

The acceptance of virtual reality exposure therapy by mental healthcare patients:
A scoping review

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Abstract

Introduction: The use of technology in mental healthcare has been gaining more recognition over the past years. This review focuses on the technology virtual reality (VR), that can be used during exposure therapy. When VR is added to exposure therapy it is called virtual reality exposure therapy (VRET). This type of therapy can be used on patients with anxiety- and trauma- and stressor related disorders. The acceptance of this type of therapy has not been explored yet and therefore the aim of this scoping review is to find out what the main findings are about this topic that can be found in scientific literature. **Methods:** Articles were searched using three different databases: Scopus, Web of Science and psycINFO (EBSCO). The snowballing method has also been used to search for relevant literature. Eleven studies were included in this review after an extensive screening process. The studies were analyzed to explore what type of mental health problems were being treated, what type of VR was used in the study (immersive, semi-immersive or non-immersive), what measurement instruments the studies used to assess acceptance and what the acceptance of VRET was according to patients. **Results:** The data from the selected studies was summarized and presented in tables. Seven out of eleven studies used a sample of patients with some type of anxiety disorder (e.g. fear of flying, spider phobia and panic disorder). Six studies used an immersive type of VR in their study using an HMD. Three used a semi-immersive VR system and only one study used non-immersive VR. Seven studies used a quantitative research method, where two used mixed methods and two used a qualitative approach. The expectation and satisfaction questionnaire, CSQ-8 and the SUS were used as quantitative measurements. Qualitative measurements included opinion sheets and interviews. All studies using a questionnaire showed a high level of acceptance of VRET. The qualitative data showed that patients experienced positive effects from the VR treatment. **Discussion:** The results from quantitative measurements of VRET acceptance are in line with similar research from different kind of patient groups. The way acceptance is measured may need some improvement according to research due to the complexity of the concept. Future research would be advised to develop a dimensional measurement instrument on VR acceptance by patients. This review showed that patients seem to accept VRET as a treatment, however research about other factors that influence the adoption of VR in the mental healthcare still needs to be done in order to bring VRET into clinical practice.

Keywords: virtual reality exposure therapy, acceptance, anxiety, trauma- and stressor related disorder, mental health patient, review

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Introduction

The use of technology in mental healthcare has increased tremendously over the past years (Tal & Torous, 2017). Technologies used in mental healthcare include; electronic patient records, mobile apps, virtual reality (VR) and telepsychiatry by means of videoconferencing, e-mail or chat. This review focuses on the use of virtual reality exposure therapy (VRET) for mental healthcare patients. Research shows the effectiveness of virtual reality as a treatment for a number of different mental health problems (Riva & Serino, 2020; Grochowska, Jarema & Wichniak, 2019; Freeman et al., 2017). VRET is mostly used on patients that require exposure as part of their therapy, this is often included in cognitive behavior therapy (CBT). Exposure helps patients slowly get used to their feared stimuli or situation, which reduces the anxious reaction (Abramowitz, Deacon & Whiteside, 2019). However, not many studies investigated the acceptance of virtual reality by their users. To explore this gap in literature, this scoping review aims to explore the main findings in scientific literature about the acceptance of virtual reality treatment by patients in order to provide an overview of the existing research on this topic. This review explores which mental health problems are treated by means of VRET, what type of VR is used in the treatment and what measurements are being used to assess acceptability of these treatments. Furthermore, the mental healthcare patients' acceptability of VRET is being mapped out. Finally, this review intends to guide future research and considerations for implementation of virtual reality in mental healthcare.

Mental health problems

The use of VR in treatment is most common for anxiety disorders and trauma- and stressor-related disorders (Gonçalves, Pedrozo, Coutinho, Figueira & Ventura, 2012; Opreș, Pinte, García-Palacios, Botella, Szamosközi & David, 2012). Anxiety disorders are among the most common mental health problems in the world. Anxiety disorders include panic disorder with or without agoraphobia, generalized anxiety disorder (GAD), social anxiety disorder, specific phobias, and separation anxiety disorder (American Psychiatric Association, 2013). Over a third of the population will be affected by an anxiety disorder during their lifetime (Bandelow & Michaelis, 2015). According to the diagnostic and statistical manual of mental disorders (DSM-5), trauma and stressor-related disorders include disorders such as posttraumatic stress disorder (PTSD), acute stress disorder and adjustment disorders (AD) (American Psychiatric Association, 2013). Trauma and stressor-related disorders have in common that exposure to a traumatic or stressful event is required as a diagnostic criterium (Benedek, 2018). The lifetime

prevalence of PTSD varies widely from 1-9% in western countries up to 37% in (post) conflict countries (Knipscheer et al., 2020). Both mental disorders cause significant distress and impact the quality of life.

Mental health treatment

Both anxiety disorders and trauma- and stressor-related disorders are often treated with cognitive behavior therapy (CBT), where cognitive and behavior therapy are combined. CBT is found to be very effective for treating anxiety disorders (Hofmann & Smits, 2008). CBT with a trauma focus (CBT-TF), such as prolonged exposure (PE), is one of the evidence-based treatments for PTSD (Bisson & Olff, 2021). Exposure therapy helps anxiety patients approach and interact with their feared stimuli such as spiders (arachnophobia), heights (acrophobia), physiological stimuli (panic disorder) (Abramowitz, Deacon & Whiteside, 2019). By repeatedly exposing a patient to their feared stimuli the anxious response will extinguish. This is accomplished in several steps, described by Rahman and colleagues (2013). First, a hierarchy of feared stimuli of the patient is developed. Second, the patient is encouraged to expose themselves to the least feared stimuli to ensure success. The exposure will be repeated until the patient will show no anxious response. Third, the patient is repeatedly exposed with increasingly feared stimuli as therapy moves on.

