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BRIEF REPORT

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Virtual reality in clinical practice

Katharina Meyerbröker[1,2]

[1]Clinical Psychology, Universiteit Utrecht, Utrecht, The Netherlands

[2]Altrecht, Utrecht, The Netherlands

Correspondence
Katharina Meyerbröker, Universiteit Utrecht, Utrecht, The Netherlands.
Email: k.meyerbroker@uu.nl

Virtual reality therapy for mental health complaints has been invented during the last two decades of the past century and has undergone a rather rapid development since then (Emmelkamp & Meyerbröker, 2021). Virtual reality not only has led to highly standardized research environments but also has created a counterpart for clinical practice for the use of exposure in vivo and for practicing social skills in real life. In the beginning, virtual environments were created to treat simple phobias. Virtual environments were built so that an individual could face his fears in virtual reality, and this was the starting point of what has been called virtual reality exposure therapy (VRET).

In VRET, it is important that an individual feels present in a virtual environment and that this environment becomes dominant above the real world. This is based on the assumption that an individual is being immersed by the technical components and feels "present" (the feeling of "being there") in the virtual environment (Meyerbröker, 2014). In this virtual environment, the individual will rather respond to events in the virtual environment than to events in the real world. Thus, the consequence of immersion is that an individual feels "present" in the actual virtual environment.

While VRET was at first especially used in the treatment of specific phobias and later on in more complex (anxiety) disorders, asking for different interventions than only exposure, the technological development has made more therapeutic aspects possible. It is possible nowadays to navigate through virtual environments and interact with avatars (persons in virtual reality) by speech and gestures, which avatars can react in real time.

Virtual reality therapy is also applicable in patients with psychoses (see Rus-Calafell et al., 2018). Virtual reality therapy has potential for (1) cognitive rehabilitation, (2) social skills rehabilitation, and (3) vocational rehabilitation in clinical practice (Schroeder et al., preprint). As the applicability of virtual reality has broadened to more complex mental health disorders, the aim of the current special issue is to provide clinicians with an up-to-date overview on the different areas in which virtual reality already has a clinically relevant additional value.

The broadened applicability of virtual reality to other disorders than anxiety disorders has also made different kind of interventions possible. Nowadays, virtual reality in clinical practice is used as an instrument to interact with others, to train certain skills (e.g., social anxiety), to learn how to react properly (e.g., autism), as an assessment tool (e.g., aggressive behavior), and also as a method how to deal with complex interpersonal situations (e.g., aggression management). Virtual reality therapy is applied not only in disorder specific interventions, but transdiagnostic factors such as limited emotion regulation can be targeted with virtual reality as well.

We commence this special issue with two disorder specific overviews of (a) the use of virtual reality therapy in anxiety and related disorders (Meyerbröker & Morina, 2021, this issue) and (b) the evidence and the use of virtual reality therapy in the treatment of eating disorders (Riva et al., 2021, this issue). Further, a study about the use of virtual reality in children with aggressive behavior to assess their social information processing capacities (Verhoef et al., 2021, this issue) is included, which provides the reader with an impression on how virtual reality can be used in a quite young population (8–13 years old). We continue the special issue with a study into the therapeutic processes of Avatar Therapy to understand the evolution of avatars' and patients' speech and changes in patient responses in patients with schizophrenia (Beaudoin et al., 2021, this issue). Further, we include a review of virtual reality as a transdiagnostic intervention tool in patients experiencing emotion regulation problems (Colombo et al., 2021, this issue). It shows, that virtual reality therapy is applicable across disorders in a transdiagnostic way.

While this prosperous technological development has a great potential, there is as well a pitfall in the use of virtual reality. The

pitfall refers to speed of the development and challenges of the multiple environments and functionalities which are used. This often leads to "old" materials and a gap in synchronization and compatibility between systems. Given that no virtual environments have been created which can be used universally across different systems, we therefore conclude the special issue with an article focusing on the different technological aspects of virtual reality in (mental) health care and its potential misconceptions (Takac et al., 2021, this issue). The reader will be provided with a critical appraisal of different types of virtual reality and a matrix how a better understanding of technological aspects can lead to more high quality research and use of virtual reality in clinical practice.

