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Factors that influence the implementation of virtual reality and biofeedback in mental healthcare
a professional's perspective

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Factors that Influence the Implementation of Virtual Reality and Biofeedback in Mental Healthcare:
A Professional's Perspective

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Abstract

Virtual Reality (VR) and biofeedback have the potential to make the treatments of mental disorders more effective. Whereas earlier work focused mainly on the effectiveness of VR and biofeedback in academic experiments, the current study focused on the perception of mental healthcare professionals regarding the implementation of VR and biofeedback in clinical practice. This is examined using a mixed-method design with a qualitative approach by conducting in-depth semi-structured interviews (N = 13), a workshop (N = 9), and workshop evaluations (N = 7) with mental healthcare professionals. Three main themes emerged. The first theme discussed how VR and biofeedback can improve current treatments in three ways: 1) solving practical restraints of in Vivo Exposure Therapy, 2) providing objective insights in bodily processes, and 3) motivating the client. However, in order for these technologies to be successfully deployed, the second theme described four preconditions professionals have: 1) maintain the goal of the treatment, 2) knowledge, experience, and proof, 3) easy to use, and 4) technological innovation. The third theme listed other important considerations of VR and biofeedback: different communication in therapies, the professional's attitude, and other purposes. From these themes it can be concluded that many professionals are positive about the implementation of VR and biofeedback in mental healthcare, but also cautious. It is most important for them that the technologies are working and ready to use. However, currently both technologies are not meeting these practical preconditions. This means that more effort is needed to satisfy the professionals' needs, which could in the end facilitate successful implementation of VR and biofeedback in mental healthcare.

Key words: Virtual Reality, biofeedback, implementation factors, perspective of professionals, mental healthcare, clinical practice

Acknowledgements

Contents

Chapter 1: Introduction

In the Netherlands twenty percent of all people are facing some kind of mental disorder over their lifetime, such as mood disorders, anxiety disorders, or substance disorders (Veerbeek, Knispel, & Nuijen, 2014). These are caused by both genetics and the environment a person is exposed to (Heim & Nemeroff, 1999). The quality of life is significantly impaired among people suffering from such disorders (Rapaport, Clary, Fayyad, & Endicott, 2005). On top of that, most mental disorders start early in life (around 15 years old) and are often chronic (Alonso et al., 2004; Kessler & Greenberg, 2002). Anxiety disorders and mood disorders are even in the top ten diseases that are the most difficult to live with (Veerbeek et al., 2014), and are very costly for society (Kessler & Greenberg, 2002). Therefore, it is vital that people suffering from mental disorders are properly supported by the mental healthcare sector, to help them cope with their symptoms and improve the quality of their daily lives substantially. To do so, mental healthcare professionals most often apply pharmacological interventions and psychological therapy (Ann & Parrish, 2008; Bateman, Brown, & Pedder, 2010). Incorporating technologies in psychological treatments has the potential to make the treatments of mental disorders more effective (Clough & Casey, 2011). This study will discuss the implementation of two of those technologies: Virtual Reality (VR) and biofeedback.

1.1   Virtual Reality and biofeedback

VR is a digital environment, generated by a computer, which creates the feeling of presence – a (psychological) sense of being there – thereby causing that the environment and stimuli in it are perceived as real (Jerald, 2016; Price, Mehta, Tone, & Anderson, 2011; Slater & Wilbur, 1997). VR is not new – for as long as human-kind exists, it has been trying to trigger the imagination by creating the illusion that something is present while it actually is not (Jerald, 2016). What started in the 1800s with a stereoscope (Zone, 2014), resulted in the development of consumer Head Mounted Displays (HMD) in the 2000s (Jerald, 2016). VR technology is becoming affordable for consumers due to the decrease in purchasing costs and the rapid increase in technological feasibilities (e.g. high resolution) and physical characteristics (e.g. low weight). Devices like the Oculus Rift, Playstation VR, HTC Vive, Samsung Gear VR, and Google Cardboard make it easy for consumers to experience VR, as described by Anthes, García-Hernández, Wiedemann, and Kranzlmüller (2016), and Jerald (2016).

Biofeedback is a newer development – it was first used in a psychological experiment in the 1960s (Beatty & Legewie, 2013). It is a process that makes it possible for a person to learn how to change their physiological activity to become healthier and perform better (Schwartz & Andrasik, 2017). There are different forms of devices to measure physiological activity, but wrist-worn devices, such as the Empatica (2018), are popular nowadays. Examples of bio-signals that can be measured are muscle activity, skin temperature, electrodermal activity, respiration, heart rate, heart rate variability, blood pressure, brain electrical activity, and blood flow (Yucha & Montgomery, 2008).

1.2   Virtual Reality and biofeedback in mental healthcare

In the treatment of mental disorders, mental healthcare professionals often encounter problems like poor engagement, high dropout rates, and poor compliance when asked to practice in between therapy sessions (Clough & Casey, 2011). A new form of psychological treatment that seems to have great potential to solve these issues, is the incorporation of VR in psychological treatments, also called Virtual Reality Therapy (VRT). In the last couple of years, lots of studies have been conducted to examine the potential of VRT, and research has shown that a wide range of mental disorders can possibly be treated using this new type of treatment (see e.g., Riva, Baños, Botella, Mantovani, & Gaggioli, 2016; Valmaggia, Latif, Kempton, & Rus-Calafell, 2016).

Biofeedback devices can also be used in the treatment of mental disorders, for example as a mean to prevent the development of stress and anxiety or to reduce the stress level by feeding back physiological information during breathing exercises (Steffen, Austin, Debarros, & Franklin, 2017). Biofeedback is mostly used as a standalone relaxation treatment, aimed at teaching the client skills which they can use outside the therapist's office (Reiner, 2008). This focuses on helping them gain control over mind and body (Yucha & Montgomery, 2008).

VR and biofeedback can also be combined (see e.g., Gaggioli et al., 2014; Gorini et al., 2010; Pallavicini, Algeri, Repetto, Gorini, & Riva, 2009). In these studies, biofeedback is used to adjust the virtual environment to the user's physical state, which has shown to reduce anxiety levels (Gorini et al., 2010). According to Lindner et al. (2017), devices measuring physiological signals can be a valuable additive to VR by providing the mental healthcare professional with informative data about the client (also known as social-biofeedback), and it enables the ability to adapt the exposure level to the emotional state of the user.