Prolonged exposure teaches trauma patients to gradually approach themselves to trauma-related memories, emotions and situations. PE consists of both imaginal exposure and exposure in vivo. Imaginal exposure tackles the traumatic memory by letting the patient talk about the traumatic event and tries to relive the trauma in their mind. Exposure in vivo tries to expose the patient to the avoided situations (Hembree, Rauch & Foa, 2003).

Exposure-based cognitive behavioral therapy is proven to be a very effective treatment for anxiety disorders (Deacon & Farrell, 2013). Despite, the demonstrated effectiveness of exposure-based CBT, Hipol and Deacon (2013) found that only 19-33% of anxiety disorder patients received therapist-assisted exposure in vivo, which is the golden standard for this type of therapy (Heimberg & Becker, 2002).

Even though exposure-based therapy is very well known for its effectiveness, it also has some barriers. For example, therapist-assisted exposure in-vivo could be hard to arrange outside the office as it can be very time-consuming and therefore costly. Another option is for the patient to do the exposure in-vivo at home, but this also comes with the potential risk of avoidance. Patients must have a lot of motivation and perseverance in order to conduct these exposures by themselves (Boeldt, McMahon, McFaul & Greenleaf, 2019; Bouchard et al.,

2017). These barriers can cause patients to experience too much distress from exposure therapy and drop out (Deacon & Farrell, 2013).

Virtual reality exposure therapy

The most promising feature of VR in mental healthcare is simulation, because of that feature it can be a perfect tool for behavioral and cognitive learning in the clinical practice (Riva, 2022). VR is a set of collaborating technologies; a device (e.g. smartphone or computer) which provides the virtual environment, and some type of controller (e.g. joystick, electronic gloves or a keyboard) for the person to interact with the virtual environment. This type of VR is called non-immersive VR. It makes use of a two dimensional (2D) virtual environment which could make it harder for a person to feel a sense of presence (Shahrbanian et al., 2012). Non-immersive VR often makes use of a screen by means of a computer or a smartphone. The second type of virtual reality is immersive VR, which adds a head-mounted display (HMD) to the collaborating technologies (Parsons, Gaggioli & Riva, 2017). The HMD offers a three dimensional (3D) virtual environment and tracks the persons head and eye movement which makes the person feel more present in the virtual environment. This fully immersed experience might also cause some side effects such as cybersickness, which leads to nausea and headaches (Weech, Kenny & Barnett-Cowan, 2019). The third type of VR is called semi-immersive VR and can be placed in between the first two types of VR. A semi-immersive VR system uses a large wall-projected screen in front of the user instead of the HMD. Because of the large screen, the user will feel almost just as present in the virtual environment as with immersive VR (Kyriakou, Pan & Chrysanthou, 2017).

When VR is added to exposure therapy, it is called Virtual Reality Exposure Therapy (VRET) (Grochowska, Jarema & Wichniak, 2019), this therapy can make a person experience exposure in a virtual environment. Because this environment is computer-generated it has a lot of different possibilities in contrast to real-world exposure (Riva, 2022). The main benefits to VRET are the engagement with the intervention and the amount of control the psychologist and patient have using VRET. Engagement refers to the way a person is involved in something. VR has a few ways of making the user feel engaged. First, the more immersion is used, such as the HMD, the more sense of presence the user experiences, meaning the person will actually feel as if they are in that virtual environment. This is especially useful in the treatment of stress- and trauma related disorders because PTSD patients are not able to avoid being exposed to the traumatic event, which is often a problem with imaginary exposure and can decrease treatment success (García-Palacios, Botella, Baños, Guillén & Navarro, 2015).

Second, VR offers a person to interact with the virtual environment as if it is a real situation such as communication between avatars (e.g. social situations) and picking up things (e.g. spiders). Both immersion and interaction make sure a person will feel engaged with the VR treatment, which could lead to a higher treatment adherence (Riva, 2022). VRET also offers a great amount of control to the situation that is created in the virtual environment. For example, it is possible to adjust the amount and the size of spiders in the situation, making it also easier to do gradual exposure. Next to that, the psychologist is able to see exactly what the patient is experiencing in the virtual environment. The control in VRET also helps the therapist to create a safe and positively framed situation for the patient, which is during one of the first exposure sessions important for the success of the session (Balzarotti & Ciceri, 2014).

Attitudes towards VRET

VRET might be a solution to the problems held with conventional exposure therapy, but what do psychologists, and even more important, patients think about this innovation in mental healthcare? Psychologists seem hesitant about the use of technologies in mental healthcare but can also see the opportunities. In 2018, a study by Feijt, de Kort, Bongers and Ijsselstein (2018) researched the view on these technologies by psychologists. The researchers found that psychologists were still very hesitant to use these technologies due to their lack of knowledge and experience with them. Because of the fast-growing development of new technologies and tools, psychologists are often not aware of their existence and their applicability into treatment. Only a few psychologists expressed their enthusiasm towards the use of technologies in their practice. The new treatment possibilities such as the use of virtual reality and biofeedback makes it possible to treat patients in new and innovating ways that were previously not possible. The outbreak of the COVID-19 pandemic required almost all psychologists to rearrange their mental healthcare delivery and they were forced to make use of digital technologies, such as videoconferencing. A study by Guinart and colleagues (2021) reported that mental healthcare workers have a very positive attitude towards the use of telepsychiatry and would like to keep using it for around 25% of their caseload. Flexible scheduling and rescheduling and a quick start of the session were reported as advantages for videoconferencing. These findings suggest that because of the covid-19 outbreak the attitudes towards the use of technologies in mental healthcare delivery has changed positively (Pierce, Perrin, Tyler, McKee & Watson, 2020).

