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The Role of Virtual Reality in Psychiatric Treatment: A Literature Review

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A B S T R A C T

Virtual reality (VR) is one of the immersive breakthroughs of rapidly growing technology. This VR technology, offers a 3-dimensional virtual environment to users while enabling interaction with this environment in various ways. VR can be seen in various sectors, including mental health care. Virtual Reality Exposure Therapy (VRET) has been established as an innovative approach for treating psychiatric disorders like social anxiety, obsessive-compulsive disorder (OCD), post-traumatic disorder, phobias, and other disorders (psychosis, functional neurological disorder (FND), and neuropsychological disorders) by offering individuals more controlled, interactive virtual environments that simulate triggering situations. In this review, the role of VR as a psychiatric treatment is explored. In total 50 articles were reviewed and reported in the study. Although the findings are promising, some limitations and challenges are detected. One of the concerns is relapse rates; no detailed studies are addressing it. In addition, in studies, cybersickness is reported, which can cause dizziness, nausea, and headache. In conclusion, while studies support VRET's effectiveness, it is necessary to investigate further its long-term effects. Future studies should concentrate on conducting larger clinical trials and incorporating VR into standard therapeutic practices to fully harness its potential in treating mental health issues.

1. Introduction

As humanity develops, investment in the technology industry continues to increase. Technology's development affects not only industries but also individuals' lives. Over time, this effect has increasingly become more personalized in terms of user experience. One example of this personalized technology is Virtual Reality (VR). VR offers the user a 3-dimensional environment and interaction with this environment.

The roots of VR technology date back to 1962. Morton Heilig, a cinematographer, invented a device called 'Sensorama,' which formed the basis for simulating multiple senses, such as sight, sound, and smell, and also a chair with motion activity to trigger individuals [1]. Heilig dubbed this device 'Experience Theater.' In 1968, Ivan Sutherland, an American computer scientist and internet pioneer, also known as the "Father of computer graphics," introduced the first head-mounted display system [2]. Since this system was very heavy, it had to be suspended from the ceiling. Because of the device's looks, it is informally called "The Sword of Damocles" as a figurative reference. This device displayed wireframe graphics and geometric shapes such as cubes or pyramids consisting of white lines on a black background. With the motion of the individual who experiences this device, the shapes are also changed according to the point of view.

During the following decades, VR began to gain momentum in various sectors, such as commerce, defense, and education. In the 1980s, the interest of NASA and the Defence Advanced Research Projects Agency (DARPA) in VR for training [3] and space simulations became well-known. NASA developed a system called "Virtual Interactive Environment Workstation" [4]. This system is used for training and space simulation. Also, DARPA used VR for the development of combat strategies and pilot training. This usage of VR showed adaptability and capacity to improve the human potential in the work environment.

During the 1990s, discussions around the impact of VR in healthcare began to emerge, with one of the most notable aspects being its application as a psychiatric

treatment method. The use of VR in psychology was particularly remarkable in this decade [5]. Researchers began investigating how it could assist individuals who experienced various psychological challenges like phobia and anxiety. One of the revolutionary studies in this field took place in 1998 [6], this study tested the effectiveness of virtual exposure therapy for overcoming the fear of public speaking. Participants in VRT sessions demonstrated a noteworthy enhancement in their confidence when speaking in front of the audience. A key milestone in this domain was in 1996 when Barbara Rothbaum and her colleagues employed VR to treat patients with flight phobia [7]. This study used a head-mounted display and a simulation of the interior of an aircraft, as well as real sound recordings of take-off, landing, and turbulence of the plane. This study includes the use of virtual environments to expose patients to the scenarios they fear, enabling them to confront and overcome their anxiety in a controlled and safe environment. This application, known as Virtual Reality Exposure Therapy (VRET), has proven to be highly effective [8], [9] and has paved the way for wider applications of VRET in the treatment of anxiety disorders [10], obsessive-compulsive disorder (OCD) [11], [12], post-traumatic stress disorder (PTSD) [13], [14] and other psychological conditions [15]. Through time, VR has continued to evolve and become affordable and advanced. Its integration into psychiatry represents the convergence of technology and medicine, offering innovative ways to address mental health issues. VR's journey from a new invention to a critical tool in healthcare underlines the transformative power of technology in improving human lives.

In this respect the aim of this study is to assess the effectiveness of Virtual Reality Therapy in treating social anxiety, OCD, and specific phobias by creating controlled, immersive environments that facilitate exposure to anxiety-inducing situations, and to understand how VR compares to traditional therapeutic methods in terms of patient engagement and long-term outcomes.