1.3   Problem statement and research aim

As described above, there are various studies that have shown the potential effectiveness of VR and biofeedback in mental healthcare (e.g. Eichenberg & Wolters, 2012; Riva et al., 2016; Rothbaum et al., 1995; Valmaggia et al., 2016). However, the incorporation of VR and biofeedback is mainly assessed in academic experiments (Menon, Rajan, & Sarkar, 2017). It is not yet standard in clinical care (Torous & Roberts, 2017). This means that there is a gap between research and practice. Earlier work focused mainly on the effect that VR and biofeedback have on treatments and summarized potential benefits and challenges. However, there is a lack of practical knowledge about how mental healthcare professionals perceive these suggested benefits, how they will actually use these technologies in clinical practice, what technological characteristics are important to them, and how technologies would actually influence their treatment.

Therefore, the aim of this study is to examine which factors influence the implementation of VR and biofeedback by mental healthcare professionals. In order to answer this question, it first needs to be established if mental healthcare professionals see added value in the incorporation of VR and biofeedback in their treatments, and if the benefits and challenges that are found in the literature are also recognized and supported by them. Additionally, it is also important to get a deeper understanding of how mental healthcare professionals want to apply VR and biofeedback in their treatment, what is needed to implement both technologies, and what their attitude is towards them. It is also interesting to examine how VR and biofeedback might change current treatment forms. For example, the implementation of VR means that the client needs to wear a HMD and the implementation of biofeedback means that lots of information about bio-data becomes instantly available.

This study will be a first step towards new insights into the practical aspects of implementation of VR and biofeedback in mental healthcare.

Chapter 2: Theoretical background

To provide more in-depth information on VR, biofeedback, and their role in mental healthcare, a theoretical background is provided. This background will allow a better understanding of how VR and biofeedback can be used in mental healthcare and potential benefits and challenges are described. Hereafter, the importance of the professional's perspective will be further explained.

2.1   Virtual Reality in mental healthcare

Cognitive-Behavioral Therapy (CBT) is a kind of psychotherapy that is often seen as the "gold standard" when treating mental disorders (Rector, 2010). For people suffering from anxiety disorders, a component that professionals often use in CBT is exposure therapy (Rector, 2010). In this therapy, the client is confronted with stimuli they perceive to be stressful or scary, and learns how to cope with them (Baños et al., 2011). Exposure therapy can be conducted in various ways, using e.g. imaginal exposure or in vivo exposure (McCann et al., 2014). During imaginal exposure, the person needs to think about stimuli that make them anxious; starting with mildly feared stimuli while gradually working towards highly feared stimuli (Rector, 2010). During in vivo exposure, a person is exposed to stimuli in real-life situations (Morina, IJntema, Meyerbröker, & Emmelkamp, 2015). VRT is used mostly for exposure purposes (Riva et al., 2010). Therefore, this kind of VRT is often called Virtual Reality Exposure Therapy (VRET), during which a person is immersed in a virtual environment and (gradually) exposed to feared or stressful stimuli within a context that is relevant to their disorder (Parsons & Rizzo, 2008). For example, a person who is claustrophobic will be placed in a small virtual room.

In 1995, the first controlled study was executed by Rothbaum et al. using VR to treat the psychological disorder acrophobia (fear of heights) among college students. When comparing the 10 participants that followed VRET with the 7 participants that were assigned to the waiting-list comparison group, it was found that after 8 weeks of treatment subjective measures of anxiety, avoidance, and distress were significantly reduced in comparison with pre-treatment levels. Reduction compared to a control group who did not receive the VR treatment was also noticed. However, in this study there was no treatment comparison group in which participants followed standard exposure treatment, and the number of participants was small. Despite these limitations, the results of this study were considered promising.

After the study of Rothbaum et al. (1995), VRET was widely investigated. Eichenberg and Wolters (2012) outlined all the findings until then in a meta-analysis and found possible effectiveness of using VRET to treat fear of heights, fear of flying, spider phobia, panic disorder, and post-traumatic stress disorder (PTSD). However, the authors were still careful in their conclusions due to the lack of randomized controlled studies. However, this meta-analysis did include multiple studies in which VRET is compared with standard exposure treatment. Additionally, they suggested that it can also be used to treat obsessive-compulsive disorder, eating disorders, sexual dysfunction, addiction, attention deficit disorder and schizophrenia, but lack of data made these results inconclusive. More recent meta-analyses provided more powerful statements about the effectiveness of VRET. It has proven to be a valuable treatment for various phobias, stress management, PTSD, and panic disorder. Besides, it is also found to be effective when treating addiction, autism, obesity, and eating disorders. Results for depression, psychosis, and schizophrenia are still inconclusive at this time. However, authors of these studies remain cautious when drawing conclusions, since many of the studies that they evaluated had small sample sizes and low statistical power (Riva et al., 2016; Valmaggia et al., 2016).

Besides VRET, other applications using VR are being investigated. VR can for instance be used as meditation and relaxation system (Kosunen et al., 2016). Another example is pain management, in which VR is used to decrease pain, anxiety, and unpleasantness; however, the neurobiological mechanisms that make it possible for VR to decrease pain perception are still unclear (Karaman, 2016; Li, Montaño, Chen, & Gold, 2011). Additionally, VR can contribute to cognitive rehabilitation for individuals with brain injury (Larson, Feigon, Gagliardo, & Dvorkin, 2014) and physical rehabilitation for elderly or individuals with neurological disorders (Shema et al., 2014). Subsequently, Falconer et al. (2016) used virtual bodies in immersive VR to create lower self-criticism and increases in self-compassion among individuals with depression. VR is also used as a tool to enhance empathy. For example for medical students to become more empathic with older adults, by showing them what it is like to be aged and experience hearing and vision loss (Swartzlander, Dyer, & Gugliucci, 2017). Further, VR can be a tool for training and education of mental healthcare professionals (Mantovani, Castelnuovo, Gaggioli, & Riva, 2003).