Attitudes towards VRET seems to be in line with the attitudes towards other technologies in mental healthcare, positive but still not frequently used in practice. A study by Lindner and colleagues (2019) researched the attitude of CBT therapists towards VRET and

found that the therapists show a positive attitude towards VRET. The therapists are especially positive about the applications of VR in mental healthcare. For example, it makes it possible for the therapist to precisely control and tailor the exposure stimuli. Even though therapists seem to have a positive attitude towards VRET, 86% of them have no experience using VR in a clinical setting.

Patients are also still hesitant about the use of technology in mental healthcare and still prefer face-to-face interventions with a therapist. Unguided e- mental health programs are perceived as least helpful to patients. Therapist-assisted e-mental health services are more accepted, but the majority of people prefer face-to-face psychological interventions (Apolinário-Hagen, Kemper & Stürmer, 2017).

Patients attitude towards VRET are conflicted. A study found that 76% of patients with a specific phobia are willing to try VR-based exposure therapy, whereas 23.7% prefers conventional in-vivo exposure (Garcia-Palacios, Botella, Hoffman, & Fabregat, 2007). 90.4% of those who preferred VRET chose it because they think in-vivo exposure is too confronting and threatening, where VR might be a less frightening first step. An additional 4.1% chose VRET because it might be very hard to control a feared situation with in-vivo exposure. Another 4.1% chose VR over in-vivo exposure because they thought it was innovative and attractive. Another study, researching the therapy preferences of PTSD patients, found that conventional PE was preferred over VRET due to the possibility of PE being able to address both combat and non-combat related PTSD (Schumm, Walter, Bartone & Chard, 2015).

These findings show that the barriers of in-vivo exposure might be solved with VRET according to patients, but this might not be true for imaginary exposure that is used in PE.

Current study

The aim of this scoping literature review was to explore the previous studies that included mental healthcare patients' acceptance of VRET. Studies that are reviewed researched the use of VRET on patients with all type of anxiety disorders and trauma- and stressor related disorders. Next to that, different types of studies are reviewed, such as case studies, quantitative studies, qualitative studies including interviews and/or focus groups and mixed methods studies that combine quantitative and qualitative research. The research questions will help guide the literature review. The research questions focus on studies that researched the acceptance of VRET by mental health patients.

1. Which mental health problems are being treated with VRET?
2. What type of VR is used in the treatment? (immersive, semi-immersive or non-immersive)
3. What measurements are being used to assess acceptance?
4. What is the acceptance of mental health patients of VRET?

Methods

In this literature review a scoping method was used. A scoping literature review tries to assess the size and scope of available literature of a specific topic. Next to that, it helps analyse the nature and extent of the available studies (Grant & Booth, 2009). The rationale for using a scoping method for the subject of this thesis is that there exist many meta analyses and other literature reviews about the efficacy of VRET but very little about VRET from the patients' point of view. A scoping review is broad in nature because its intention is to summarize the breadth of the topic. However, Levac and colleagues (2010) discuss that a scoping review needs clear and focused research questions as well in order to determine the direction of the review. This scoping literature review was conducted conforming to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMA) guidelines (Page et al., 2021).

Search strategy and selection criteria

Concerning the search strategy, three electronic databases were searched; Scopus, Web of Science and psycINFO (EBSCO). The choice has been made to use two more broad databases and one that is specifically focussed on literature regarding social and behavioural sciences. All three electronical databases make use of Boolean operators in order to make the search functional. The search term Virtual Reality Exposure Therapy were used as well as the abbreviation VRET. In order to find relevant literature about patients' acceptance of VRET multiple synonyms were used. Next to that, the search term patient and synonyms were used in combination with the synonyms for acceptance to make the search more specific. Finally, relevant terms relating to anxiety disorders and trauma- and stressor related disorders were added to the search. The selected terms that are used during the search in all three databases of this literature review were: ("*Virtual Reality Exposure Therapy*" OR *vret*) AND (*opinion* OR *attitude* OR *acceptance* OR *acceptability* OR *perspective* OR *experience* OR *perception* OR *viewpoint* OR *view* OR *preference*) W/7 (*patient** OR *client**) AND (*psychotherap** OR "*mental health*") AND (*anxiety* OR *phobia* OR *ptsd* OR "*post traumatic stress disorder*" OR *trauma*)