2. Research Method

This literature review is a composition of 50 reviewed articles focusing on the use of VR and other behavioral interventions for the treatment of psychological conditions, such as social anxiety disorder (SAD), post-traumatic stress disorder (PTSD), obsessive-compulsive disorder (OCD) and specific phobias. For this review, the following keywords are used: “virtual,” “reality,” or “VR,” “VRET”, “social anxiety disorder,” “social phobia,” “SAD,” “post-traumatic stress disorder” or “PTSD,” “obsessive-compulsive disorder,” “OCD” or “contamination fear,” “Spider-phobia,” “Arachnophobia,” “Exposure Therapy,” “gamification,” or “cognitive-behavioral therapy.” Additionally, “Psychiatry AND VR”, “Neuroscience AND VR”, and “Arachnophobia AND virtual AND reality AND exposure AND therapy” filters were utilized in the analysis. Articles were sourced from reputable databases, including PsycINFO, PubMed, SpringerLink, and ScienceDirect, and span the years [range, e.g., 1997–2025]. Amongst all results, 50 articles were selected according to their relevance and contribution to VRET research. The selected studies met the following criteria: (1) Experimental or clinical trial studies, (2) Published in peer-reviewed journals, (3) Utilize VRET as the main intervention. Studies that only discuss VR without an application were excluded from the analysis.

3. Result and Discussion

The filtered studies were reviewed according to their topics. There are various studies which are about different disorders. Therefore, filtered 50 studies were examined and reported under different categories.

3.1. Anxiety-Related Disorders (General, Social, and Public Speaking Anxiety)

Orr et al. (2023) evaluated the safety and effectiveness of VR therapy for patients who have stress and general anxiety disorders in metaverse-based environments. The average duration of the treatment is 125.2 days, which the majority of the participants completed, and 30 days is considered the minimum time for the treatment. Also, high satisfaction scores (CSAT= 4.12/5) were reported. According to the study findings, anxiety reduced by 34.4%, and stress decreased by 32.3%. Post-treatment shows that memory scores increased by 125%. The study suggests that VR can be an alternative tool for remote mental health care however further studies are needed to confirm its effectiveness. According to participants, VR is an applicable and safe therapy method for stress and general anxiety. The study shows that VR therapy can be done without a clinician [16].

Rubin et al. (2022) conducted a randomized pilot investigation assessing the impact of Attention Guidance Training (AGT) as an addition to VRET for individuals suffering from social anxiety disorder. A total of twenty-one participants were randomly divided into two groups: one receiving only VRET and the other receiving VRET combined with AGT. The results indicated a significant decrease in social anxiety symptoms in both groups; however, there was no notable difference in the level of anxiety reduction between those receiving VRET alone and those receiving VRET + AGT. While AGT did affect gaze patterns, such as enhancing attention toward audience members, the small sample size hindered the ability to identify substantial differences in social anxiety outcomes [17].

Jeong et al. (2021) tried to identify the ideal number of Virtual Reality-Based Individual Cognitive Behavioral Therapy (VRET-CBT) sessions for addressing social anxiety disorder. Participants were categorized into three groups: the early termination group (fewer than 9 sessions), the normal termination group (9-10 sessions),

and the session extension group (more than 11 sessions). The primary measure used in this study was the Brief Fear of Negative Evaluation (BFNE), which indicated that all groups experienced a significant reduction in scores. The normal termination group struck the best balance between effectiveness and efficiency, while the early termination group saw the most substantial decrease in BFNE scores. Interestingly, those who extended their sessions beyond 10 experienced only minimal additional benefits. The study suggests that for some individuals—particularly those who respond quickly—5 to 6 sessions may be sufficient to achieve a meaningful reduction in symptoms [18].

Lee et al. (2021) examined how participatory and interactive Virtual Reality Treatment affects prefrontal cortex activity and lightens social anxiety disorder. The study shows that prior to VR treatment, with tasks viewing first-person videos of social scenarios, individuals with social anxiety disorder showed reduced activity in the right frontopolar PFC. After completing six VR treatment sessions, there was a notable increase in activity in both the frontopolar prefrontal cortex (FPPFC) and the orbitofrontal cortex (OFC). With third-person videos, frontopolar prefrontal cortex (FPPFC) and orbitofrontal cortex (OFC) activities are increased after the sixth session of VR treatment. Also, third-person videos showed earlier changes rather than first-person perspectives due to observation from a distance, which makes it easier to self-evaluate [19].

Lindner et al. (2021) aimed to examine a previously proven VR-enabled treatment protocol using affordable VR hardware. The study included 23 participants, as a single subject, and four psychologists who had minimal VR training. The treatment process consisted of three-hour VRET sessions and a four-week online transition program. The therapy simulated situations that participants might encounter while giving a public speech and presented a variety of scenarios. The study resulted in a significant reduction in public speaking anxiety. This study demonstrated that it worked as intended by reducing anxiety and improving the quality of the delivered performance [20].

Reeves et al. (2021) investigated 360° Video Virtual Reality Therapy focusing on public speaking by comparing two groups alongside a control group: the 360° Audience group, where participants are exposed to a virtual audience, and the 360° Empty group, where participants are in an empty room. The study used a head-mounted display to deliver a 360° experience. The study's participants made speeches on topics chosen by themselves. Both the 360° Audience group and the 360° Empty group showed significant reduction compared to the control group. However, the 360° Audience group reported more presence level and more reductions in fear of negative evaluation (FNE). Participants who experienced 360° Video Virtual Reality Therapy benefitted from this study for up to 10 weeks. Additionally, participants reported the usability, feasibility, and reduced intimidation associated with VRET compared to conventional in-vivo exposure [21].

