to themselves [6]. Therefore, self-compassion is considered as an essential component in current depression intervention and is widely used in cognitive-behavioural therapy (CBT).

However, self-compassion implemented in the CBT often used imagery in which some patients might lack insightful exposure to compassion, and this could lead to reduced effectiveness of the compassion experience [7]. To address this problem, current studies utilized virtual reality (VR) in depression intervention. Virtual reality is a simulated artificial experience that delivers multiple sensory cues to individuals so that individuals could better immerse themselves in a particular scenario [8]. Past research identified that implementing VR is effective at treating various mental disorders, such as phobias [9] and post-traumatic stress disorder (PTSD) [10]. Among these VR-based treatments, exposure to the VR environment enables individuals to experience the stimuli more intensely than the traditional treatments. Notably, current studies revealed that when the VR technique is implemented in depression intervention, it was effective at reducing depressive symptoms [11].

Meanwhile, it is noticeable that reviews on VR depression intervention are limited, and the existing empirical studies on VR-based depression intervention were all conducted in the laboratory. To examine whether the VR paradigm is an appropriate depression intervention that could be transferred to in a real-life setting, it is necessary to scrutinize its effectiveness. Therefore, the primary goal of this paper is to discuss the effectiveness of VR depression treatment. Particularly, the linkages between depression, self-criticism, and compassion are summarized. Further, the applications of VR in mental disorder treatments are reviewed. Finally, current studies on the VR paradigm as a depression intervention are discussed.

2 Mechanism for Depression Intervention: Perfectionism, Self-criticism, and Self-compassion

2.1 Depression, Perfectionism, and Self-criticism

Depressive symptoms include depressed mood, losing interest in everyday activities, major changes in weight and sleeping patterns, feelings of worthlessness, recurrent suicidal thoughts, and poor concentration [2]. Moreover, perfectionism was identified as a common characteristic among depressed patients, and perfectionism often engenders self-criticism [3]. Specifically, perfectionism is characterized by strong feelings of worthlessness. It was demonstrated that self-critical people have perfectionistic expectations (it sometimes could be unrealistic) towards themselves, and they always exhibit the need to work hard to compensate for the failure of meeting their expectations and standards. Furthermore, people with perfectionism always exaggerate the consequences of the negative events and exhibit a greater fear of failure, and therefore it led to excessive evaluations toward oneself [3]. Hence, self-criticism is considered a vulnerability factor that is related to various pathologies manifested as stressful events occur. Building upon these findings, a specific strategy called self-compassion that specifically tackled self-criticism was developed.

2.2 Self-compassion

Self-compassion is defined as that showing compassion towards self when encountering stressful events, and it is a regulator technique that does not involve self-evaluation [6].

Three essential components are essential in self-compassion: self-kindness, common humanity, and mindfulness [12]. Specifically, self-kindness enables people to understand and accept themselves when they confront failures. While common humanity conveys the concept that personal inadequacy is a universal human experience. Mindfulness is a non-judgmental and receptive state in which negative emotions are neither suppressed nor exaggerated. Consequently, people who lack self-compassion skills could be easily affected by their negative thoughts and feelings. Further, self-compassion involves being kind to self, embracing the reality of imperfection, shifting the attention that intensely focuses on self away, and accepting the present moment [13].

To investigate the underlying mechanism of self-compassion, participants in Leary et al. performed a task that was considered awkward and mildly embarrassing [4]. Then participants and the observers rated the performances on the videotaped tasks. Interestingly, results revealed that less self-compassionate participants rated their performances significantly lower than the observers'. That is, less self-compassionate participants might not have an accurate perception of their performance. Meanwhile, highly self-compassionate people were found more adaptive and showed less emotional fluctuation when encountering negative life events [4]. Thus, self-compassion is a critical buffer that protects people from difficult situations and enables people to remain optimistic as life is going in an unexpected direction.

As such, self-compassion was considered a beneficial approach for depression intervention. Further, self-compassion is tightly related to various pathologies, such as depression [14]. Particularly, better self-compassion was linked to happiness, positive moods, and optimism [5]. When the variable of self-esteem was ruled out, it was demonstrated that self-compassion was a predictive factor of the occurrence of depression [6]. This profoundly highlights the importance of self-compassion in depression intervention. Recent studies implemented self-compassion in CBT and found a significant improvement in well-being. Specifically, it was revealed that compassionate images effectively enhance self-compassion among self-critical people [15]. Further, an online exercise that aimed to teach depressed patients demonstrated that self-compassion significantly reduced the depressive symptoms, and the effect of the intervention was still found at one-, three-, and six-month follow-ups [14]. Therefore, it is plausible to conclude a positive impact of self-compassion on depressed patients.

