A Literature Review of Virtual Reality (VR) applications in Mental Health Treatments: What are the Potential Applications of Virtual Reality in Therapeutic Interventions?

Dr. Jessica Grahn

Fasika Ghetnet

400378055

McMaster University

Department of Psychology, Neuroscience & Behaviour

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Abstract

In this paper, I conducted a literature review on the diverse applications of virtual reality (VR) in the treatment of psychiatric disorders. I collected 17 studies; 15 explored VR as a clinical trial or therapeutic intervention for patients with psychiatric disorders or symptoms, and two surveyed public opinion on VR involvement in psychiatric healthcare. The studies were included based on their fulfillment of the following characteristics: human participants, randomized controlled trials comparing VR-based intervention to a control or therapeutic intervention population, published in a peer-reviewed journal, and written in English. Across the chosen studies, positive results were seen in the efficacy of managing psychiatric symptoms of depression, anxiety, paranoia, and mood regulation. However, future directions should include diversifying participant samples and size, increasing the observational and experimental length of the VR interventions to enhance understanding and credibility of findings. This review will explore the benefits of exploring VR as a tool for therapeutic treatments and its limitations via the dissection of experimental studies in treating psychiatric disorders.

Keywords: Virtual reality, immersion, psychiatric disorder, efficacy

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Virtual reality (VR) is a technology that creates a simulated, interactive environment that can mimic or alter real-world settings or transport users into entirely fictional spaces. According to Mandal (2013), VR relies on digital tools to generate immersive 3D environments, engaging users' senses—primarily sight, sound, and sometimes touch—to produce a sense of presence, as if they are physically situated within the virtual space. The core concept of VR is to replicate or entirely fabricate sensory experiences to make users feel “inside” the environment.

Mütterlein (2018) elaborates on three foundational elements that define the VR experience: immersion, presence, and interactivity. Immersion is the extent to which VR isolates users from the physical world, fully engaging their senses in the virtual environment. VR systems achieve immersion through headsets, spatial audio, and sometimes haptic devices that enhance the feeling of being “inside” the virtual world. Presence is defined as the psychological experience of feeling genuinely located within the virtual space rather than merely observing it. High levels of presence can make VR experiences more impactful, particularly in applications like therapy and training. Interactivity is the user’s ability to navigate, manipulate, or respond to elements within the VR environment. The degree of interactivity in VR can vary, but significantly enhances engagement and makes the virtual experience more lifelike.Together, these elements differentiate VR from other digital media by creating a more immersive and responsive environment, as highlighted by Mütterlein’s “three pillars.” This combination allows VR to support applications in fields like mental health, education, and entertainment, providing controlled, engaging environments that can be customized to individual needs (Mandal, 2013; Mütterlein, 2018).

The rising prevalence of mental health issues has brought a global crisis into focus (Stephenson, 2023). The increase in mental health awareness has been a double-edged sword; while it has fostered greater understanding and reduced stigma, it has also highlighted significant gaps in access to care, and the integration of mental health services into broader healthcare systems (Stephenson, 2023). Increased awareness has highlighted the need for innovation in the domain of psychiatric and therapeutic treatments, thus leading to the emergence of virtual reality as a tool for symptom treatment and management. Despite this, the introduction of these new tools faces difficulties, as public perception is a key factor in determining the success of incorporating and using innovative mental health technologies. It is crucial to comprehend society's views on mental health treatments, such as incorporating virtual reality, in order to tackle issues, establish credibility, and guarantee equitable availability of these developments.