Zainal et al. (2021) investigated self-guided VRET for individuals with SAD compared to the control group. Forty-four participants who were diagnosed with SAD underwent 4+ sessions of self-guided VRET featuring two anxiety-provoking scenarios: an informal dinner party and a job interview simulation. Study results show a significant reduction in social anxiety symptoms with VRET. 80% of the participants completed in-vivo exposure homework between VRET sessions. 85% of the participants report that VRET can be used with similar problems. In conclusion, self-guided VRET can be an alternative to therapist-led exposure therapy [22].

Bouchard et al. (2017) have examined three group, one using VR exposure, one doing real-life exposure, and a waitlist group, all aiming to help social anxiety. The study was conducted with a total of 59 participants, including 17 in the VRET group, 22 in the in-vivo exposure group, and 20 in the waiting list control group. Both the VRET and in-vivo exposure groups received 14 sessions of CBT and exposure therapy. This study shows that VR exposure therapy worked as well as real-life exposure. Participants experienced the benefits that lasted six months. Therapists found Virtual Reality (VR) to be beneficial for patients who were reluctant to confront real-life situations, as it provided an environment that allowed for privacy and control [9].

Stupar-Rutenfrans et al. (2017) investigated the effectiveness of 360° Video Virtual Reality Exposure Training at home-based intervention using mobile applications for speaking anxiety. In the study, there were three sessions: an empty room (low anxiety), a small audience (moderate anxiety), and a large audience (high anxiety). It is observed that participants with initially high anxiety levels showed significant reduction and confirmed VRET is most effective for those with severe symptoms. Changes were also observed in the moderate-anxiety group, still significant improvements, however, less pronounced than in the high-anxiety group. According to self-reports, scores significantly decreased after intervention for both groups. Participants reported that using home-based applications is easy to use and easy to integrate into their routines. Also, participants appreciated the realism of the environment. Minimal cybersickness was reported [23].

Anderson et al. (2013) compares VRET to exposure group therapy for social anxiety disorder, particularly with public speaking fears. Ninety-seven participants took place in the study, 62% of whom were women with a mean age of 39. The study was carried out in real-life settings and environments. Individuals who were in the VRET group had a significant drop in their anxiety symptoms due to social anxiety as much as exposure to group therapy, and the effects of VRET stuck around for

a year. The study highlights the potential usage of virtual reality for treating social anxiety disorder [8].

Baños et al. (2011) evaluated the efficacy of a virtual reality system designed to treat a stress-related disorder called EMMA's World, compared to traditional Cognitive Behavioral Therapy (CBT) for treating stress-related disorders (SRDs). EMMA's World was not only as effective as CBT in reducing symptoms of SRDs but also showed greater reductions in depression scores than traditional CBT. Additionally, relaxation and social functioning showed improvements with EMMA's World. Participants in the EMMA group reported higher satisfaction with treatment compared to traditional methods because EMMA's world is more personalized, more flexible, and a more user-centric therapeutic approach [10].

Wallach et al. (2009) investigate the comparison between virtual reality cognitive behavior therapy (VRCBT) and traditional cognitive behavior therapy. At the beginning of the study, 112 participants took place however, 24 of those left the study, and the remaining participants were divided into 28 participants for the VRCBT group, 30 participants for the CBT group, and 30 participants for the waiting list control group. The study took 12 weeks and 12 sessions. While the CBT group used imaginal exposure, the VRCBT group experienced a head-mounted display device and made a speech in front of the virtual community. The study revealed that both the VRCBT and CBT groups showed better results than the waiting list control group. However, the hypothesis about VRCBT being superior to CBT could not verified. Remarkably, participants in the CBT group had twice the dropout rate compared to VRCBT, which shows the attractiveness of VR [24].

Slater et al. (2006) examined the impact of VRET on public speaking anxiety in a virtual environment. A total of 40 people took part in the study, consisting of 20 individuals who were comfortable with public speaking and 20 who experienced anxiety. However, to ensure statistical balance, some participants were later excluded. Ultimately, the final group included 20 individuals without fear of public speaking and 16 who had fear, bringing the total to 36 participants. Participants were split into two groups to give 5-minute speeches in either an empty virtual meeting room or one with a neutral virtual audience of five people. Before the speeches, participants completed a questionnaire assessing their anxiety levels and a self-assessment scale for physical reactions. Additionally, heart rate measurements were taken during and after the speeches. This study found that individuals with phobias experienced triggers when they sensed a "presence," even in a virtual reality setting, similar to real-life situations. These results suggest that virtual reality could be an effective tool in addressing social phobia [25].