3 Development of VR in Clinical Application

3.1 Virtual Reality (VR) and VR Exposure Therapy (VRET)

VR aims to create a virtual environment that delivers multiple senses to individuals such as visual, auditory, and force cues [9]. In particular, there are two primary types of VR: non-immersive VR and immersive VR [16]. Non-immersive VR usually involves interfaces (e.g., computer screen) and input devices (e.g., keyboards). Immersive VR often utilized advanced interface devices (e.g., headset) and body motor sensors, and people can interact with the environment via a headset. Meanwhile, immersive VR input devices record the subject's motions and emotions, and the virtual environment is modified accordingly [17]. Past research revealed the body illusion wherein the perception of the body differs from the physical structure could be found in the environments created

by VR [18]. In this way, VR is sufficient to cue people an illusion of owning a virtual body and renders them to interact with an artificial environment that either simulates or deviates from the real world.

Importantly, VR boosts an enormous body of work and is widely used in treatments for various mental disorders. Especially, most studies primarily focus on VR exposure therapy (VRET). VRET aims to reduce patients' stressful reactions by gradually and repeatedly exposing the stimulus to correct the problematic reactions of patients with phobias or PTSD [9, 10]. In VRET, the combination of exposure techniques of traditional CBT and a VR environment allows participants to have an immersive and interactive experience. Through the process of habituation and extinction, participants' avoidance behaviours toward the feared stimuli are reduced [18].

3.2 Applications of VR in Clinical Psychology

VRET is widely implemented in the treatments for anxiety disorders. Specifically, utilizing VRET to treat phobias has garnered the most attention. For example, in Rothbaum et al. [19], twenty college students who indicated a substantial fear of heights were recruited, and they were allocated to either a VRET or a wait-list condition. In the VRET condition, virtual environments such as outdoor balconies and glass elevators were presented, and participants were encouraged to stay in the VR scenario as long as they could until their level of anxiety decreased. Interestingly, results revealed a significant improvement in the VRET group on the self-reported anxiety and avoidance of heights compared to the wait-list condition. Furthermore, another study found that VRET was even more effective than the traditional in vivo exposure at changing attitudes towards avoidance behaviours [20].

Additionally, it is worth noticing that VR is effective at treating PTSD. PTSD is a mental disorder that develops after exposure to a traumatic event, and mental distress and avoidance behaviours are common symptoms among patients with PTSD [21]. Similar to the treatments for anxiety disorder, exposure therapy is a crucial stage to reduce patients' stressed reactions. For example, VR implemented scenes such as gunfire and helicopters to treat patients with war-related PTSD. Particularly, studies on veterans found that the symptoms of PTSD significantly decreased after completing the VRET, and its lasting effect was found at a six-month follow-up [10]. Moreover, Beck et al. also revealed a promising effect of VRET on subsyndromal PTSD [22]. Thus, VRET could be viewed as an effective PTSD treatment.

4 VR as an Intervention for Depression

The prevalence of depression has increased to 25% during the pandemic [1]. Meanwhile, social distancing has posed difficulties for face-to-face CBT. Thus, evaluating whether the VR approach is appropriate for depression intervention is imperative. Recent research has shifted focus to embodying VR in depression intervention. The core mechanism is to inculcate the feeling of self-compassion by implementing the technique of virtual embodiment [7].

Additionally, first-person perspective (1PP) was found easier for participants to immerse themselves in a given scenario. Building upon the existing studies, Falconer et al. exploited VR to teach patients who were highly self-critical to be compassionate to themselves [7]. Forty-three females randomly assigned to the 1PP or the third-person perspective (3PP) condition. In the 1PP condition, participants as an adult avatar interacted with and confronted a crying child avatar. In the second stage, their characters were switched: participants played the role of the crying child and re-experienced the compassion that they gave to the crying child previously. In the 3PP condition, participants experienced the same scenario from an external perspective, which means participants saw the scenario rather than embodying in the child body. The findings demonstrated that both delivering and receiving compassion lead to a reduction in self-criticism. In particular, it appeared that participants in the 1PP condition immersed themselves in the scenario better. Thus, it could be explained that providing the participants with a virtual “self” enhances and deepens the experience of self-compassion, reducing self-criticism.