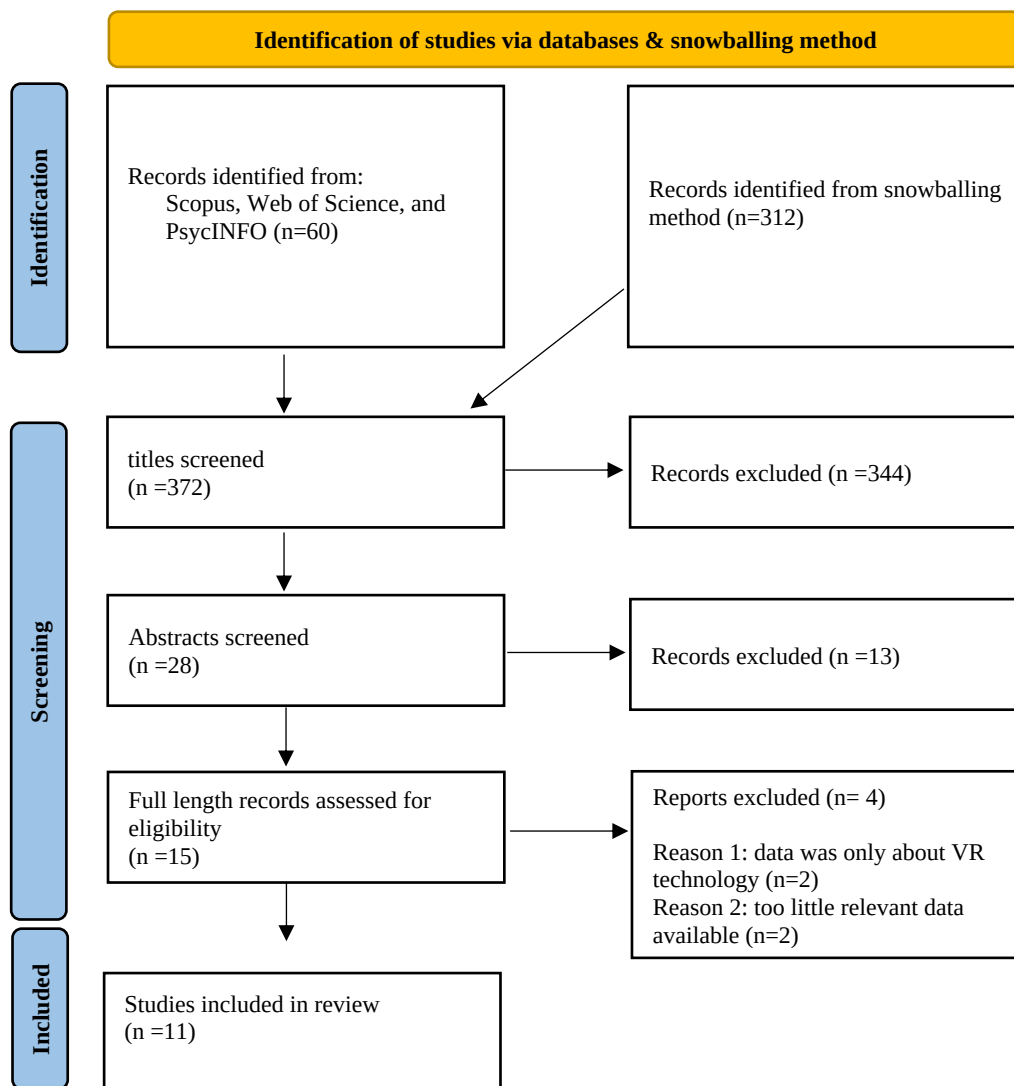
In addition, the snowballing method is used, where references within found literature is used to find relevant literature for this review (Wohlin, 2014). Wohlin (2014) describes backward and forward snowballing. Backward snowballing refers to identifying new papers by using the reference list of a scientific paper. Forward snowballing refers to identifying new

papers by finding papers citing a specific paper. The ladder can be done using Google Scholar. Both backward and forward snowballing methods were used as a search strategy.

Inclusion and exclusion criteria were developed in order to make the identification of scientific literature as specific as possible. First, the language of the papers was either in English or Dutch, other languages were excluded. Second, papers from the time period 2006 to 2021 were considered, papers outside this timeframe were excluded because of the fast development of technology. Third, types of articles that were included are original research that is published in a peer reviewed journal, dissertations were excluded. Fourth, the participants of the studies must be diagnosed with a mental health disorder as described in the DSM 5 or DSM-IV, studies with participants without a mental health disorder were excluded. Fifth, the participants of the studies must be over 18 years old as this review focuses on adults.

Studies found were screened using the following steps. First the papers were screened by reading the title. The second step was to screen the papers by reading the abstract. The third step was to read the full paper and determine the usability by taking the inclusion and exclusion criteria into account. Every step, irrelevant articles were excluded from the review. Figure 1 illustrates the process of the article selection in this research.

Figure 1. PRISMA flow diagram for article selection



Procedure and analysis

The studies included in this review were fully read and analysed in order to answer the research questions. The main aim of this review was to explore the acceptance of VRET by mental health patients. First, it was investigated which mental health problems are being treated using VRET. Table 1 shows specifically which type of anxiety disorder or trauma- and stressor related disorder are being treated with VRET in the studies included in this review. Next to that, table 1 shows other characteristics about the studies in order to gain insight in the type of samples being used for these studies. Characteristics such as gender and age are also shown in table 1.

The second research question was to investigate the type of VR that is used in these studies. Table 2 shows what intervention was used in the studies and what type of VR system was used. The VR systems were categorized immersive, semi-immersive or non-immersive.

Immersive VR can be identified by the use of an HMD. Semi-immersive VR uses a large wall-projected screen and non-immersive VR uses just a computer or smartphone screen.

Further, it was explored what measurement were being used to assess acceptance. Table 3 shows what measurement instruments were used in the studies. Additionally, the research method was mentioned and if acceptance was the primary or secondary outcome measure of the study.

The last exploration of this scoping review was the acceptance of mental health patients of VRET. Table 4 shows the quantitative data from the studies that used a quantitative measurement instrument to assess acceptance. Per author it is shown which instrument is used and at what the moment(s) of assessment were. Most important, the results are shown using mean scores and standard deviations. Table 5 shows the qualitative data from the studies that used a form of qualitative data. Existing themes and codes were investigated and formed into new codes that represent the essence. The definition of the new code was presented as well as examples and quotes.

Results

Participant characteristics

Eleven studies were included in this scoping review. Table 1 shows the participant characteristics. Seven out of the eleven studies had a sample of patients with some sort of anxiety disorder. The anxiety disorders researched in this review were panic disorder with agoraphobia (n=2) and different types of specific phobias such as fear of flying (n=2), spider phobia (n=2) and acrophobia (n=1). Four out of the eleven studies had a sample of patients with a trauma- and stressor related disorder. Two studies specifically used a PTSD sample and the remaining two studies used a mix of PTSD, adjustment disorder and pathological or complicated grief. The sample size of the studies ranged from 4 to 193. Every study but one had a majority of females in their sample. One study has a large male sample which consisted of military veterans.