The studies reviewed reveal that VRET are significantly effective, especially in the treatment of anxiety disorders. Positive results were also obtained in specific areas, such as social anxiety and public speaking [18], [20], [21]. VR therapies offer a more accessible, flexible, and user-friendly alternative to traditional face-to-face therapy methods; at the same time, they provide individuals with the opportunity to receive therapy in privacy. The fact that significant improvements were observed in some individuals, even in short-term applications such as only five to six sessions, shows that these therapeutic approaches are customizable. The high satisfaction level of the participants and the success of VRET systems that can be applied in the home environment without the need for a specialist point to the adaptability of this method to large masses.

3.2. Obsessive-Compulsive Disorder (OCD)

Fajnerová et al. (2023) showed that in the VR environment, patients with obsessive-compulsive disorder exhibit more anxious and high-compulsive behaviors than normal individuals. As a result of this situation, it is possible to conclude that this VR environment is ready to be a suitable tool for VRET working in OCD areas. Another important finding is that the levels of simulator sickness resulting from VR use were kept low, and the general evaluation did not have a negative effect. Therefore, these findings suggest that virtual exposure therapy may help treat OCD [26].

Zadbar et al. (2023) found that both VRET and Cognitive Behavioural Therapy (CBT) significantly reduced symptoms of obsessive-compulsive disorder (OCD) ($F = 192$; $Eta = 0.67$; $P < 0.001$). The benefits of both therapies were maintained over time, as indicated by follow-up tests, with no notable difference between VRET and CBT ($P < 0.05$). There were notable decreases in symptoms associated with obsession, washing, repetition, and skepticism, whereas the control group did not exhibit any significant improvement. These results indicate that VRET could serve as an equally effective alternative to traditional CBT and may represent a promising option for treating OCD [27].

Javaherirenani et al. (2022) designed a study to see the effect of Virtual Reality Exposure and Response Prevention (VRERP) on obsessive-compulsive disorder patients with the contamination subtype and compare VRERP to traditional in-vivo exposure therapy. VRERP group showed more reduction with the Yale-Brown Obsessive-Compulsive Scale compared to the in-vivo group. Beliefs in OCD reduced significantly in the VRERP group. In the VRERP group, only two participants reported side effects (nausea, dizziness, headache), and the VRERP group maintained their gains for 3 months after treatment [12].

Miegel et al. (2022) investigated the use of VR-based exposure and response prevention. The study was done with eight female patients with OCD subtype of contamination, and over six weeks, participants took VERP (VR-based Exposure and Response Prevention)

sessions. As a result of the study, a significant reduction in compulsions and a strong improvement in OCD symptoms were observed. Therapy successfully decreased distress and physiological arousal. Also, it is shown that participants feel an intermediate level of presence [28].

Cullen et al. (2021) compared virtual reality exposure and response prevention (VRERP) to in-vivo therapy to determine its acceptability. Both approaches showed the same increase in anxiety. VRERP increased the therapeutic interaction among the participants and facilitated a higher level of participation, also decreasing the denial of the therapy and creating a safe place for the participants. The physiological responses were the same for both VRERP and in-vivo ERP, which shows that VRERP can be an alternative treatment [11].

Inozu et al. (2020) examined the effects of VR-ERP on individuals with contamination-based obsessive-compulsive disorder (C-OCD). As a result of this study, a significant decrease in anxiety and disgust scores was observed in the experimental group after the sessions. It was concluded that the VR environment successfully provoked disgust and anxiety, and VR-ERP could be an alternative to in vivo exposure therapy [29].

Van Bennekom et al. (2017) revealed that virtual reality-based gaming can effectively trigger OCD patients. Most of the participants (7 out of 8) reported that there were no anxiety or sleep problems after VR treatment' only one of the participants experienced anxiety due to touching contamination. All of the patient's state that they want to play the game one more time. This suggests that the game can be used to assess OCD symptoms in a controlled environment. The research suggests that this method can be used not only for diagnostic evaluation but also for treatment [30].

Laforest et al. (2016) determined the effectiveness of in-virtuo therapy, using virtual reality (VR) to treat obsessive-compulsive disorder (OCD) with a contamination subtype. Three people were involved in the study, which lasted 12 weeks. In Participant 1, it was observed that the decrease in obsessions and compulsions was in a mild range, the gains were preserved in the 4-month follow-up, but a mild relapse was observed in the 8th month. Participant 2 also showed the same result as Participant 1 and sustained improvements across both follow-ups. Participant 3 showed significant improvement from severe to moderate range after treatment however, some residual symptoms remained. VR is controllable and enables participants to confront fear stimuli, with all participants reporting the VR experience as immersive and with minimal negative side effects [31].

Kwanguk Kim et al. (2012) investigates how virtual reality can provoke OCD patients. Twenty-four participants with symmetry, ordering, and arranging compulsions took place in the study. Participants needed to complete three tasks: No limit task, in which patients did not have any time limit to arrange and order the objects, Limited Number of Operations Task, patients were allowed to arrange the objects at most 35 operations, Time Limit Task, patients had to complete arrangement within 70 seconds. Every participant completed every three tasks within three days. The study reveals that a VR environment can be an effective tool for provoking OCD patients, and the questionnaires show a strong relationship between OCD symptoms and anxiety levels. In addition, time pressure is the one of the significant factors in provoking OCD patients [32].

