# "Healthy" Deceits with Mixed Reality

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## Abstract

Because of its capacity to alter the perception of the surrounding environment, mixed reality technology (MR) has potential for in-the-wild management of anxiety—both chronic (e.g., anxiety disorders) and acute (e.g., situation-induced anxiety). Recently, several components of Cognitive Behavioural Therapy leverage these technologies as part of ongoing cognitive restructuring or as part of relaxation or exposure experiences. However, while most of these researchers focus on the promising benefits of these technologies, a deeper discussion on the potential harm through the misuse of these techniques is still missing. To ignite a conversation about the two sides of the same coin of MR for mental health, we present several scenarios where mixed reality approaches might be used to deceive users rather to support them.

## Author Keywords

Augmented Reality, Mental Health, Cognitive Behavioural Therapy, Virtual Reality

## CSS Concepts

•Human-centered computing~Human computer interaction (HCI)~HCI theory, concepts and models•Applied computing~Life and medical sciences~Consumer health•Computing methodologies~Computer graphics~Graphics systems and interfaces~Mixed / augmented reality

## Introduction

Experiencing anxiety can be stressful and debilitating, as these experiences are harmful both to short-term health [14] as well as causing long-term problems for well-being [34]. Present social, physical, and environmental structures of crowded cities, for example, increase the risk of experiencing temporary and acute anxiety produced by crowded commuter trains, air travel, or stressful situations in private as well as in professional environments [26,51,53]. Given that there has been an increase in anxiety-related disorders across the population, a demand for effective forms of treatment is greater than ever.

Cognitive Behavioural Therapy (CBT), a popular intervention approach [17,18], aims to decrease maladaptive behaviours and increases adaptive ones by modifying their antecedents and consequences of behavioural practices, which result in new learning [41]. Cognitive interventions aim to modify maladaptive cognition, self-statements or beliefs [3]. Digital solutions that help mitigate experienced anxiety or build resilience to potential threats yield large and lasting benefits for the users [5]. Prominent examples for such development are the rising amount of successfully deployed internet-based approaches to deliver anxiety interventions [20,44,46]. These approaches mostly rely on mobile platforms because they allow fast treatment delivery to a large number of patients [19], proving the accessibility of these treatments [22], real-time monitoring and tracking of treatment progress [6], and potentially proving adherence [12,27,57].

In recent years, immersive technologies, such as virtual reality (VR) and augmented reality (AR), have proven to be promising for the treatment of various mental illnesses and are described as "indispensable tools in the toolbox of psychological researchers" [24,45,60]. In particular, the application of CBT in MR has drawn the attention of researchers and psychotherapists due to treatment efficacy. There are various examples of digital CBT, ranging from clinical interventions [47] to popular meditation apps for subclinical usage [50]. For example allows VR to immerse a patient into a feared situation, to learn a less harmful behaviour in this situation as part of an ongoing treatment.

While there is rapidly growing evidence for positive effects of MR in the mental health context, one controversial question has barely been evaluated: Is it possible that these techniques could be abused in some manner? In the following sections, we will provide potential scenarios where immersive mental health interventions and assessment strategies could be exploited. Can we use these techniques to construct immersive deceits to reshape the personal cognition of users in other contexts as well? What are the consequences of these deceits outside therapy's safe environment?

Current standard ethics textbooks, while discussing medical and health-related issues in detail, pay little attention to current technological risks, e.g. in the MR field. While the current debate on potentials and risks of Artificial Intelligence has pushed the discussion of data and algorithm ethics [23,35], Mixed Reality, as we have tried to show, poses similar ethical challenges, and the discussion of VR / MR ethics has gained momentum recently [1,30,39].

The main contribution of this work is an overview of potential challenges which Human-Computer Interaction researchers must face in the next couple of years to ensure that MR can fulfill the promises made by previous research. In the following, we present and discuss an open list of potential issues in MR (mis)use:

## Cognitive Restructuring in the Wild: Challenges and Potential

The overall goal of cognitive restructuring is the reassignment of non-harmful thoughts to a given stimulus, which was negatively primed before. Malicious beliefs and behaviours that have been learned over years are replaced with less harmful thoughts about a stimulus. Several researchers confirm cognitive restructuring as effective intervention [13] for anxiety [28], depression [16], and substance abuse [52].