2.1.1   Benefits and challenges of using Virtual Reality in mental healthcare

Standard exposure treatments come with several issues; people are scared of facing their fears in real-life and therefore refuse therapy or drop out of therapy early (Garcia-Palacios, Botella, Hoffman, & Fabregat,

2007), and it is relatively costly due to the necessity to be performed outside of the professional's office (Kampmann et al., 2016; Krijn, Emmelkamp, Olafsson, & Biemond, 2004). VRT can possibly help mental healthcare professionals overcome these issues. To start, it is proven that individuals perceive VRT to be less aversive than in vivo exposure – participants not only preferred VRT over in vivo exposure, but also showed lower refusal rates when asked to follow therapy (Garcia-Palacios et al., 2007; Garcia-Palacios, Hoffman, Kwong See, Tsai, & Botella, 2001). In addition, in some cases VR can be less costly than exposing an individual to the same stimuli in the real world and it can also be less time consuming than treatment outside the office (Kampmann et al., 2016; Riva et al., 2010). For example, when a client has fear of flying, it is difficult for the professional to provide exposure therapy in the real world – as this implies they need to go to the airport, buy tickets, and get on a plane repeatedly. Exposing a client to a plane in VR is less expensive and less time consuming, and would otherwise not be possible (Rothbaum, Hodges, & Smith, 1999). In addition, therapy is also conducted in a safe and private setting (Riva et al., 2010), in which the professional has the ability to control and manipulate the environment - and therefore the frequency, intensity, and duration of exposure to stimuli – completely (Hartanto et al., 2014; Morina et al., 2015). The mental healthcare professional can customize the (virtual) environment to the specific needs of each individual (Eichenberg & Wolters, 2012), and provides the possibility to repeat certain parts of the therapy (Baños et al., 2011; Kampmann et al., 2016).

Of course, there are also challenges to be taken into account when using VRT, which are also widely acknowledged. Virtual environments need to be targeted to the client to address specific problems (Eichenberg & Wolters, 2012). As described above, it is possible to customize an environment specifically to each individual, but in daily practice this costs a lot of time – and therefore money (Baños et al., 2009; Riva, 2009). With the recent developments of smartphone-based HMDs (see e.g., Anthes, García-Hernández, Wiedemann, & Kranzlmüller, 2016), it becomes possible for professionals to use the equipment in their therapy, but the lack of clinical content and standardized software for VR makes it more difficult to use and requires technical support (Clough & Casey, 2011; Riva, 2009; Turbyne, de Koning, & Denys, 2017). In addition, to use VR professionals need to acquire certain technological skills, which means they have to be trained to use the equipment (Eichenberg & Wolters, 2012). Furthermore, when using VR technologies, simulation sickness (or cybersickness) may be an unfortunate side issue, in which the user experiences dizziness and nausea (Eichenberg & Wolters, 2012). According to Pot-Kolder, Veling, Counotte, and Van Der Gaag (2018), cybersickness and the level of anxiety a person is experiencing may even be linked, but the

authors are careful in drawing conclusions since findings cannot be generalized to all individuals. However, this should be kept in mind when working with VR in mental healthcare treatments in which lots of people experience anxiety. Last, there are no clear ethical guidelines for treating mental disorders in virtual environments (Yellowlees, Holloway, & Parish, 2012).

2.2   Biofeedback in mental healthcare

Imagine that you are terrified of spiders. Whenever a spider is spotted at your home, you are unable to sleep. You are in constant fear of a spider crawling into your bed. In situations like these, when people experience the emotion fear, their bodily reactions are mediated by the neurological defense system of which the amygdala is the main component. Therefore, when threats appear, the amygdala actuates sensory systems to amplify attention and perceptual processing. At the same time, autonomic responses, facial muscle action, and electrical brain activity are modulated as well (Lang & McTeague, 2009). In order to provide people with more knowledge about the physiological processes going on inside their body when experiencing certain emotions, and to give them the opportunity to control them, biofeedback is very helpful (Bersak et al., 2001). Biofeedback is based on a research area called psychophysiology, which is a combination between physiology (how body parts work) and psychology (how a person behaves) (Bradley & Lang, 2007; Kersten - van Dijk, 2017), which helps to better understand the interaction between mind and body (Cacioppo, Tassinary, & Berntson, 2007). Biofeedback is based on 'physiological self-regulation', since it entails that someone has voluntary control over the central nervous system and the peripheral nervous system, the latter consisting of the somatic nervous system and the autonomic nervous system. A person gains this control through a feedback loop by adjusting their behavior when learning about their bodily state (Gruzelier & Egner, 2004).

Clients with mental disorders often have maladaptive bodily responses; people coping with anxiety and stress issues have heightened autonomic nervous system activity (e.g. increased heart rate and shortness of breath), while clients suffering from depression have hypoactive responses (Lee, Kim, & Wachholtz, 2015; Schoenberg & David, 2014). Stoyva and Budzynski (as cited in Gruzelier & Egner, 2004), described how biofeedback is used in clinical settings, in three steps: 1) acquire awareness about maladaptive bodily responses (e.g. increased heart rate), 2) learn self-regulation by associating changes in body and mind with changes in maladaptive responses, and 3) apply these learned skills in daily life. When using biofeedback, it becomes easier for clients with mental disorders to modify their bodily responses by

for instance guiding them to breathe at a certain frequency (Lehrer, 2017). This makes it possible to experience more positive states such as relaxation and physiological stability (Schoenberg & David, 2014). As described by Steffen et al. (2017), in several studies biofeedback has been used as a tool to help individuals deal with anxiety and depression, and to decrease stress levels to prevent the development of such disorders, which showed positive results.

However, biofeedback is not only a tool to assist the individual, but can also provide the mental healthcare professional with valuable information about their client. This is closely related to the social-biofeedback model, which entails that the caregiver gets information of the bio-signals of the individual, which they can communicate with this person, thereby contributing to the development of the person's emotional self-awareness (Gergely & Watson, 1999). However, including social-biofeedback in therapy sessions is hardly investigated in literature.

2.2.1 Benefits and challenges of using biofeedback in mental healthcare

Using biofeedback can have many benefits. For one, it helps individuals to better understand how physiological responses are related to emotions like anxiety, and subsequently allows them to mediate their physiological responses by providing instant feedback (Lee et al., 2015; Yucha & Montgomery, 2008). Additionally, contemporary devices that measure bio-signals can be wearable and non-obtrusive (Lisetti et al., 2009), and new sensors and technologies are being developed as we speak, such as electronic textiles (biosensors in clothes) and temporary tattoos (silicon sensors on the skin) (Lanata, Valenza, Nardelli, Gentili, & Scilingo, 2015; Liu, Pharr, & Salvatore, 2017; Soh, Vandenbosch, Mercuri, & Schreurs, 2015; Stoppa & Chiolerio, 2014). Thereby, it can be available to patients at all times, allowing them to use it whenever they need it – they are not necessarily bound to therapy sessions (Reiner, 2008). This also provides mental healthcare professionals with important information about their clients' mental state outside of therapy (Clough & Casey, 2011; Reiner, 2008). In addition, including psychophysiology in diagnostics of mental disorders is suggested to give the mental healthcare professional the opportunity to develop therapies that are more powerful and targeted because they combine self-reports with measurements on bodily processes, providing stronger data (Lang & McTeague, 2009).