K Kim et al. (2008) examined the use of VR on OCD patients, especially with checking rituals. In the study, it is observed that OCD patients showed significantly higher anxiety in the VR environment than healthy controls and showed a greater decrease in anxiety after checking behavior. VR can provoke anxiety and measure compulsive behaviors in OCD patients with checking rituals and VR is seen as a potential tool for diagnosis and exposure-based treatments [33].

Reviewed studies on OCD reveal that virtual reality-assisted therapies, especially VR applications combined with exposure and response prevention techniques, are as effective as traditional cognitive behavioral therapy methods [12], [27]. Especially in certain obsessive-compulsive symptoms such as the contamination subtype, it has been observed that virtual environments can trigger the expected anxiety and compulsions in individuals and thus successfully support the therapeutic process [28], [29]. The fact that VR environments offer a controlled and safe experience facilitates the participation of individuals who refuse to be exposed to real life [11], [31]. In addition, some studies have shown that VRET can be used not only for treatment but also as a diagnostic assessment tool [30], [34].

3.3. Post-Traumatic Stress Disorder (PTSD)

Best et al. (2023) evaluated the integration of low-cost virtual reality technology (VR Photoscan) into trauma-focused cognitive therapy for the treatment of PTSD in a community mental health setting. The study was conducted with a 38-year-old man experiencing PTSD following a violent assault. With VR photoscan and TF-CT, the traumatic scene was recreated with imaginal exposure therapy and the therapy lasted for several weeks, 10 sessions. The patient's PTSD symptoms decreased from severe PTSD to non-diagnostic threshold and depression decreased from moderate to minimal depression. The patient reported high satisfaction, considering the VR system to be realistic and useful to prepare for real-world exposure [35].

Trahan et al. (2021) used VRET in their study to treat a student veteran who had symptoms of both social anxiety and PTSD (Post-Traumatic Stress Disorder). Using a mobile application, 12 VRET sessions were used in the study. The participant showed a 52.6%

reduction in social anxiety and an 11% reduction in PTSD. With the therapy, sleep quality increased, and more strong neural connections were observed. The study underscores the use of VRET for treating social anxiety in student veterans [36].

Beidel et al. (2019) evaluated the effectiveness of Trauma Management Therapy (TMT) with VRET for treating combat-related PTSD. Conducted with 92 veterans and active-duty personnel with combat-related PTSD, treatment lasted 17 weeks and 14 VRET sessions. It is observed that both groups (TMT and VRET + psychoeducation) showed reductions in PTSD symptoms, and anger levels decreased. In addition to these findings, TMT provides benefits in improving social integration. In conclusion, VRET combined with group interventions may offer a better treatment for PTSD [13].

van 't Wout-Frank et al. (2019) investigate the combination of transcranial direct current stimulation (tDCS) with virtual reality exposure for posttraumatic stress disorder. The study includes twelve veterans. The participants split into two groups. In the sessions, the war environment was simulated with the "Bravemind" VR system. The study reveals that both groups showed a decrease in stress. However, the tDCS + VR group showed a more rapid decrease in stress than the sham tDCS group. Also, both groups showed a reduction in PTSD symptoms. However, tDCS+VR showed a longer time than sham tDCS+VR. Participants did not correctly predict their group, meaning that the presence of tDCS had no expectation effect [37].

Beck et al. (2007) aimed to investigate the effectiveness of VRET on- post-traumatic stress disorder symptoms of motor vehicle accidents (MVAs), where individuals can reduce reexperiencing, avoidance, and emotional numbing. The study is conducted with six participants and 10 VRET sessions. After the sessions, individuals showed a significant reduction in reexperiencing, avoidance, and emotional numbing. Participants reported high-level 'presence' (perceived reality) and satisfaction with the treatment. These results highlight the potential usage of VR as a valuable tool in enhancing traditional exposure therapy for trauma survivors [38].

Difede & Hoffman (2002) examined the treatment of a PTSD patient with VRET who did not respond to traditional imaginal exposure therapy, which occurred after the 11 September 2001 World Trade Centre attack. After 6 VRET sessions, a 90% reduction in PTSD symptoms and an 83% reduction in depression were observed. The results of this study emphasize that VRET is a valuable tool for PTSD, especially for the treatment of patients who do not respond to conventional treatment methods [14].

When the reviewed studies are evaluated together, a common finding is that VRETs are effective in reducing PTSD symptoms [13], [35], [38]. The studies show that both in individual cases (e.g., victims of violence or traffic accidents) and in larger groups (e.g., veterans, active-duty personnel), similarly, symptoms are significantly reduced [14], [36]. It is noteworthy that VRET provides high satisfaction and positive outcomes even in individuals who do not respond to conventional therapies [14], [35]. In addition, increasing accessibility with mobile applications or low-cost systems shows that this method is also applicable in field conditions [35], [36]. However, it has been observed that when integrated with complementary techniques such as tDCS, therapeutic efficacy can be faster and longer lasting [37]. In common, the fact that the participants find VR experiences realistic and experience a 'sense of presence' stands out as an important factor that increases the effect of the therapy [38].