Table 1. Participant characteristics

	Authors	Mental health problem	Sample size	gender	Mean age (SD)
1	Baños et al. (2009)	PTSD, Adjustment disorder and pathological grief	19	68.42% female	n.a.
2	Beck, Palyo, Winer, Schwagler & Ang (2007)	PTSD	8	87.5% female	49.5 (7.03)
3	Botella et al. (2014)	Fear of flying (specific phobia)	4	75% female	36 (7.53)
4	Botella et al. (2007)	Panic disorder and agoraphobia	37	70.3% female	34.7 (12.31)
5	Campos et al. (2018)	Fear of flying (specific phobia)	46	69.57% female	37.59 (11.13)
6	Donker et al. (2019)	Acrophobia (specific phobia)	193	66.84% female	41.33 (13.64)
7	Guillén, Baños & Botella (2018)	PTSD, complicated grief and adjustment disorder	50	n.a.	n.a.

8	Kramer, Savary, Pyne, Kimbrell & Jegley (2013)	PTSD	14	14.29% female	32.9 (7.8)
9	Lindner et al. (2020)	Spider phobia (specific phobia)	7	86% female	36.29 (13.38)
10	Quero et al. (2014)	Panic disorder and agoraphobia	29	79.3% female	32.79 (8.28)
11	Rothbaum et al. (2006)	Panic disorder and agoraphobia	83	80% female	n.a.

Study characteristics

Table 2 summarizes the study characteristics of the studies used in this scoping review. A variety of different research design was used by the studies. Most of the studies (n=8) only used VRET as the intervention in their study. Three studies chose to compare VRET to in-vivo exposure therapy (IVO). the amount of VRET sessions varied a lot from as low to two 3-minute sessions to as high as eight 90-minute sessions. Most studies (n=6) chose to use immersive VR by means of an HMD. Three studies used semi-immersive VR where a large wall-projected screen was used. Only one study used non-immersive VR and one study did not specify what type of VR was used in their research.

Table 2. study characteristics

	Authors	research design	intervention	VR type
1	Baños et al. (2009)	Quasi-experimental design	VRE treatment: EMMA's world	Semi-immersive
2	Beck, Palyo, Winer, Schwagler & Ang (2007)	Uncontrolled case study	2 psychoeducation sessions + 8 90-minute long VRET sessions	Semi-immersive
3	Botella et al. (2014)	Alternating treatment design	3 VRET sessions + 3 VRET+CR sessions	Immersive
4	Botella et al. (2007)	CCT	2 psychoeducation sessions + 7 VRE sessions vs 7 IVO sessions vs WL	Immersive
5	Campos et al. (2018)	RCT	Internet-based exposure treatment: NO-FEAR Airlines	Non-immersive

			self-applied vs therapist-assisted	
6	Donker et al. (2019)	RCT	VRE treatment: ZeroPhobia app vs WL	Immersive
7	Guillén, Baños & Botella (2018)	Mixed methods	VRE treatment: EMMA's world	Semi-immersive
8	Kramer, Savary, Pyne, Kimbrell & Jegley (2013)	Mixed methods	2 3-minute VRET sessions	n.a.
9	Lindner et al. (2020)	Qualitative study	1 3-hour VRET session using the Itsy app	Immersive
10	Quero et al. (2014)	Between-group design	VRE session (50- minutes) vs IVO session (25-minutes)	Immersive
11	Rothbaum et al. (2006)	CCT	4 psychoeducation sessions + 4 VRE session vs 4 psychoeducation sessions + 4 IVO sessions vs WL	Immersive

Measurements

Table 3 shows the measurement instruments used by each study in this scoping review. Most of the studies (n=7) used a quantitative research method to research acceptance. Two studies used a mix of quantitative and qualitative measurements. Six studies using a quantitative measure for acceptance decided to use an expectations and satisfaction questionnaire using the Borkovec and Nau (1972) guidelines. The other two quantitative measures used were the System Usability Scale (SUS) and the Client Satisfaction Questionnaire (CSQ-8). Two studies did solely a qualitative interview about the VR exposure treatment. The other qualitative measure used was an opinion sheet for participants to write their opinion freely. Further, six studies researched the acceptance of VRET by mental health patients as a primary objective and five studies as a secondary objective.

Table 3. Acceptance measures

	Authors	Research method	Outcome measure	Acceptance measurement instrument(s)
1	Baños et al. (2009)	Quantitative	Secondary	Expectations and satisfaction questionnaire following the Borkovec and Nau (1972) guidelines
2	Beck, Palyo, Winer, Schwagler & Ang (2007)	Quantitative	Secondary	Client Satisfaction Questionnaire (CSQ-8) by Larsen, Attkisson, Hargreaves & Nguyen (1979)
3	Botella et al. (2014)	Quantitative	Primary	Session opinion questionnaire following the Borkovec and Nau (1972) guidelines
4	Botella et al. (2007)	Quantitative	Secondary	Expectations and satisfaction questionnaire following the Borkovec and Nau (1972) guidelines
5	Campos et al. (2018)	Quantitative and qualitative	Primary	Expectations and satisfaction questionnaire following the Borkovec and Nau (1972) guidelines, Usability and Acceptability Questionnaire adapted from the System Usability Scale (SUS) by Brooke (1996) and a qualitative interview with 10 questions about usefulness of exposure scenarios, fixed pictures, sounds, psychoeducation, overlearning and the opinion about receiving support or not
6	Donker et al. (2019)	Quantitative	Secondary	System Usability Scale (SUS) by Brooke (1996)
7	Guillén, Baños & Botella (2018)	Quantitative and qualitative	Primary	Expectations and satisfaction questionnaire following the Borkovec and Nau (1972) guidelines and an opinion sheet for the participants to write freely about the treatment