There are also challenges that need to be considered when applying biofeedback. There is a time lag between having certain emotions and having the corresponding physiological changes (which also varies over time); the sensors can be unreliable due to movements errors, different bodily positions, and

air temperature and humidity; there are many-to-many relationships between emotions and their physical characteristics (e.g., an increased heart rate can mean a high stress level, but also physical exercise); and there are differences between individuals (Fairclough, 2008). Furthermore, the way in which bio-signals are displayed to a great extent determine their interpretation. As shown by Merrill and Cheshire (2017), people almost always link elevated bio-signals to certain emotions and moods, like stress, anxiety, and restlessness; even if people have no clue what a certain bio-signal actually is. This means that mental healthcare professionals need appropriate training on how to deal with biofeedback techniques in order to provide the appropriate support to the client (Schoenberg & David, 2014). Subsequently, ethical issues should also be addressed. The data acquired with bio-sensors has the potential to violate a person's privacy and can be used for immoral purposes, especially when it falls into the wrong hands (Cowie, 2015). Particularly when it comes to technologies measuring emotions, the risk of "Othello's error" should be considered. This states that an innocent person might show expressions of lying but is in fact only trying to convey having feelings such as being afraid of being disbelieved, feeling guilty about something else, feeling the need to prove the other wrong, or simply being surprised (Ekman, 1992). This means that we should always keep in mind what triggered a particular reaction before interpreting it, otherwise unjust conclusions might be drawn (Frank, 2017). This is also the case for mental healthcare professionals. When using bio-data, they do not know what caused for example an increased heart rate. Therefore, it might be used to start a conversation between therapist and client to explore what this bio-data means, as is suggested by Schoenberg and David (2014). Another challenge has a more practical nature, namely usability and technological problems. When Dekker and Champion (2007) used bio-sensors to measure heart rate and skin conductance, they discovered that the device (wrapped around the fingers) hindered the usage of certain navigation tools and thereby distracted the participants. For mental healthcare professionals such issues might mean that clients are less focused on their exercises, possibly reducing the added value of using such a tool. Therefore, feedback from the professionals and clients on the usability and feasibility of technological devices is important to enhance its ability to add value to treatments (Luxton, McCann, Bush, Mishkind, & Reger, 2011).

2.3   Combination of Virtual Reality and biofeedback

There are various studies that combine VR and biofeedback. For example, in a study by Gorini et al. (2010), a VR system was developed to give individuals relaxation therapy. One group used the VR system without

biofeedback, another group used the VR system with biofeedback, and there was a control group that did not receive any treatment. In this case, biofeedback meant that the person's heart rate influenced certain components in the virtual environment, such as the intensity of a fire, the movement of waves, or the size of a stressful image. They found that both groups that received VRT had improved clinically, but that only the group receiving additional biofeedback had significantly reduced anxiety levels, and a lower heart rate and skin conductance. Biofeedback is used in similar ways in other studies, namely by adjusting the virtual environment to the user's physical state; equal results were found (Gaggioli et al., 2014; Pallavicini, Algeri, Repetto, Gorini, & Riva, 2009).

An innovative health tech solution is found by the Dutch company Jamzone, called 'Stressjam'. This is a combination of VR, biofeedback, and applied games (Maarsingh, Martin Abello, & Bos, 2017). Stressjam consists of many fun and challenging tasks on a virtual island, in which a player must control his or her stress level in order to fulfil these tasks. The main idea behind this game is to regulate a player's stress system and to develop a new stress-mindset, using stress in a good and healthy way. The pilot study concluded that the game succeeded in improving a person's mindset towards stress, and had at the same time high personal involvement and a good score on usability and learnability. Jamzone stated that these positive short-term effects show potential for (future) research to investigate how this game could help people with emotional, behavioral, and mental health problems in the future.

However, the combination of VR and biofeedback is barely investigated in clinical practice. This means that it is unknown for which purposes mental healthcare professionals would implement both technologies in their treatments.

2.4 The professional's perspective

Many of the benefits and challenges of VR and biofeedback that are described above are not proven in clinical practice, only in academic research (Menon et al., 2017). Regarding VR, only one study was found that investigated how professionals think about VRT, and found the same benefits and challenges as described in section 2.1.1 (Segal, Bhatia, & Drapeau, 2011). However, a critical note should be made since these outcomes are based on an online questionnaire which was not randomly sampled, making it possible that only therapists who are already familiar and/or enthusiastic about VR have responded. In addition, for biofeedback it seems that especially social-biofeedback is useful in the professional's treatment, which would make these more powerful and targeted, as proposed by Lang and McTeague (2009). There is

however no literature that examined this in clinical practice. Furthermore, Lindner et al. (2017) suggested that social-biofeedback can be a valuable additive to VR. However, there is a lack of research focusing on how the professional would use the combination of VR and biofeedback.

Studies that did focus especially on the perspective of the professional mostly addressed the adoption of online counseling in mental healthcare. However, there might be similarities in the professionals' needs when adopting online counseling and when adopting VR and biofeedback; both are novel technologies that need to find their way into mental healthcare. For example, it was found that many professionals find training and support, easiness to use, and suitability of the clients important for the implementation and use of online counseling (Koufou & Markovic, 2017; Mallen, Vogel, & Rochlen, 2005; Perle et al., 2013; Simms, Gibson, & O'Donnell, 2011). Additionally, the attitude of mental healthcare professionals towards these technologies also matters. According to Ager (as cited in Clough & Casey, 2011), some professionals feel negatively towards the implementation of technology, which can be caused by various challenges as described in section 2.1.1 and section 2.2.1. Feijt, De Kort, Bongers, and IJsselsteijn (2018) found that the key driver for adoption of online counseling among psychologists is believing in and experiencing the added value of the technology. The outcomes of studies on the adoption of online counseling cannot be generalized to the professional's opinion regarding the incorporation of VR and biofeedback, but it does indicate factors that might be important for professionals when examining the implementation of VR and biofeedback in mental healthcare.