3.4. Phobias

Andersson et al. (2024) conducted an open trial and feasibility study examining the feasibility of VRET for the treatment of spider phobia. This study was conducted with over 12 participants and was based on a single-session phobia treatment method. All participants accepted the treatment and 11 participants completed all treatment stages. As a result of the treatment, a significant decrease in spider fear was observed in all participants, which concluded that VR-hardware for therapist-assisted exposure (VRET-AP) is an effective alternative treatment method. Also, it is thought that VRET-AP method should be tested in larger studies [39].

Roesmann et al. (2023) examined the effects of VRET on spider phobia and the mechanisms that affect the success of the treatment during the treatment period. The main results of the study revealed that the decrease in fear during the session is a determining factor in the effectiveness of the treatment. In other words, the decrease in the level of fear experienced during the session plays an important role in the treatment of spider phobia. These findings reveal the necessity of focusing on strategies to reduce fear during the sessions in order to increase the effectiveness of VRET [40].

Roesmann, Leehr, et al. (2022) investigated the generalization response of individuals to fear and whether VRET would increase or decrease the neural activity in the brain that caused these reactions to feel safe. Participants underwent brain imaging before the VRET. It was observed that fear in the brain decreased and the neural activity created by feeling safe increased in patients who responded to the treatment, and these neural responses were lower in those who did not respond. This article showed that VRET played a role in overcoming fear and increasing the neural activity of trust [41].

Roesmann, Toelle, et al. (2022) aimed to examine the fear responses of individuals with spider phobia and the effects of these responses on the brain, and VRET was

used in the treatment. The neural responses to safety signals in the participants' brains were examined, and it was observed that individuals who showed higher neural activity to strong safety signals responded more positively to VRET. As a result, the study attempts to understand how neural measurements taken before treatment affect the response to VRET, and in this context, it is aimed to personalize treatments [42].

Lindner et al. (2020) was a qualitative study that had participants experience a gamified and automated version of VRET. Findings indicated that the gamified and automated VRET was engaging for participants and found that the gamification elements in the treatment contributed to the perception of the treatment as a serious game. The study found that the treatment was effective in reducing fear of spider phobia [43].

Miloff et al. (2019) aimed to compare automated virtual reality therapy for spider phobia with traditional face-to-face single-session treatment. The study included 100 participants who were randomly assigned to two groups: VRET and one-session treatment (OST). Low-cost hardware and automated software were used in the virtual reality treatment. Both groups showed significant and significant reductions in behavioral avoidance and self-reported fear after treatment. VRET achieved the same long-term results as OST. These results suggest that more extensive trials are needed to evaluate the effectiveness of VRET outside of the clinical setting and to determine the effects of the presence of a therapist on therapy [44].

Tardif et al. (2019) conducted a study with 59 individuals with spider phobia examined with dividing them into three random groups: only visual stimulus presented, visual and tactile stimulus presented or visual, tactile and haptic feedback presented group. Participants' fears were measured with scales such as 'Spider Fear Questionnaire (FSQ)', 'The Self-Efficacy Perception Questionnaire (PSE-SQ). The results indicated a notable link between the reduction in dysfunctional beliefs (especially those about spiders) and the increase in participants' sense of self-efficacy. These findings underline the importance of enhancing self-efficacy and modifying dysfunctional thoughts as key components that drive and influence the success of exposure therapy [45].

Minns et al. (2018) explored the use of 3D exposure-based treatment for individuals with spider phobia. Seventy-seven participants were included in the study, and 87% of participants were female. The findings suggest that patients who experienced the 3D exposure-based treatment therapy showed a significant reduction in their level of spider phobia. Patients who experienced 3D exposure-based treatment rated that treatment as highly immersive compared to the 2D control condition. This study creates realistic VR experiences and emphasizes the potentiality and practicality of VR-based treatment to overcome specific phobias [46].

Michaliszyn et al. (2010) aimed to compare VRET and traditional exposure therapy to determine which one is more effective. The study was conducted with 43 participants; 16 participants took VRET with the virtual spider, 16 participants took in vivo therapy with the real spider, and 11 participants were on the waiting list and did not take any treatment. All of the participants took 90-minute sessions once a week for 8 weeks. Both groups showed a similar significant fear reduction. Both in vivo and in-virtuo exposure are efficient methods of treating spider phobia. With follow-up assessments, 3 months after the treatment, both groups showed permanent improvement [47].

Miloff et al. (2016) aimed to compare gamified VRET with traditional one-session exposure therapy (OST). The study randomly assigned 100 participants to the VRET and OST groups. As a result of the findings, a significant decrease in spider fear and an improvement in the ability to cope with the phobia were observed in both groups. It was observed that gamified VRET was more interesting for the participants, which resulted in increased participation. The study results showed that VRET can be as effective as traditional treatment methods [48].