8	Kramer, Savary, Pyne, Kimbrell & Jegley (2013)	Qualitative	Primary	Qualitative interview about VR as a screening tool for PTSD and VR as a treatment tool for PTSD, participants were asked to rank VR on a 5-point scale ranging from very unacceptable (1) to very acceptable (5)
9	Lindner et al. (2020)	Qualitative	Primary	Semi-structured interview about the treatment expectations, psychoeducation, problems and glitches of the app and the outcome of the VR treatment
10	Quero et al. (2014)	Quantitative	Primary	Expectations and satisfaction questionnaire following the Borkovec and Nau (1972) guidelines
11	Rothbaum et al. (2006)	Quantitative	Secondary	Client Satisfaction Questionnaire-8 (CSQ-8) by Larsen, Attkisson, Hargreaves & Nguyen (1979)

VRET acceptance

Table 4 shows the quantitative results from all the studies that used a quantitative measurement to assess acceptance of VRET. The studies (n=6) that used a Borkovec and Nau (1972) questionnaire all show a high level of satisfaction when looking at the post-treatment results only. All but one study show means scores for the post-treatment between 8 and 10. Two studies used the CSQ-8 and both show a high satisfaction level among their participants. Where 32 was the highest means score, both studies results were above a mean of 29. Another two studies used the SUS to inspect acceptance of VRET. Both studies show a high level of acceptance according to their scores. One study was classified ‘good’ and the other as ‘excellent’ according to Bangor and colleagues (2008).

Table 4. quantitative VRET acceptance results

Authors	Measurement instrument	Moment of assessment	Results
Baños et al. (2009)	Borkovec and Nau (1972) Questionnaire	Pre- and post-treatment	Mean between 7-8 pre-treatment, 8-9 post-treatment (0-10 scale)
Botella et al. (2014)	Borkovec and Nau (1972) Questionnaire	End of each treatment session	Total mean between 8-9 (0-10 scale)
Botella et al. (2007)	Borkovec and Nau (1972) Questionnaire	Pre-, post-treatment and 12-month follow-up	Mean between 8-9 pre-treatment, 8-10 post-treatment, 8-10 follow-up (0-10 scale)
Campos et al. (2018)	Borkovec and Nau (1972) Questionnaire	Pre- and post-treatment	Mean between 7-9 pre-treatment, 6-9 post-treatment (0-10 scale)
Guillén, Baños & Botella (2018)	Borkovec and Nau (1972) Questionnaire	Pre- and post-treatment	Mean between 7-9 pre-treatment, 8-10 post-treatment (0-10 scale)
Quero et al. (2014)	Borkovec and Nau (1972) Questionnaire	Pre- post-treatment and 3-month follow-up	Mean between 8-10 pre-treatment, 9-10 post-treatment, 9-10 follow-up (0-10 scale)
Beck, Palyo, Winer, Schwagler & Ang (2007)	CSQ-8	1-month post-treatment	Mean=31, SD=0.89 (8-32 scale)

Rothbaum et al. (2006)	CSQ-8	Post-treatment	Mean=29.56, SD=3.39 (8-32 scale)
Campos et al. (2018)	SUS	Post-treatment	Mean=75.35, SD=14.74 (0-100 scale)
Donker et al. (2019)	SUS	Post-treatment	Mean=86.44, SD=10.81 (0-100 scale)

Four studies decided to use a qualitative method to assess the acceptance of VRET by their participants. Three studies used an interview as their method and one study an opinion sheet. Campos and colleagues (2018) used an interview to ask their participants 9 questions about the usefulness of their program that they had to rate on a scale of 1 (very little) to 5 (very much) and one dichotomous question (yes or no), which is actually a quantitative method. Patients did have the opportunity to elaborate on their answers if they wanted to, which is considered qualitative. Quantitative results show that all VR program components, such as exposure scenarios, fixed pictures, sounds and overlearning, were rated as useful. Over 70% of participants would like access to the program to use in the future for themselves at home. Participants elaborated that they would prefer 360° view images or videos instead of a fixed picture.

The remaining three studies did a qualitative analysis. Table 5 shows the original themes and codes used in the studies. Themes that were similar in all studies were investigated. New codes were identified, and were given their definition accompanying with examples and quotes from each study. The code ‘perceived immersion’ was identified from similar original codes from the studies. Participants from all three studies illustrated that they felt like the VR experience felt real to them. The code ‘treatment effects’ was identified from similar original codes from the studies. Patients described that they felt less anxious and have less flashbacks than before treatment.

Table 5. Translation of original codes into new codes from the studies with qualitative data

Original themes and codes	New codes	Definition	Examples and quotes
- Re-experiencing the experience through the virtual system - Immersion - Content / technology - Becoming absorbed	Perceived immersion	The way patients experience their traumatic/feared experience through VR	- “Photographs helped me to place myself in the event and relive the accident” (Guillén, Baños & Botella, 2018) - “I know my heart rate went up, I could tell that, probably more than it did when I was actually there” (Kramer, Savary, Pyne, Kimbrell & Jegley, 2013) - “The sounds in it and everything were dead-on, so I was impressed with that, really impressed” (Kramer, Savary, Pyne, Kimbrell & Jegley, 2013) - “Ehm, it wasn’t real spiders, you know, but at the same time, it felt very scary because they, it’s similar to how they behave in real life” (Lindner et al., 2020)
- Change (emotional change, coping, relief, cognitive change) - Benefits - Treatment	Treatment effects	The positive effects of the VR treatment according to patients	- “Not as many memories come to my mind like before, and images come and go; they do not hurt; I’m not scared” (Guillén, Baños & Botella, 2018) - Patients stated to be less anxious, less attentive to fears, have increased knowledge and seeing thing differently (Lindner et al., 2020) - “Every time you did it then it’d just be less, you’d be more numb to it, I guess” (Kramer, Savary, Pyne, Kimbrell & Jegley, 2013)