To conclude, this study tries to fill the gap between academic research and practice, by getting a better understanding of the factors that are important for mental healthcare professionals when implementing VR and biofeedback in clinical practice.

Chapter 3: Methodological framework

3.1 Research design

In order to examine which factors influence the implementation of VR and biofeedback by mental healthcare professionals, a mixed-method design was applied (Schoonenboom & Johnson, 2017). The study consisted of three parts using different qualitative data collection methods: in-depth semi-structured interviews, a role play workshop, and workshop evaluations (see Figure 1). The combination of three different data collection methods provided the opportunity to explore the research topic from different angles, thereby using the strength of each method optimally (Marshall & Rossman, 1995).

Part 1	In-depth interviews
Part 2	Workshop: role play
Part 3	Workshop evaluations
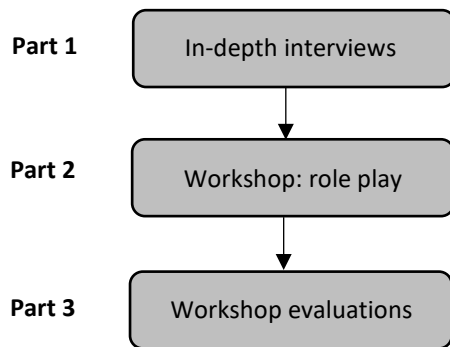
Figure 1. Illustration of the three-part study design

In the first part, in-depth semi-structured interviews with mental healthcare professionals were conducted. They were asked about their opinions regarding the usage of novel technologies in mental healthcare: VR, biofeedback, and combinations of the two. During these interviews, the added value, possible applications, and implementation necessities were discussed. The interviews made it possible to explore how mental healthcare professional think about using these technologies in their therapy, and to ask profound questions about opinions and underlying beliefs. The second part was setting up a workshop, in which small groups of professionals took part in a role play, in which they used a combination of VR and biofeedback. The role play was conducted three times, each with different participants. In groups of three, each professional got a different role that they needed to play: one person played a client with a specific mental disorder, another person played the therapist, and the last person observed the interaction between client, therapist, and the technologies. The workshop was useful for various reasons. To start, it actively

incorporated professionals in the implementation process of VR and biofeedback in mental healthcare, focusing specifically on the user's needs whereby the creation of ideas was triggered. The workshop made it also possible to observe how mental healthcare professionals interact with these technologies, and learn about their behavior while using the technologies. This helped the researcher to better understand the future context-of-use of the technologies, namely the office of a professional. Furthermore, the workshop provided the opportunity to investigate whether themes that were identified in the in-depth interviews correspond to the behavior of the professionals. Therefore, using role play was seen as a valuable addition when exploring how a technological system should be implemented (Seland, 2006). A short period after the workshop an evaluation with the professionals was conducted by phone, which was the last part of this study. The evaluation provided the opportunity to ask the participants profound questions about their experiences, reflect upon the observations that were made, and get their grounded opinion about the usage of novel technologies in mental healthcare.

3.2   Participants

For both the interviews and the workshop, mental healthcare professionals were mostly recruited using the network of the GGzE (Mental Healthcare Organization Eindhoven), which is an organization that focusses on providing the best support for individuals with psychological problems. Their aim is to reduce the client's problems and to make daily life more pleasant (GGzE, n.d.-b). The participants of this study mostly treated clients that are suffering from disorders related to anxiety and panic, PTSD, compulsion, depression, and emotion regulation, bipolar, personality, psychosomatic, addiction, psychosis, and dementia.

In order to get a wide spectrum of opinions, it was important to have participants with different backgrounds for the interviews, see Table 1. The participants that were interviewed and participated in the workshop mostly worked in a public mental healthcare setting, had various job positions, and had differing experience levels as caretaker. In addition, the sample consisted of professionals that were already acquainted with biofeedback and/or VR (since initial knowledge about these technologies makes it easier to distinguish the benefits and challenges these technologies might have during therapy), as well as professionals that were less familiar with the implementation of VR and biofeedback in mental healthcare, in order to explore other perspectives. For the workshop, a small group of professionals was invited (see

Table 2) to participate in a roleplay in which they used a combination of VR and biofeedback in a therapeutic setting. During this workshop, only a few of the professionals had experience with biofeedback and/or VR.

The sample size for the interviews was determined by a saturation criterion. This means that data was collected until the point that no new themes were found (Francis et al., 2010). An adequate sample size was established in two steps. First, an 'initial analysis sample' was determined, in which the sample size for the first round was assessed. Second, the 'stopping criterion' was specified, to establish the amount of interviews that do not initiate new themes before saturation is reached. It was advised by Francis et al. (2010) to have an initial sample size of ten participants and a stopping criterion of three participants. Therefore, thirteen mental healthcare professionals were recruited for the interviews part of this study. Since there were no new themes found during the last three interviews, the data collection was saturated and no new participants were recruited.

To keep the data of the workshop as reliable as possible, the role play was conducted three times, each time with three different mental healthcare professionals. This meant that the workshop had a total of nine participants. It should also be noted that two of the participants were no practitioners, but experience experts. An experience expert is a person who is familiar with psychiatric issues or has experienced these issues themselves, but has overcome these and now helps others by sharing their experiences and knowledge. Becoming an experience expert is often accompanied by social pedagogical education (GGzE, n.d.-a).

Table 1. *Demographic details of the participants of the interviews (n=13).*

Characteristic	Category					
Age	21 – 35	36 – 50	51 – 65			
	4	5	4			
Gender	Male	Female				
	5	8				
Mental healthcare setting	Public	Hospital	Private practice		Disabled care	
	10	1	1		1	
Job position	Psychologist	GZ-psychologist	SPV	Nurse	Case manager	Prevention worker
	3	6	1	1	1	1
Time as caretaker (years)	1 – 5	5 – 10	10 - 20	> 20		
	2	1	4	6		
Familiarity with VR and biofeedback	Good	Moderate				
	9	4				
Used VR in mental healthcare	Yes	No				
	4	9				
Used biofeedback in mental healthcare	Yes	No				
	1	12				

Note. GZ-psychologist = Mental Healthcare Psychologist, SPV = Social Psychiatric Nurse

Table 2. *Demographic details of the participants of the workshop (n=9).*

Characteristic	Category				
Age	21 – 35	36 – 50	51 – 65		
	4	4	1		
Gender	Male	Female			
	2	7			
Mental healthcare setting	Public				
	9				
Job position	Psychologist	GZ-psychologist	Nurse	Prevention worker	Experience expert
	3	1	2	1	2
Time as caretaker (years)	1 – 5	5 – 10	10 - 20	> 20	
	3	2	3	1	

Note. GZ-psychologist = Mental Healthcare Psychologist

3.3   Data collection

Data was collected in three different ways, as was described in section 3.1. At the beginning of both the interviews and the workshop, the participants filled in a consent form in which the study was explained and their anonymity was guaranteed. They were also asked if they agreed with recording the interviews. Additionally, both the interviews and the workshop started with acquiring some general information, such as age and job description.