Shiban et al. (2015) investigated fear reactivation before VR exposure therapy and aims to improve treatment outcomes by reducing fear. Participants were divided into two groups: The reactivation group and the control group. While the reactivation group experienced a virtual spider, the control group experienced a virtual plant. In both groups, within the session, a significant reduction in fear ratings and skin conductance levels was observed. With the spontaneous recovery test (SRT), no return of fear is observed, which means VRET is effective in preventing spontaneous recovery of fear. Treatment was highly effective in reducing phobic fear up to 6 months following treatment [49].

Garcia-Palacios et al. (2007) compared acceptance and refusal rates of VRET vs. in vivo exposure therapy (IVET) by patients with specific phobias such as animal phobias, claustrophobia, social phobia, etc. The study was done with 150 participants. 76% of participants preferred VRET over IVET and only 3% of the participants refused to participate. 90.4% of the participants report that VRET is more attractive, innovative, and easier compared to IVET. 57.7% of the participants preferred the IVET report, arguing that to overcome fear it is necessary to face real objects. In conclusion, VRET is more acceptable to patients with specific phobias compared to IVET [50].

Wilhelm et al. (2005) investigated the mechanisms of VRET, especially the Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS), in contrast to in-vivo exposure therapy (IVET). Behavioral Activation System results show that IVET showed a strong heart rate response, counter to VRET. Behavioral Inhibition System results show that both VR

and IVET evoked strong skin conductance levels. According to these results, further studies are needed to explore VRET mechanisms and if new active motor components could enhance BAS activation [51].

Côté & Bouchard (2005) investigated the effectiveness of VRET in treating arachnophobia. In the study, both objective measures and self-reported outcomes were evaluated for the effect of therapy. At pre-treatment, none of the participants completed the behavioral avoidance test, whereas post-treatment, 60.7% of the participants reached step 9, and 46.4% of the participants completed all ten steps. Also, the fear of spider records decreased from 99.71 to 48.86. In pre-treatment, it was observed that participants' heart rates showed reduced inter-beat intervals, whereas, in post-treatment, heart rates significantly decreased due to reduced physiological arousal and anxiety. These findings prove strong evidence for the clinical application of virtual reality exposure reality in treating specific phobias [52].

Robillard et al. (2003) investigated the levels of anxiety and presence experienced by phobic and non-phobic participants when exposed to therapeutic virtual environments derived from computer games. Phobic participants experienced significantly higher anxiety during VR exposure compared to non-phobic participants. Anxiety was linked to the phobogenic stimuli in the virtual environment, which shows the effectiveness of therapeutic virtual environments derived from computer games (TVEDG). When it comes to presence scores, phobic participants reported significantly higher scores compared to non-phobic participants. As a result of the study, a high level of anxiety correlated strongly with a greater sense of presence in the virtual environments. Studies show that the realism of virtual reality environments is higher than that of non-phobic environments. Minimal sickness was reported by both groups [53].

Garcia-Palacios et al. (2002) conducted a controlled trial to examine the effect of VRET on the treatment of spider phobia. The study was conducted with a total of 23 participants and these participants were divided into two groups; participants in the treatment group and a waiting list control group. Participants in the treatment group were treated with VRET by closely examining, touching, and exposing spiders in a virtual kitchen. The treatment group experienced a significant decrease in fear and avoidance compared to the control group and according to the Behavioural Avoidance Test (BAT) measurement, the treatment group showed a significant improvement compared to pre-treatment. All participants remained in treatment until the end of treatment and 83% showed a significant improvement. Based on these results, it was shown that VRET can be an effective method for the treatment of phobias [54].

Wiederhold et al. (2002) aimed to compare phobic and nonphobic individuals' psychological responses in a virtual reality environment. The skin resistance scale shows that in VR therapy, sweat activity increases, which is a response to anxiety. Study shows that over six VR sessions, 33 out of 36 phobic individuals with fear of flying showed significant anxiety reduction during VR exposure. The remaining individuals were non-responders, they did not show a decrease in skin resistance or anxiety. This shows that success in VR therapy depends on individuals' adaptability to the VR environment [55].

Carlin et al. (1997) included a one-hour VR and tactile exposure therapy application per week for 12 weeks to a female patient who had been afraid of spiders for 20 years. In the first stages of the therapy, the patient was exposed to photographs and plastic models, and when her anxiety slowly decreased, VR therapy was started. As a result of the treatment, the participant's fear of spiders and avoidance reactions in her behaviors also decreased significantly. The fact that the participant's experiences in virtual reality also affected the real world supports the effect of VR therapy [56].

In general, phobia-based studies show that VRET is an effective and acceptable method in the treatment of specific phobias such as spider phobia [39], [47], [52]. In the studies, significant reductions in fear levels were observed in both single-session and multi-session processes [44], [49], [54]. VRET applications not only reduced behavioral avoidance but also strengthened individuals' self-efficacy perception [45]. Gamified or automated versions increased user engagement and made the therapeutic process more motivating [48], [57]. Neuroimaging-based studies have shown that VRET can predict individual responses by influencing signals in the brain associated with trust and threat perception [40]–[42]. Moreover, both subjective assessments and physiological measurements revealed that virtual environments offer a heightened sense of reality, which enhances therapeutic efficacy [53], [55]. The fact that the majority of participants preferred VRET to traditional face-to-face therapy suggests that this method has the potential to reach wider audiences [58], [59].