Two recent surveys on public opinion explored individuals' perspective of VR as a tool in mental health, and results highlighted various advantages and concerns of implementation and cost (Bergin et al, 2024; Renner et al, 2020). Cost and technological proficiency emerged as significant barriers, with many individuals expressing discomfort with their ability to use VR technology effectively, which may discourage its adoption. To address these concerns, potential solutions such as cost-sharing models, rental services, or insurance coverage could be explored. Additionally, concerns were raised about VR's capacity to replicate non-verbal communication, such as body language and facial expressions, which are often considered vital during therapy sessions. Innovations like facial tracking, haptic feedback, and other sensory manipulations may enhance the therapeutic experience and address these shortcomings. However, they also found that many participants appreciated the lack of a face-to-face requirement, particularly for those who may find traditional therapy settings intimidating. Public perceptions of VR as effective for treating conditions like phobias and anxiety were also encouraging. However, acceptance of VR appears influenced by cultural and generational factors, with younger individuals more open to trying the technology, likely due to their familiarity with digital platforms, while older individuals may approach it with caution. Understanding these nuanced opinions can inform strategies for introducing and implementing VR in mental health care, ensuring it meets diverse needs and expectations.

While virtual reality (VR) has demonstrated significant promise in enhancing therapeutic interventions, a thorough examination of its thematic applications and limitations is necessary to fully understand its potential and guide future developments in this rapidly evolving field. VR offers unique opportunities to expand mental health support beyond traditional clinical settings, particularly for underserved and rural populations with limited access to care. Its flexibility allows for delivery in diverse settings such as clinics, homes, and mobile centers, making it an appealing option for individuals with mobility challenges or social anxiety. Moreover, VR’s immersive and interactive nature can enhance engagement, increasing patient adherence and motivation throughout the therapeutic process.

Another key advantage of VR lies in its capacity for personalization and controlled exposure. Therapists can tailor virtual environments to suit individual client needs, enabling gradual and structured therapeutic experiences. As the initial costs of VR equipment may be high, it has the potential to reduce long-term treatment expenses by shortening therapy durations or supplementing sessions remotely. These features underscore the potential of VR to revolutionize mental health care, making it more accessible, engaging, and cost-effective. It is vital that we continue to explore VR's versatility and innovative capabilities to render it as an effective and transformative tool in mental health care.

Personalization of VR and Mechanisms of Action

Virtual Reality for Treating Depression

The combination of VR and cognitive behavioural therapy (CBT) is a novel experimental combination and has been seen as an effective treatment plan for individuals with depression and/or depressive symptoms. Depression is often categorized by experiences of persistent negative emotions (e.g. sadness and anxiety), lethargy, lack of energy, loss of interest in activities (National Institute of Mental Health).

A study by Lindner et al. (2019) explored the ways in which VR can effectively help manage symptoms of depression by utilizing the following techniques: customization of VR experiences, mechanisms of action, translating CBT techniques to VR, and psychological principles. Traditional CBT techniques—such as cognitive restructuring, behavioural activation, and exposure therapy—can be adapted and implemented within a VR context. Further, VR can provide a more immersive, engaging way to practice these strategies, enhancing the therapeutic experience. VR interventions can be personalized to fit individual needs, preferences, and emotional states. This customization allows for greater flexibility in addressing specific aspects of depression, such as negative thought patterns, avoidance behaviours, and emotional regulation. VR's immersive nature may facilitate emotional processing, reduce avoidance behaviour, and increase engagement with therapeutic activities. It may also promote a sense of presence that helps individuals confront distressing emotions or situations in a safe, controlled way.

The following studies implemented the various features explored by Lindner et al. (2019); the first was conducted by Falconer et al. (2016). The study explored self-compassion in individuals with depression, as it is seen that symptoms of depression include low levels of self-compassion. Participants were put in an environment where they embodied a first-person perspective and performed acts of kindness toward a virtual version of themselves. In one condition, participants acted as adults and showed empathy towards a virtual child by offering comforting words and gestures while the child was crying. In the second phase, participants switched to embodying the child avatar, enabling them to receive comforting messages and gestures from their adult self, increasing self-compassion and reducing self-critical behaviours. Results revealed a significant increase in self-compassion and a considerable decrease in self-judgment among participants of the VR program compared to a control group that did not join. Another study focused on cultivating positive experiences in future thinking, mood, and wellbeing (Habak et al., 2021). Results showed that there were notable enhancements in participants' mood, future thinking, and psychological wellbeing as determined by standardized tests.