Furthermore, immersive VR was found to be potentially beneficial in reducing depression-related symptoms. Falconer et al. [11] recruited fifteen participants with depression. Before participants started the embodiment, they were provided compassionate sentences and were asked to remember these sentences as much as they could. In the first phase, participants were asked to wear a body-tracking suit to ensure their movements and physiological reactions were recorded. In the VR headset, participants saw a crying girl and had to use compassionate sentences to confront the girl. When the participants were soothing the girl, the girl gradually gave positive responses and stopped crying. In the second phase, the character switched (participants became the crying girl), and their forgone compassionate behaviours were played back via the adult avatar. Findings showed that the depression severity and self-criticism were significantly reduced after this activity, and the rating on self-compassion significantly increased. This was explained that when participants re-experienced the compassion from themselves, their experiences were deepened. In another study by Shah et al. [23], a quasi-experiment also indicated that depressed patients had significantly lower scores on stress and depression subjective ratings after they completed a VR-based intervention in relation to depression. Taken together, these two studies demonstrated the potential beneficial influences of immersive VR experience on later depression-related outcomes.

Shah et al. [23] and Falconer et al. [11] give a strong implication to the clinical practice. It is important to notice that VR has some significant advantages over the traditional CBT for depression. Firstly, controlling the environment becomes easier for the therapists, such as adjusting the intensity and frequency of exposure [17]. Secondly, VR conveys more sensory cues, and this enables the environment to be more realistic and deepen the individuals’ experiences. Compared to traditional CBT, participants could immerse themselves in the given artificial scenario as more sensory cues are involved to mimic the real-life situation. Therefore, there might be a greater likelihood that they utilized the technique of self-compassion when encountering a stressful event in daily life. Lastly, VR-based treatment for depression might greatly reduce the face-to-face therapist time [11].

5 Limitations and Future Directions

Although the experimental process was strictly controlled by experienced researchers, and thus it leads to the question: to what extent the standardized experimental process could be transferred to a real-life clinical practice? For example, before participants were embodied in the VR environment in Falconer et al., they were given compassion-focused therapy [11]. Furthermore, participants were given generic sentences and practised these sentences with the researchers before they repeat them to the avatar. Therefore, it is apparent that a rigorous process and well-trained researchers are also required in the local clinics to achieve the same effect, and making the process of VR intervention simpler is crucial before transferring to real-life clinical practice.

In addition, adherence to VR-based intervention should also raise some concerns. In Falconer et al. [11], participants performed a single immersive VR scenario repetitively, which might reduce patients' motivation to complete the whole treatment because of the cumbersome and dull process. Thus, it is likely that the effectiveness of the VR-based approach is reduced, and a high drop-out rate might occur. Although a significant effect was found at a four-month follow-up, follow-ups with longer periods are needed to examine the effect of VR intervention in the longer run.

It is also interesting to note the characteristics of recruited subjects and their feedback on the VR experience. According to Falconer et al. [11], the sample comprised 14 white people except for one Asian. Clearly, this study was grounded in a Western epistemological tradition that was understood in the Western cultural frame, and there might be culturally incongruent in other cultural contexts. Accordingly, it is necessary to replicate this finding among a population with different ethnicities. Some participants indicated that the fluidity of movement, VR environment, and facial expressions of the avatar could be improved. Therefore, the issue of to what extent participants felt immersed in the VR environment is still unclear. Although the score on the patient health questionnaire significantly improved, it could be a result of demand characteristics. Thus, future developments in VR-based intervention must improve the VR experience to make it more natural, acceptable, and aesthetic to patients.

Finally, the absence of control conditions is the main concern of the present empirical studies on immersive VR-based intervention for depression. In Shah et al. [23] and Falconer et al. [11], none of the participants were allocated to a control condition. Moreover, among the recruited 15 participants in Falconer et al. [11], most of them were receiving depression treatments (e.g., antidepressant medication or psychological therapy) at the time of the study. Quadratic changes in transient mood, PHQ-9 scores, and self-compassion and self-criticism scores on SCCS were all non-significant. Consequently, it is difficult to distinguish the effect of the VR intervention on later psychological outcomes with other potential confounding variables. As such, the findings could be contaminated, and it is necessary to conduct replications with cleaner experimental designs with control conditions.

6 Conclusion

The present article aimed to review and evaluate the effectiveness of the VR paradigm for depression intervention. Previous studies identified a promising effect of self-compassion in reducing depressive symptoms, and current research tried to implement this technique using a VR paradigm in the treatment of depression. VR is a simulated experience that delivers various sensory cues, and this renders patients immerse in the given scenario easily, which profoundly implies that VR could be a powerful tool for improving psychological interventions using avatar embodiment experiences. Through reviewing previous empirical studies, the positive effect of the VR paradigm in depression intervention was found. Notably, questions regarding the feasibility, treatment adherence, and absence of control condition were unclear at the time. Furthermore, there are only a few empirical studies investigating the implementation of the VR paradigm in depression interventions. To conclude, VR has a huge potential for promoting psychological well-being. Regarding future directions, future studies must replicate the studies with control conditions to re-examine the reliability of the current findings. Meanwhile, developing abundant VR scenarios and simple VR experiences is necessary before implementing this technique in a real-life setting.

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