3.5. Other Disorders

3.5.1. Psychosis

Pot-Kolder et al. (2020) evaluated whether Virtual Reality based Cognitive Behavioral Therapy is cost-effective for individuals with paranoia in psychosis and compares it to treatment-as-usual (TAU). VR-CBT group showed significantly improved social participation with spending time with others. Also, 48% of the patients showed a reduction in momentary paranoia in contrast to TAU, which is 19%. Although VR-CBT's costs are higher than TAU in the short-term, in the Netherlands, it is acceptable considering €80,000/Quality-Adjusted Life Years. To offer VR-CBT to patients with paranoid delusions is an

economically viable however for long-term cost-effectiveness evaluation, further research is needed [15].

3.5.2. Functional Neurological Disorder (FND)

Bullock et al. (2020) aimed to investigate the effectiveness, safety, and applicability of personalized virtual reality-based mirror visual feedback and VRET for functional neurological disorders (FND). The study pre-result showed that with 86% of the completion score, it proves the applicability of the methods. Both groups (VR-MVF, VR-ET, and control group) find VR therapy relaxing and engaging. The study results indicate that VR-based treatments have the potential to target FND symptoms effectively, and with further research, they hold promise as viable treatment methods [60].

3.5.3. Neuropsychological Disorders

Rizzo et al. (2004) examined the potential of VR technology as a tool for neuropsychological assessments and rehabilitation is emphasized. VR technology controls over stimuli and provides insights. VR technology stands out as being ecological since it creates virtual environments realistically. Simulating with VR also helps to create safe environments for patients with risky activities like war areas, driving, extreme heights, etc. Also, gamified elements in VR are a motivation for patients to create new insights for therapy, it also motivates young adults. These findings of the article support VR as an alternative, innovative, and practical approach [61].

Studies in less studied areas such as psychosis, FND, and neuropsychological conditions show that VR-based therapies can be applicable and effective in these disorders [15], [60]. Studies have shown that VR applications not only alleviate symptoms but also increase social interaction, support motor functions, and contribute to the restructuring of cognitive skills [60], [61]. In applications carried out with low-cost or customizable systems, both participation rates and user satisfaction were found to be high [15]. In particular, VR's capacity to create realistic and safe environments shows that it offers a new and flexible tool for clinical interventions. In addition, gamified content and audiovisual interactions made the process more attractive for individuals with low motivation [61]. These findings suggest that VR-based therapies can be considered not only as complementary but also as direct treatment tools in some cases.

4. Conclusion

VR has changed therapeutic approaches by providing an innovative and interactive treatment environment for the field of psychiatry. Unlike traditional methods, VR makes therapy more effective by motivating individuals to actively participate in the treatment process. VR secures the health of individuals by simulating the psychiatric disorder in a safe environment with a realistic scenario. For instance, individuals with social phobia who practiced giving speeches in a simulated meeting room and gradually overcame their fears through VR Exposure Therapy (VRET), experienced reduced anxiety levels and felt more comfortable in social environments, as the therapy supported their desensitization process.

The gamified and interactive nature of VR significantly increases the motivation of patients to participate in therapy, and it has also been observed that receiving instant feedback in VR motivates more. In particular, the personalized scenarios make the treatment process more patient-centered. Thanks to this more individualized therapy, the therapy process was more efficient. It can also be stated that one of the biggest advantages offered by VR is the customized therapy experience. Virtual environments can be adapted according to the individual's needs and responses to therapy, which shows how much more flexible VR is compared to the traditional type of treatment approach, especially for children or individuals with limited access to therapy, VR makes therapy processes more accessible and effective.

Although the existing literature reveals that VR technology is effective in the treatment of psychiatric disorders, there are still important research gaps that need to be addressed. In particular, relapse rates, i.e. whether patients who receive VR treatment re-experience symptoms after a certain time, have not been sufficiently analyzed. More comprehensive studies on the long-term effectiveness and durability of VR-based interventions are needed.

However, although VR therapies have positive results in many patients, they carry various side effect risks for some individuals. Symptoms similar to motion sickness in virtual environment called 'cybersickness' may cause negative effects such as dizziness, nausea, and eye fatigue in individuals who spend a long time in a virtual environment [62]. In which patient groups these symptoms are more common, how their severity varies among individuals, and strategies to minimize these effects have not been adequately addressed in the literature.

In addition, lack of expert training is an important factor limiting the dissemination of VR therapies in clinical practice. Psychologists and therapists need to attend special training programs in order to use VR technology effectively. However, the lack of such training programs and limited guidelines for the integration of VR into clinical protocols could make the applicability of therapy processes difficult. In this context, the standardization of VR-based psychotherapies and the development of comprehensive training programs for therapists are among the main issues to be addressed in future research. Most of the studies reviewed were limited to small sample groups. Larger and longer-term

studies should be conducted to more clearly understand the impact of VR-based treatment management.

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