Both Falconer et al. and Habak et al. demonstrated how VR can lead to positive cognitive changes (e.g., promoting self-compassion, and cultivating future thinking), which is also a primary goal of traditional CBT. These cognitive shifts are part of the mechanisms of action, which highlights how VR can facilitate changes in thinking patterns to reduce depressive symptoms. Both studies support Lindner et al.'s emphasis on customizing VR interventions to better meet the needs of individuals with depression, whether through self-compassion or fostering future-oriented thinking.

Controlled Environmental Setting

Virtual Reality Exposure Therapy (VRET) for Treating Specific Phobias

Virtual Reality Exposure Therapy (VRET) uses immersive VR technology to help patients confront and manage specific phobias in a controlled environment. By simulating real-world scenarios, VRET allows for gradual, repeated exposure to feared stimuli, making it an effective treatment for phobias, anxiety reduction and emotional regulation. A phobia is characterized by a persistent fear of the presence or anticipation of an object or situation which leads to significant feelings of fear, anxiety and avoidance (National Institute of Mental Health). Common phobias include flying, closed spaces, and insects.

For instance, Ferrand et al. (2015) explored the effectiveness of combining cognitive-behavioural therapy (CBT) with VR exposure to address the fear of flying (FOF). In their study, 157 participants underwent a one-day intervention that included CBT techniques alongside VR scenarios designed to simulate flying experiences. Using the Flight Anxiety Situations (FAS) and Flight Anxiety Modality (FAM) questionnaires, the study found significant reductions in flight-related anxiety across multiple subscales, supporting the integration of VR into therapeutic interventions for FOF.

Expanding on the application of VRET, a single-subject trial conducted in 2020 investigated the effectiveness of gamified and automated VR therapy for arachnophobia. The study included 26 participants and used a virtual reality setup that simulated realistic interactions with spiders, incorporating gaming elements like levels, points, and rewards to boost engagement and motivation. The results showed notable decreases in self-reported arachnophobia, reduced behavioural avoidance, and improved physiological responses to spider-related stimuli.

These studies collectively highlight the potential of VRET in reducing phobia symptoms and improving patient outcomes. Common elements within these studies include the effectiveness of VRET in decreasing anxiety and avoidance behaviours, as well as its capacity to engage users through interactive and immersive experiences. However, differences in the use of gamification, immersion customization, and participant populations—such as veterans versus civilians—suggest the need for tailored approaches depending on the specific phobia or trauma type being addressed. These insights emphasize the versatility of VRET while pointing to the importance of individualizing treatment to maximize its efficacy.

Virtual Reality Assisted Therapy for Treating Schizophrenia, Schizoaffective Disorder and Psychotic Disorder

Virtual Reality Assisted Therapy (VRAT) is emerging as a promising tool in the treatment of schizophrenia and schizoaffective disorder. VRAT leverages immersive virtual environments to simulate real-life situations that help patients practice social skills, manage negative symptoms, and confront hallucinations or delusions in a safe, controlled space. By providing interactive exposure to social or cognitive challenges, VRAT helps patients build coping strategies, improve emotion recognition, and increase assertive behaviours..

Rus-Calafell et al. (2014) explored the impact of a VR-integrated program on social skills among patients with schizophrenia or schizoaffective disorder. Their findings revealed significant improvements in negative symptoms, social functioning, and social anxiety. Objective measures also highlighted gains in emotion perception, assertive behaviours, and conversational engagement, with most of these benefits persisting at a four-month follow-up.

Dellazizzo et al. (2020, 2021) expanded this exploration to treatment-resistant schizophrenia by integrating VR with cognitive-behavioural therapy (CBT). Their studies showed that VR-based interventions not only reduced the severity of auditory hallucinations but also improved depressive symptoms, overall schizophrenia symptoms, and quality of life. Notably, VR therapy achieved larger reductions in negative symptoms and greater improvements in social functioning compared to traditional CBT. Participants also expressed higher satisfaction with VR therapy, citing better coping strategies and enhanced symptom management.