The in-depth interviews were semi-structured. Each interviewee was asked about their opinions regarding VR and biofeedback in mental healthcare separately. In the first part of the interview, they were asked if they had ever heard of VR in mental healthcare, if they had ever used it, what their opinions were regarding VR, and if they could mention some benefits and challenges of using it. The same questions were asked about biofeedback. Afterwards, they were asked if they were open to the usage of VR or biofeedback in their work environment, and what their opinions were regarding the combination of VR and biofeedback. Additionally, possible applications were discussed and their opinions regarding these. In Appendix A, a complete topic list including all the questions addressed in the interviews can be found.

The role play of the workshop was conducted three times, each including different mental healthcare professionals. Each round had a duration of 45 minutes, in which three professionals participated, which gave a total of nine participants that participated in the entire workshop. This meant that each round was basically the same, which ensured the reliability of the obtained data. Each round started with a short explanation about the purpose of the study and what was expected of the participants. After this, there was a short introduction to the usage of VR and biofeedback in a therapeutic setting, provided by the company Mind Mansion which also facilitated the equipment. When it was clear to the participants how the technology worked, they all quickly tried out the equipment to experience the VR and get a better understanding of how the technology worked. After this, the role play started. During this situation, one person played a client with claustrophobia in the virtual environment of an elevator. The person playing the client got a wired VR HMD on their head and a biofeedback devices around their wrist. Another person played the therapist, who used the VR and biofeedback to treat this person. The third participant was an observer. They watched the interaction between de client and the therapist, and wrote down their observations. This was done to get a more objective opinion of a professional who is not actively participating in the scenario. During this role play, the therapist could conduct the therapy the way they

liked, however, both client and therapist were asked to express their thoughts and opinions out loud to get a better understanding of what was happening during this practice situation. Both therapist and observer saw the client's view on a computer monitor, but only the therapist saw the client's bio-data on a mobile phone which they were holding in their hand. For two rounds, the role play took approximately ten minutes, after which the situation was repeated but with a switch in roles between the participants. For the other round, the role play took approximately twenty minutes, since the participant playing the client was experiencing real fear. This approach ensured valuable insights from different perspectives. During the entire workshop, the researcher observed the interaction between the client, the therapist, and the technology. At the end of the workshop, the participants who played the client and therapist were first asked about their experiences. After this, the observer gave comments.

Last, an evaluation was conducted by contacting the professionals that visited the workshop by phone, in which their opinions regarding this event and their experiences were asked. This was done approximately one week after the workshop. The evaluations were done with seven participants, since two did not respond to the request. However, this was not seen as a problem, because most information that was found during the evaluations was also found during the workshop. A topic lists including the questions addressed in the workshop evaluations can be found in Appendix A.

3.4   Data analysis

The interviews and workshop were analyzed using thematic analysis. This is a method used to identify, analyze, and report patterns that occur within data – also called themes (Braun & Clarke, 2006). According to Braun and Clarke (2006), thematic analysis has six phases, which were followed during this research. In the first phase, familiarization with the data took place. The verbal data was transcribed into written text and was read repeatedly before starting with the search for meaning and patterns. The second phase was the generation of initial codes. Data was organized into basic, meaningful groups using ATLAS.ti 8 software (ATLAS.ti, n.d.). In the third phase, the search for themes started. Basically, the codes generated in phase two were analyzed and combined in a theme, by looking at the relation between different codes. This was done by an iterative process in which different combinations of codes finally resulted in a hierarchical structure in which three main themes were found. In phase four these themes were reviewed, thereby repeatedly examining the inter-code-relationships. When the data was mapped into themes, phase five

begun. In this phase, the essence of each theme was discovered and defined. Phase six was the final phase, in which the fully worked-out themes were finished and explained in this report in Chapter 4.

3.5   Data validation

To ensure the quality of the current study, reliability, confirmability, credibility, and transferability will be discussed (Miles & Huberman, 1994). To start, reliability was addressed by conducting a coding check by one of the supervisors of this study. Based on this, the researcher examined the data again to make sure no valuable information was missed or misinterpreted. After discussion, there was a reasonable agreement between supervisor and researcher regarding the reliability of the study. Additionally, confirmability was addressed by discussing the categories, category groups, and themes with the supervisors of the researcher on multiple occasions. Furthermore, since this study consisted of three different research methods, it was possible to compare the results to check credibility. It was found that the outcomes of the in-depth interviews, the workshop, and the workshop evaluations showed great similarities. The most important differences was that the in-depth interviews focused more on the opinion of the professional, the workshop gained practical information, and the workshop evaluations reflected upon the professionals' experiences during the workshop. Furthermore, to improve the transferability, mental healthcare professionals were included with varying positions within (mostly) a public healthcare setting, different age and experience levels, and varying familiarity and practical experience with VR and biofeedback. Last, connecting the results with existing literature also contributed to the validation of the results of the current study.

Chapter 4: Results

This section describes the results of the thematic analysis in three main themes. The first theme discusses the improvement of current treatments using VR and biofeedback, consisting of 1) solving practical restraints of in Vivo Exposure Therapy, 2) objective insights in bodily processes, and 3) motivation for the client. The second theme describes the professional's preconditions for successful deployment of the technologies, which are to 1) maintain the goal of the treatment, 2) knowledge, experience, and proof, 3) easy to use, and 4) technological innovation. The third theme entails other important considerations of VR and biofeedback: the way communication in therapies will change, the professional's attitude, and other purposes of the technologies. The results of the in-depth interviews, workshop, and evaluations of the workshop will be treated as a whole, since there were many similarities found. However, at the end of this chapter a short comparison between the different data collection method is made.

4.1   Improve current treatments using VR and biofeedback

To begin with, all participants pointed out several issues of current treatments. These issues will be shortly discussed, accompanied by the role technologies can play to improve the treatments.