Discussion

This scoping review aimed to explore the main findings in scientific literature about the acceptance of virtual reality treatment by mental healthcare patients. The first research question was to figure out which mental health problems are being treated with VRET in the studies focusing on acceptance of VRET. This scoping review concludes that most of the research done in this field focus on treating different kinds of anxiety disorders with VRET. The remaining studies focused their research on using VRET on trauma- and stressor related disorders. It is not surprising that most research used VRET on anxiety patients because it is still believed that exposure, as part of CBT, is the gold standard to treat anxiety disorders (Wechsler, Kümpers & Mühlberger, 2019). This does not seem the case for the treatment of trauma- and stressor related disorders, as they can be treated with many other evidence-based treatments other than prolonged exposure, such as EMDR and trauma focused CBT (Bisson & Olff, 2021). Furthermore, this study did not focus on any other mental health problems that are also being treated with VR, such as schizophrenia, depression, substance disorders and eating disorders (freeman et al., 2017). Research shows that even in forensic mental healthcare, where people often have comorbidities and other difficulties, there are great opportunities with the use of VR in treatment (Kip, 2021).

The second research question intended to find out what type of VR the studies in this particular field were using in their research. Almost half of the studies using VR, used immersive VR during their research, whereas three used semi-immersive VR and only one study non-immersive VR. Research shows that immersive VR gives the user the most sense of presence in the virtual environment (Shahrbanian et al., 2012). On the contrary, Tortella-Feliu and colleagues found that more sophisticated immersive conditions (e.g. a larger screen projection) did not resulted in better treatment results. Nevertheless, both studies suggest that this topic needs further investigation.

The third research question tried to find out which measurement instruments the studies in this review used to assess acceptance of VRET. Six studies used an adapted version of the expectation and satisfaction questionnaire by Borkovec and Nau (1972). This questionnaire originally intends to assess credibility and expectancy for improvement by therapy. The questionnaire has questions such as ‘how logical does this type of treatment seem to you?’ and ‘How successful do you feel this treatment would be?’. The scale shows to possess a high internal consistency with a Cronbach’s alpha between 0.84 and 0.85 for the entire scale (Deville & Borkovec, 2000). Two studies in this review used the CSQ-8 and two other studies the SUS

to assess acceptance of VRET in their study (Larsen, Attkisson, Hargreaves & Nguyen, 1979; Brooke, 1996). The CSQ-8 contains questions such as ‘Overall, how satisfied are you with the service you received?’ and ‘If a friend needed similar help, would you recommend this to a friend?’. CSQ-8 has a high internal consistency with a Cronbach’s alpha of 0.92 (De Wilde & Hendriks, 2005). SUS has questions such as ‘I felt very confident using the system’ and ‘I thought the system was easy to use’. This questionnaire shows high internal consistency with a Cronbach’s alpha of 0.91 (Bangor, Kortum and Miller, 2008). Questions in both questionnaires can be adapted to fit you a specific type of treatment, such as VRET.

The questionnaires that are used by the studies in this review seem to have good psychometric properties and do seem to measure a form of acceptance. But these questionnaires also have a downside, they only focus on one side of acceptance. The questionnaire by Borkovec and Nau (1972) specifically focusses on patient satisfaction, just like the CSQ-8. The SUS has a specific focus on usability. When looking at the Technology Acceptance Model (TAM) by Davis (1986), multiple aspects are considered with technology acceptance and eventually actual use. The model suggests that perceived usefulness and perceived ease of use determines use acceptance. The model has been updated and tailored to specific technologies many times (e.g. TAM2, TAM3 and UTAUT). However, TAM still has been the model that is used most in research about users’ technology acceptance (Lei, 2017). A study by Abu-Dalbouh (2013) on technology acceptance of patient progress applications suggests that more factors are related to technology acceptance by patients such as user satisfaction and attribute of usability. Another study by Mütterlein & Hess (2017) found even more factors to be of influence on VR acceptance and adapted and built a multi-level framework. They suggest that the baseline model includes factors such as individual beliefs (e.g. immersion, presence and perceived ease of use), the baseline model is influenced by higher-level contextual factors such as environment attributes (e.g. isolation and distraction) and individual-level contextual factors such as user attributes (e.g. age and personality traits). This shows how complex technology acceptance actually is. Therefore, it might be use useful for studies that research the acceptance of technology in mental healthcare to consider that acceptance is such a complex construct that cannot be measured with only one questionnaire. It might be a good idea for studies to use multiple questionnaires to assess acceptance or use a questionnaire based on a model that includes multiple factors of acceptance, such as the TAM model or an adapted version.

Two studies in this review used next to a quantitative measurement instrument also a qualitative method to invest the acceptance of VRET such as an opinion sheet or an interview. Two studies only used a qualitative approach by means of an interview. Interview questions

were very different in each study but all intended to find out the opinion of the patients on the VR treatment they received.

The last and most important research question was ‘what is the acceptance of mental health patients of VRET?’. Looking at the quantitative results from the three different questionnaires used in the nine different studies, all came out very positive with high scores. Patients seem to find the VR treatment to be successful and are satisfied with their results. Botella and colleagues (2015) did a small literature review on VRET acceptability by PTSD patients and found very similar results to this review. Another study by Garcia-Palacios and colleagues (2007) showed that VRET is even more easily accepted by anxiety patients than in-vivo exposure. Further, research shows that the acceptance of VR treatment is high amongst other patient populations, such as psychosis and the medical condition fibromyalgia (Herrero, Garcia-Palacios, Castilla, Molinari & Botella, 2014; Rus-Calafell, Garety, Sason, Craig & Valmaggia, 2018).