In early psychosis, the VEEP study by Thompson et al. (2020) investigated the feasibility and acceptability of delivering social cognitive therapy in a virtual world. Participants found the VR intervention engaging and helpful in addressing social cognition issues, with high program completion rates. Similarly, Pot-Kolder et al. (2018) demonstrated that VR-based CBT effectively reduced paranoid thoughts and social avoidance in psychotic disorders. The virtual environment provided a secure space for exposure and cognitive restructuring, allowing patients to confront and challenge anxiety-provoking social scenarios, ultimately enhancing their engagement in therapy.

Together, these studies highlight VRAT's ability to improve symptom management, social skills, and emotional processing in schizophrenia and related schizoaffective and psychotic disorders. VR's immersive and interactive nature fosters a safe environment for therapeutic engagement, enabling patients to tackle their challenges more effectively. However, future directions should include implementing increased long-term studies, as more research is needed to assess the sustainability of VRAT's benefits over time, especially as it applies to chronic and treatment-resistant symptoms of schizophrenia. Further, hybrid treatment models should be considered to explore how VRAT can complement pharmacological treatments and other therapeutic interventions could lead to more holistic, multidimensional care for patients with schizophrenia.

Realism and Immersion

Virtual Reality Assisted Therapy for Treating Substance-Use Disorder and Gambling Disorder

Virtual Reality Assisted Therapy (VRAT) is emerging as a promising tool in treating substance-use disorder (SUD) and gambling disorder by providing immersive, controlled environments where patients can confront cravings, triggers, and addictive behaviours. For individuals with SUD, VR enables realistic simulations of substance-related cues, such as drug paraphernalia or alcohol, offering an opportunity to practice coping mechanisms in response to cravings.

Hone-Blanchet et al. (2014) explored the use of VR in craving assessment and cue-exposure therapy (CET) for SUDs. The study demonstrated that VR could effectively trigger cravings by simulating realistic substance-related environments. In doing so, it provided an opportunity for participants to develop coping strategies, such as cognitive restructuring and emotional regulation. These techniques helped individuals manage cravings in everyday scenarios, suggesting that VR not only enhances participation in therapy but also offers a dynamic and precise method to evaluate the strength of cravings and urges in real-life contexts.

Similarly, Bouchard et al. (2017) examined the potential of VR in treating gambling disorder by combining it with cognitive-behavioural therapy (CBT). Their research included several studies investigating the feasibility, emotional triggers, and integration of VR into traditional therapeutic methods. The first study found that participants felt the VR tool was highly engaging and realistic, making it a suitable option for therapy. The second study showed that the VR scenarios successfully stimulated gambling-related urges and emotional responses, similar to those experienced in actual gambling situations, thereby confirming its potential for exposure-based CBT. In the third study, participants using the VR tool in conjunction with CBT demonstrated enhanced emotional regulation and a decrease in gambling cravings. This indicated that VR could improve the application of CBT methods, providing a controlled and immersive setting where patients could practice skills such as cognitive restructuring and impulse control.

These studies highlight the effectiveness of VR in addressing addiction-related issues by offering realistic simulations where patients can confront their triggers in a safe environment. By enhancing traditional therapies like CBT with immersive experiences, VR has the potential to improve treatment outcomes for both SUD and gambling disorder. Future directions for research could focus on refining the VR environments to address a broader range of addictive behaviours, exploring the long-term effects of VR-assisted therapy on relapse prevention, and expanding the use of VR to include other forms of addiction. Additionally, studies could investigate how VR can be combined with other therapeutic modalities, such as mindfulness or group therapy, to further enhance treatment effectiveness.

Sustainability and Ethical Concerns

Virtual Reality Assisted Therapy for Treating Anorexia Nervosa

Virtual Reality (VR) is a novel and limited therapeutic tool for treating Eating Disorders (EDs), particularly in addressing core symptoms such as body image disturbance, distorted perceptions of food, and eating-related anxieties. VR can offer a potentially dynamic, immersive environment where individuals can engage in real-time simulations that replicate the scenarios and challenges typically faced in ED treatment, all within a controlled and safe virtual space. In the context of body image disturbance, which is central to disorders like Anorexia Nervosa (AN) and Bulimia Nervosa (BN), VR has the unique ability to manipulate and alter body image perceptions. Through full-body illusions or avatar customization, patients can experience a more accurate, less distorted version of their bodies. This exposure can help challenge harmful self-perceptions that contribute to disordered eating behaviours.