4.1.1   Solve practical restraints of in Vivo Exposure Therapy

When mentioning the usage of VR in treatments, every professional's first reaction was to talk about anxiety treatments and performing in Vivo Exposure Therapy (iVET) – which entails conducting exposure exercises in real life. Therefore, exposure therapy became a prominent topic of this study.

"I would use it to lower the threshold towards behavioral experiments, and therefore I would mainly use it for anxiety treatments or for people with compulsion complaints." (P8, I)

Unfortunately, it is often difficult – or even impossible – to perform iVET. There are practical restraints such as not having enough therapy time or simply because it is impossible to reconstruct certain situations.

"Nowadays it isn't possible to do everything in Vivo, because it is really expensive care and there were some big cuts. We only have 45 to 50 minutes for individual sessions, that's it, in which everything must happen. It just isn't possible to go somewhere and really do in Vivo, that's just not possible. " (P3, I)

Many professionals see VR as a valuable tool to solve these issues: VR makes it possible to reconstruct every situation and perform exposure exercises in the professional's office. For example, a person who has had a traumatic experience (e.g. a car accident) cannot relive this experience, and a client suffering from fear of flying cannot go into an airplane twice a week, just to practice. However, using VR these options can suddenly become part of therapy sessions. A car accident can be simulated and re-experienced under supervision of the professional, and it is possible to practice going on a plane every week. In addition, it also provides the professional with the ability to control and manipulate the environment better, and the professional can discuss with the client what he or she wants to work on in a session, thereby giving the client more control of their own recovery process.

"Some things you can't practice anymore. If people are afraid to go up the streets, then you can give them the exercise to walk on the streets. But to people who have had a traumatic childbirth, you can't say to give birth again next week to see how it is then. Using technology, you can relive parts of such situations." (P8, I)

"You can manipulate the environment. Now I am dependent on what happens, which isn't bad, but this would provide the ability to control it better." (P11, I)

Although VR provides many opportunities for treatments, most professionals do not see VRT as a replacement of iVET. All professionals agree that in the end clients always have to face their fears in real life. Therefore, VRT is seen as an intermediate step that provides the ability to apply iVET sooner, which will probably shorten the treatment duration.

"That's the next step. That's what you want to do with these people. And eventually they need to be able to do it in real life, since VR will always be an artificial situation." (P4, I)

"The treatment will be shortened when applying VR as an intermediate step." (P13, I)

4.1.2 Objective insights in bodily processes

During the interviews, all professionals stated that the focus in clinical practice lies mostly on subjective measures. In the beginning of the treatment the client is asked to fill in questionnaires about their complaints, and during the treatment process the professional often has to assess the extent of recovery using questionnaires and oral examination. During therapy exercises, the client is asked to rank their fear on a scale from 0 to 10 (in which 0 means having no fear while 10 means experiencing extreme fear). However, it turns out that many clients find it difficult to express how their body feels exactly, and some

professionals pointed out that non-verbal observations are not always enough for them to adequately find out what causes certain emotions in the client. During the interviews and the workshop it was found that biofeedback can provide professionals with valuable insights into how a client's body reacts during treatment.

"For a long time we acted as if the body was there, but that we shouldn't do anything with it. But in fact it is really important that we do something with it" (P11, I)

"People find it very difficult to estimate how anxious they are and if they are anxious at all. I had someone who said: 'I'm not afraid, I'm just tense'. And you know what? That person was extremely anxious, but she just didn't know it. And biofeedback can provide wonderful insights in this." (P7, I)

Many professionals mentioned that they wanted to monitor bodily signals during exposure exercises, so that they can discuss a sudden increase in heart rate with the client to find out what specific stimuli or thought triggered the client's fear. In addition, discussing the bio-data together, the professional and client can obtain more accurate knowledge about the specific problem of the client. This objective insights in bodily processes make it possible for the professional to provide more targeted help.

"It think it would provide possibilities, because if you can see that someone's heart rate increases, than you can navigate better to help them confront the scary stimuli." (P3, E)

"If you are dealing with a difficult situation and you can see in the measurements when the most difficult moment is, then you can discuss why that's the most difficult moment and what you can do." (P12, I)

Biofeedback is seen as especially useful in combination with exposure exercises in VR. As was observed during the workshop, many professionals tried to use the bio-data to find out what was triggering the fear, and some even tried to provide the client with feedback about their physiology. It was especially noticed that most professionals were not really interested in specific numbers about for instance heart rate, skin conductance, or body temperature, but would rather like to see peaks and valleys to examine if anxiety and stress levels are increasing or decreasing. Unfortunately, during the workshop the biofeedback was not working correctly, though many professionals expressed that they would want to use it to link the feelings and behavior of the client to the bio-data.

"If people start to panic or become really angry, or something like that, in the VR, you can use the biofeedback to see that their blood pressure increases or that something changes in their bodily signals and ask the client what they feel. You can show them that even if they did not yet get a panic attack or became aggressive, that

already something is happening in their body. So that you use it to help people get to know that intermediate stage and sooner feel the signals." (P8, I)

In addition, for some professionals, having pre and post physiological measurements gives them the opportunity to see more objectively what the effect is of the treatment. They can use this to evaluate if the treatment coarse needs to be redirected, which might make it more effective.

"In the first session you can see how much tension there is, and in the tenth session you see if that tension became less or not, using the biofeedback." (P12, I)

However, it should also be mentioned that a minority of the professionals say that they do not need biofeedback because they already get enough information from subjective measures. This group believes that people's experiences are more important than what a device is saying.

"Fear is really subjective. If people say, it is an 8 when 10 is the maximum, I accept that to be true. So then I don't need the information about how their biology responds." (P1, I)

More easily discuss progress

Biofeedback can also be used as a valuable tool to look back on the week. According to many professionals, clients can use this data to discuss in more detail what troubled them that week and what went well. At the same time, professionals can help the client to interpret this data in an appropriate way. However, it should be noted that the data is the client's property and therefore the client's responsibility. It is not seen as a tool for the professional to control the client.

"I would like to look at it together with the client. In my opinion, the data belongs to the client, but it can be used to measure tension. Now we are doing that cognitively by asking the clients to look back themselves, but then it is easier to look back together." (P2, I)

4.1.3 Motivation for the client

Increase treatment accessibility

For many people, making the decision to go to therapy and finally confronting the fears that have been haunting them for such a long time is a massive step, often even too big. However, it is often a smaller step for them to confront their fears in a virtual environment. This means that using VR in therapy can lower the threshold to start therapy, by making an intermediate step of practicing in a virtual environment while

physically being in the safe office of the professional. Thereby, people might become more motivated to actually confront their fears. This is also confirmed by the participants of the workshop.