Results from the qualitative analysis produced two new codes that were represented in three studies. ‘Perceived immersion’ relates to the way a person felt like the VR experience was real to them and ‘Treatment effects’ which focuses on the positive effects the VR treatment brought to the patients. These results show that perceived immersion and the positive effects the treatment had, have an influence on the acceptance of VRET. When comparing these results to other studies very similar codes come up. However, next to the similarity there is also a lot of variety of codes among other studies. For example, a study on virtual reality in nursing education found similar results, factors that show acceptance were the features of VR (e.g. immersion) and advantages of VR (e.g. practice a scenario in a safe platform) (Adhikari et al., 2021). However, this study also found a negative factor on acceptance which was related to physical complaints from the VR experience (e.g. dry eyes and a stiff neck). Roberts and colleagues (2019) did a study on VR acceptance among older adults. They found even more codes that represents positive and negative factors that influence acceptance, such as emotional experience, content preferences, equipment usability and perceived usefulness. Altogether, qualitative research towards VR acceptance is very helpful in identifying the factors that influence technology acceptance.

This review shows that mental healthcare patients have a positive attitude towards VRET and accept it as a psychological treatment. However, the implementation of VRET into clinical practice is still going slowly mostly due practical issues, such as technology being developed so quickly that VR hardware and software are outdated too soon for institutions to get their investment paid off (Meyerbröcker, 2021). Lindner (2020) thinks that mental health

interventions such as a VR game application about spider phobia should be released free on application marketplaces to boost adoption because patients will be able to practice with VR exposure at home on their own smartphone. This makes it easier for institutions to let their patient experience VRET without needing to purchase an expensive VR system. Nevertheless, clinical practice still needs to wait until mass adoption of VR by consumers occurs. Lindner and colleagues (2019) express that even though VRET is not used a lot in clinical practice yet, practitioners are very curious and are willing to use it. Other research also shows the interest in using VR in treatment is there but training in VRET is usually unavailable for practitioners. They suggest that for VR adoption it is important to make training available and address therapists needs and concerns (Boeldt et al., 2019). It seems that both patients and practitioners have positive attitudes towards VRET which means there is one less obstacle in the adoption of VRET into clinical practice. However, as discussed above there are many other obstacles that hinder technology adoption into mental healthcare (Titzler, Saruhanjan, Berking, Riper & Ebert, 2018).

Strengths and limitations

This review gives a good overview of the research that has been done on this specific topic which is important because it provides the potential scope and size of the topic. The studies included have quantitative and qualitative research methods which gives this review next to the numbers more depth and understanding.

Limitations of this scoping review need to be considered to improve future research. First, only three databases were used during the search of this scoping review. Scoping reviews try to offer an exploratory assessment of the scope of the topic (Grant & Booth, 2009). Therefore, it is common that many databases and other platforms are used to search for relevant studies on this topic. This scoping review did not do a very thorough search using many databases or other resources. This may be the reason that the number of articles included in this review is this little. If more databases were searched and other resources were utilized, more relevant articles could have been added to this scoping review, providing a more complete assessment of the size and scope of this topic. A database that could have been considered is ACM, which is a database with a collection of more technical publications. When the search string used in this study is used in both databases a few dozen of possible relevant articles pop up. However, after some inspection the articles do seem more focused on the technical part of VRET such as the design of the VR system (Brinkman et al., 2012; Mozgai, Hartholt, Leeds & Rizzo, 2020). Another possibility to search for relevant literature is Google Scholar because it is a search

engine that searches for articles on the whole internet. Because this is a scoping review that tries to gather as much literature about the specific topic as possible, the use of Google Scholar might have been a good addition to this review.

Second, the issue with the assessment of quality of the articles used in his review. Quality exclusion criteria were not established before or during the search. This was due to the lack of available research, making every possible relevant article good enough. However, this scoping review intended to collect as many studies possible on the topic of acceptance of VR, instead of trying to do a quality appraisal of the collected studies (Grant and Booth, 2009). Thus, according to Grant and Booth (2009) findings cannot be used to specifically advise clinical practice due to the lack of quality assessment. However, directions for future research can be made.

Directions for future research

This scoping review shows that research on the acceptance of VRET by mental health patients is still limited. However, this review is a step forward in acknowledging that research on technology acceptance in mental healthcare is very important.

The implementation of VRET and other technologies into mental healthcare is an important topic that does need more research. Most studies in this review only used a quantitative research method, with mostly just one measurement instrument to measure patient acceptance. Because acceptance is such a complex construct to measure, it would be better to use multiple or a more dimensional measurement instrument. One study in this review did use two measurements to assess acceptance, however it failed to do a proper qualitative assessment (Campos et al., 2018). Qualitative research shows that it can be very helpful to understand better why patients accept VRET as a treatment and what factors influence acceptance. Future research on VRET acceptance should include a mixed-methods research method in order to gain a better understanding of the construct acceptance. Next to that, researchers may want to develop a dimensional measurement instrument for technology acceptance for future VRET acceptance research to use. The use of the same measurement instrument would be a perfect base for a meta-analysis on this topic.

In conclusion, the scoping review provided support that mental healthcare patients do accept VRET as a treatment for their anxiety- or trauma related disorder. It shows that patients are getting more interested and supportive of the use of virtual reality and other technologies in mental healthcare. This might motivate mental healthcare workers, such as psychologists, to start using more of these technologies in their practices.

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