In a study by Keizer et al. (2016), the researchers explored whether a VR full-body illusion could improve body image disturbance in individuals with anorexia nervosa (AN). The study involved 30 participants diagnosed with AN, who were randomly divided into a VR intervention group and a control group. The VR intervention aimed to manipulate body image perception and challenge the distortions that often maintain the disorder. The findings indicated that individuals in the VR group experienced a notable decrease in body image disturbance, as measured by reliable psychological assessments. This suggests that VR could be an effective tool for addressing body image issues in AN, potentially offering a novel approach to treatment in a field where such disturbances are central to the disorder's pathology.

With minimal research in VR applications for treating eating disorders, VR shows limited potential in improving body image disturbance in individuals with eating disorders, with several critical questions remaining regarding the sustainability of these interventions. Can VR interventions maintain their effectiveness over the long term, or do they require ongoing exposure? Moreover, are improvements in body image perception sufficient to lead to lasting changes in eating behaviours, or is there a need for a more comprehensive approach that includes nutritional counseling, psychotherapy, and family support? These questions are essential for understanding the long-term viability and therapeutic potential of VR for EDs. Future research should focus on follow-up studies to assess the sustainability of VR interventions, explore their integration with other therapeutic methods, and evaluate whether such interventions can produce lasting behavioural changes.

Personalization and Long-Term Efficacy

Virtual Reality Exposure Therapy for Treating Post-Traumatic Stress Disorder

Virtual Reality Exposure Therapy (VRET) has emerged as a powerful tool in the treatment of Post-Traumatic Stress Disorder (PTSD), particularly among populations exposed to extreme trauma, such as military personnel. By immersing patients in realistic virtual environments that simulate their traumatic experiences, VRET allows individuals to safely confront and process distressing memories in a controlled, therapeutic setting. This exposure-based treatment helps reduce the psychological impact of trauma, alleviate anxiety symptoms, and increase emotional regulation by enabling gradual desensitization.

A key study by Reger et al. (2011) demonstrated that VRET was effective in reducing PTSD symptoms among active-duty soldiers exposed to the trauma of the World Trade Center attacks, with significant decreases in PTSD and anxiety symptoms observed both during treatment and at a six-month follow-up.

While VRET has demonstrated promising results in treating PTSD, particularly in military personnel, it is important to acknowledge that PTSD is a highly personal and complex condition. Patients have vastly different responses to treatment, and while some may benefit from immersive exposure, others might find it overwhelming or triggering. The effectiveness of VRET will largely depend on how well it is tailored to the individual needs and tolerances of patients. For optimal outcomes, it will be essential to develop adaptive VR environments that can adjust in real-time to the emotional and physiological cues of the patient. These adaptive systems would allow for more personalized exposure, ensuring that the therapy aligns with the patient's unique recovery journey. Future research should focus on refining VRET to be more responsive and customizable, as well as exploring its integration with other therapeutic approaches to create a comprehensive and effective treatment strategy for PTSD. Additionally, long-term studies are needed to assess the sustainability of the benefits of VRET, particularly in the context of different trauma types and diverse patient populations.

Real-World Integration and Long-Term Efficacy

Virtual Reality Exposure Therapy for Treating Anxiety Disorders (Generalized Anxiety Disorder and Social Anxiety Disorder)

Virtual Reality Exposure Therapy (VRET) has also emerged as a promising treatment for Anxiety Disorders, including Generalized Anxiety Disorder (GAD) and Social Anxiety Disorder (SAD). Both disorders are categorized by symptoms of excessive and maladaptive fear, anxiety and worry in relation to social and situational settings (Khdour et al., 2016).