In research, virtual reality has finally become more accepted as highly standardized research paradigm. Its additional value has been demonstrated in research into disorder relevant aspects (Dibbets, 2020) and potential treatment mechanisms (Kampmann et al., 2019). With its potential to manipulate certain aspects within a virtual environment and the high control virtual reality provides, it is of additional value in treatment research. The actual working mechanisms of VRET itself are still considered a black box. Although it is often assumed that the working mechanisms of VRET are the same as the working mechanisms of exposure in vivo, research into the working mechanisms of VRET is scarce. When it is assumed that VRET has the same underlying mechanism as exposure in vivo, the current theoretical model on explaining the effects of exposure therapy (Craske et al., 2014) falls short on explaining the effects of VRET. For example, in patients with obsessive–compulsive disorder, a public door handle evokes negative outcomes (such as being contaminated). According to this theory, patients learn in exposure therapy that these negative outcomes cannot occur or will not have the same consequences as in real life. For instance, touching a public door handle in VRET will not put you at risk of being contaminated. Usually the violation of this expectancy leads to the formation of a new inhibitory ("safety") association. In VRET, however, contamination cannot occur. This raises the question as to whether expectancy violation with regard to these outcomes can still take place and accounts for the effects of VRET, as is currently assumed in exposure in vivo.

The dissemination of virtual reality in clinical practice is still going slowly due to a lot of practical aspects. First, as mentioned above, the technological developments are going so fast, that what is bought yesterday is already old and often not compatible anymore with the systems of tomorrow. Therefore, institutions are reluctant to invest in virtual reality as its use needs a few years to get payed off. The cost effectiveness for the use in clinical practice is still not well demonstrated. For many clinicians, the developmental costs of a virtual reality environment are not evident. It is often assumed that acquiring a head-mounted display and a computer to generate the virtual environments are the only investment that needs to be done. Actually, the major costs for high quality virtual environments lay in the development of virtual reality environments and their functionality.

It is often suggested that virtual reality therapy will enhance the efficacy of an already evidence-based treatment. This has not been demonstrated yet, and a rationale why this could be an assumption is still missing. However, given the high control a virtual environment provides, it is perceived as more easily accessible for patients to do the first steps within exposure (Garcia-Palacios et al., 2007). Another aspect which has an additional value above exposure in vivo is the possibility of starting treatment from home under supervision of a therapist who can guide the exposure from the office. Thus, VR can be used as an option to bridge the gap where possible, but it is not a magical instrument to enhance the efficacy of empirically supported and well evidenced treatments.

But where do we go from now? One of the future directions of high importance for the use of VR is its use in children and adolescents. Virtual reality has demonstrated its applicability in health care in children on how to deal with preoperative anxiety. But further research into the use of VR has been limited to skills training in children with autism, education, healthy eating, or safety in swimming. In psychiatric disorders in adolescents, research has been scare. However, there is a high potential especially in adolescents to make use of virtual reality in clinical practice. Adolescents are not only vulnerable for developing psychiatric disorders during adolescence, but they also show greater opportunities to profit from treatment (Crone, 2009). Here, virtual reality is a potentially fruitful approach to conduct, for example, exposure, given its low barriers and playful elements. Connecting with the technological driven environment of adolescents, VRET has a high potential to improve the effects of treatment and as a potential preventive intervention at early stage.

The final question is what works for whom? Are there populations that can rather profit from VRET than from exposure in vivo? Research into personality characteristics to predict therapy success has been scarce in VRET. Earlier it has been suggested that absorption could play an important role (Meyerbröker, 2014). Absorption refers to the capacity to become more immersed in movies, acting, and different imaginal activities. Although it has been suggested as well that individuals who are more introvert might benefit more from VRET, there is still no strong evidence to support this. Although from a clinical perspective it may be likely that individuals with high needs of control could profit more from VRET, there is yet no robust evidence that certain personality traits predict potential benefits.

Given that all these important questions are still not answered yet, there is a compelling need for high-quality, well-designed, and adequately powered research into processes involved in virtual reality and into its efficacy.

Finally, we hope that this special issue will not only provide an overview of what already has been achieved with the use of virtual reality in clinical practice but also provide a sense of excitement of what lies ahead in the future.

ORCID


Katharina Meyerbröker https://orcid.org/0000-0002-3122-6331

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