With the rise of mobile devices, more clinical experts start to adapt such techniques to help patients in their ongoing reorganization of personal thoughts with either supervised applications [2,36] or even unsupervised applications [48]. Some researchers suggest the combination of these approaches as a middle ground to lower the costs while keeping a high efficacy of the intervention [7].

MR interventions may become the next step in the evolution of internet-based intervention design [10,55]: Patients will not only have their phone and their personal imagination, but also additional multisensory support to dive deeper into a immersive illusion. Novel approaches, such as on-demand interventions, would become feasible for patients, which may help one cope with situational anxiety, such as being in crowded areas. For example: Stressful stimuli can be blurred out and positive elements, such as experiencing nature [11], can be highlighted through a MR device. However, the core of the intervention could be abused to promote other thoughts as well. Thoughts about a situation could be reshaped in a negative way. For example, instead of priming relief and relaxation in the surrounding environment, the application may also draw attention to a product or service. While this approach of bias-modification was previously used as part of interventions for mental health [54], it could be exploited for different purposes like commercial advertising.

## Distorting the Body Image

Another aspect, where MR technologies have shown potential, is the usage of altering body image [49]. These technologies are used to reshape the perception of the own body, which is an essential part of body-related mental illnesses, such as eating disorders, where a distorted body image plays a crucial role in the maintenance of the illness [38]. But what happens if the transformation of the own body image is used in a harmful manner? For example, previous research showed negative effects of (social and traditional) media on self-esteem [21,58]. MR applications may intensify these negative effects by enforcing the distorted image of the personal body. While the visualisation of one's own body distortion plays an elemental role in the therapy context, it could become harmful, when these images stay present all the time. Users may try to follow unhealthy beauty trends, propagated through MR. The perception of being in a "perfect body" may reinforce the distortion of the body image, because it can highlight the difference between the idealized body and the own body. Realistic and immersive presentations can emphasize own

imperfections in detail and may propel the development of more severe mental health problems.

Previous work showed that the virtual representation of the user – the avatar – can even change the user's behaviour in and outside of MR applications, which is a core concept of the Proteus effect [8]. While this effect may be useful to increase the efficacy of therapies in MR on the one hand [9], it may pose a risk if misused: For example, the substitution of the patient's body with an altered virtual avatar may induce a feeling of owing over a virtual body – the body ownership illusion [4,32,56]. This illusion may lead to overestimations of one's own capabilities, which can lead to harmful and even dangerous effects for the affected user. Furthermore, the visual appearance of the own avatar can also alter the user's attitude. Prior investigations revealed that implicit racial bias can be decreased with avatars of different skin colors [42]. If misused however, whether intentionally or not, the contrary may occur, and racial bias may be increased.

### Reducing Resilience or Trivializing Danger with Overexposure
Besides the possibility of a patient confronting their own fears in a safe context of exposure therapy, MR is also used as part of relaxation exercises [25,31]. Patients may be able to meditate with a MR device and perform special meditation exercises in combination with biometric data-based interfaces, such as breath exercises to calm down. However, the misuse of exposure may harm the resilience to threats in the real world, which may increase the personal experienced anxiety in the physical world. Although virtual stimuli can induce real stress and anxiety [37,59], false performed exposure could make patients overconfident,

which may lead to underestimations in corresponding situations in reality, where threats are not recognized due to habituation effects [43].

### Assessment Techniques Outside the Clinic
Besides the pure experience of MR, the data generated by immersive technology may also become a potential challenge as well: As previous researchers have shown, data such as GPS [29], gaze [15], skin conductance [33] etc. may be used to determine the mental health of users. While these data may play an essential role for the assessment of mental health problems, they could also become valuable information for third parties. More data may be recorded and allow a clearer characterization of the user. This may be used to create more personalized experiences and advertisements based on the personal needs but also potentially playing with the own anxiety to promote a product. As previous researchers already state, the assessment and intervention with MR also challenges the ethical boundaries in the context of mental health [40,55].

### Conclusion
MR technology may enable a broad range of novel approaches for assessments and interventions of mental illnesses. However, a growing challenge for designers to deal with both sides of the same coin: On the one hand, immersive experiences may help deal with severe mental burdens which reduce the overall quality of life for affected patients. However, on the other hand, the misuse of immersive interventions with regards to mental health may be dangerous for individuals as well as for society. Therefore, a critical discussion about benefits and potential risks is urgently needed as technology continues to evolve.

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