Anderson et al. (2017) explored the long-term effects of VRET when combined with Cognitive behavioural Therapy (CBT) for Social Anxiety Disorder (SAD). The study followed participants over a period of 4-6 years, assessing the long-term impact of VRET. The results showed that participants continued to experience significant reductions in social anxiety symptoms and demonstrated improvements in overall social performance. These participants were exposed to realistic, virtual environments that simulated social situations, such as a virtual classroom, auditorium, and conference room. They were also supported by group therapy, where they could practice social skills and interact with others in a controlled setting. The combination of VRET and group therapy was found to be an effective long-term treatment option for SAD, emphasizing the potential for immersive exposure and social interaction to improve therapy outcomes.

In another study by Guitard et al. (2019), the focus was on Generalized Anxiety Disorder (GAD) and the efficacy of VR in exposing patients to anxiety-inducing scenarios. Participants with GAD were randomly assigned to one of two groups: one exposed to a standardized catastrophic scenario in a virtual reality environment, and the other exposed to a personalized anxiety-provoking scenario via imagination. The results showed that both groups experienced a notable reduction in anxiety symptoms. However, the VR group demonstrated significantly greater engagement and stronger emotional reactions during the exposure. This suggests that VRET may offer a more engaging and effective treatment option compared to traditional cognitive interventions, potentially improving therapeutic progress and outcomes for individuals with GAD.

While Virtual Reality Exposure Therapy (VRET) has shown great promise in the treatment of Social Anxiety Disorder (SAD) and Generalized Anxiety Disorder (GAD), it is still in the early stages of widespread clinical application. The studies reviewed suggest that VRET can be an effective tool for long-term management of social anxiety, offering participants the opportunity to practice social skills and reduce anxiety in immersive virtual environments. Additionally, the use of standardized catastrophic scenarios in GAD treatment demonstrated that VR can trigger emotional reactions more effectively than traditional imaginative exposure, providing a more engaging and dynamic therapeutic experience.

However, several key areas require further exploration. First, while VRET shows positive short-term effects, the long-term outcomes remain unclear. Do the improvements in anxiety and social performance observed after treatment continue once the virtual exposure is removed? What is the rate of relapse in patients once they return to real-world scenarios, and how can we ensure that VRET leads to sustained behavioural change? Future research should focus on addressing these questions, examining the long-term benefits of VRET, and exploring how to optimize treatment protocols for sustained success in real-life environments.

Conclusion

Virtual Reality (VR) interventions have made transformative contributions across several therapeutic fields, notably in depression management, exposure therapy, and craving management. By immersing patients in controlled virtual environments, VR offers a dynamic and engaging way to address psychological conditions, particularly those involving anxiety, trauma, and addictive behaviours. In exposure therapy, VR allows patients to confront fears in a safe and customizable space, improving the effectiveness and engagement of traditional methods. In craving management, VR offers a promising avenue for substance use treatment, where individuals can face triggers in a controlled, immersive setting, thus reducing the likelihood of relapse. Research in VR applications as a tool for mental health is a promising avenue for the future of treatment and equitable accessibility for patients with mental health concerns.

However, while VR holds immense promise as a therapeutic tool, it is important to recognize the limitations. Despite its effectiveness across various domains, the success of VR interventions depends heavily on their customization to meet the individual needs of patients. Furthermore, ethical considerations, such as the potential for re-traumatization, must be carefully managed to avoid negative effects during therapeutic use. VR offers high engagement, immersive potential, and the ability to simulate a wide variety of therapeutic scenarios, making it a valuable tool in modern psychotherapy.

In terms of next steps for research, it is clear that VR requires increased longitudinal studies that examine the long-term effects of VR interventions, particularly in fields like PTSD, anxiety, and eating disorders. The integration of biofeedback to tailor VR experiences based on real-time physiological responses holds promise for enhancing treatment outcomes. Further exploration of personalized VR adaptations will also be crucial, as the effectiveness of VR interventions can vary significantly across individuals and psychological conditions. By addressing these gaps, researchers can optimize VR therapy and ensure that it remains a reliable and ethically sound tool for improving mental health outcomes.

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