"Maybe that way you have the courage because it isn't real. But for your brain that doesn't matter, than it is real. So than you can practice with someone who doesn't have the courage in real life, but in this way does. I see an advantage in that." (P11, I)

"It felt like a really safe practice situation." (P2, E)

Activate client

Many clients find it difficult to transfer therapy to their home situation. However, according to almost all professionals, practicing outside of the professional's office is one of the most important things to do. Unfortunately, in practice many clients are unable to conduct these exercises, for various reasons such as being too tired or being unconfident about their performance during these exercises. Therefore, some professionals see great potential in providing clients with a VR HMD and a biofeedback device, to stimulate practicing at home. For instance, when clients need to learn to relax, they can use the VR HMD to create a safe and quiet environment which makes it easier to focus on their exercises, and biofeedback can provide positive feedback by confirming that someone is becoming more relaxed.

"That is often the biggest bottleneck, to get people to do exercises, also outside of therapy. " (P1, I)

"You often hear from people that they try to do an exercise, but when the dishes are still on the kitchen counter they see that they have to do the dishes and start making a planning in their head of all the things they still need to do. Maybe you can control this using VR." (P4, I)

"Making a connection between having certain feelings and your body, because sometimes people are so tense that they forget how it is to be relaxed, and I think that using biofeedback can help people to become better at this." (P5, I)

In addition, VR can also be used to motivate clients to be more proactive. Clients suffering from depression and clients who stopped doing physical activities because they are too painful or difficult are often hard to motivate to actively participate in daily life. VR can possibly be used to provide a positive virtual environment that activates clients by lowering the threshold to do more activities.

"For depressed people you often see that they are in a circle in which they start doing less, causing them to have less satisfaction and get less positive stimuli. So if you can develop something that they can get positive stimuli again, for instance someone who is totally into nature but can't overcome the threshold to actually make that

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forest walk, maybe using VR you can provide them with some positive stimuli which will make them feel better and maybe convince them to actually go over that threshold." (P5, I)

4.2 The professional's preconditions

When implementing VR and biofeedback in the mental healthcare system, many professionals show similar preconditions that technologies should satisfy in order for them to be accepted in clinical practice.

4.2.1 Maintain the goal of the treatment

For all mental healthcare professionals it is of the most importance that the main goal of the treatment stays intact. For example, when conducting exposure therapy for anxiety treatment, the aim of this treatment is that the client learns to cope with feeling anxious. The aim is not to learn to relax in difficult situations. The client needs to experience that nothing bad happens when feeling anxious and to accept this feeling. Eventually, this will lead to experiencing less tension when facing a difficult or scary situation.

"Decreasing the fear during anxiety treatment is not the ultimate goal. Presumably it will decrease, but the goal is that people can again participate in daily life, even though they are anxious. So decreasing the fear is only extra, it shouldn't be focused on." (P7, E)

This means that VR and biofeedback are just a means to help the professional achieve this specific goal. How this should be done in practice can best be explained with an example, focusing on the combination of VR and biofeedback. There are different ways to do this. However, when conducting exposure exercises, many professionals think that clients should not get information about their bio-signals while doing the exercises, since this might even make them more anxious (which is not the goal). They should rather get this information afterwards to discuss this with the professional.

"It isn't the goal of the therapy. People need to learn to cope with the fact that they are not in control, and now you really start playing with this. This doesn't happen in real life either." (P1, I)

"Then you should actually have a graph afterwards, in which you can see the specific moments that you stepped in the elevator and that you stepped out of it, so you can see what it does to your anxiety. In this way, you can see the first time you practiced, and also the second time." (P7, E)

But, when conducting relaxation or mindfulness exercises, receiving biofeedback at the same moment can help someone to relax by providing positive feedback (which is the goal). During such exercises it might

even be valuable to get this feedback more implicitly by having their biofeedback influence components in the virtual environment. Such an application was described by one professional, which was experienced at a conference:

"The more you relaxed, the higher the flower came, and it kept on growing, growing, growing. At a certain moment, that flower even opened up. The moment you start thinking again, the flower went down. So that shows your lack of focus immediately, but it also gives a reward the moment you start relaxing again. In this way, people can see: I can do this." (P4, I)

This example tries to elucidate that, while it is important that clients learn how their bodily reactions are related to their emotions, there is no specific protocol that can be applied all the time. The way both VR and biofeedback should be used, needs to be determined based on the underlying goal of the treatment for the specific client.

Treatment suitability

According to all professionals, every treatment needs to be well-suited to the specific client. This means that the technologies should make it possible to adapt the content of the therapy to the client's issues. For example: when performing anxiety treatment, the ability to adapt the virtual environment to the specific fears of a client is a wish many professionals have, since some situations are too scary for one client while for the other it is not yet scary enough. This was also found during the workshop, in which some professionals asked about possibilities to adapt the environment to provoke for instance more fear or to change the surroundings around the elevator to create a 'safe' space in VR.

"One person is afraid of a spider because it moves unexpectedly, while the other is afraid of a spider because it looks scary, and so on. You really need specific scenarios." (P7, I)

"You need to have environments that are specifically frightening for people. So you need to have the right context, specialized to each individual." (P3, I)

In addition, providing well-suited treatments can also mean that sometimes VR and/or biofeedback should not be applied. The majority of the professionals claim that it is very dependent on the client as a person and the specific mental disorder someone has if the incorporation of these technologies would actually improve the quality of the treatment. For example, VR and biofeedback can become an obsession, they can be perceived as scary, and clients with less cognitive abilities will simply not understand them. However,

all professionals agree that the technologies should only be used if it helps the person to become better, which means that it is important to screen clients before starting to use the technologies.

"We often want to do one-size-fits-all, but you have to be incredibly careful what suits someone." (P4, I)

"You have to screen well, not everyone will be suited." (P10, I)

"People with a panic disorder are very afraid that there is something wrong in their body, so if they see that their heart rate increases, they tend to say: 'you see, there is something wrong, I'm getting an heart attack'. That's the thought that makes them even more anxious, which will increase their heart rate even more. The moment they start practicing with biofeedback, this can become an obsession, that they start monitoring everything compulsively. Especially for people with panic disorder and people with complaints related to compulsion I can imagine this will get too much attention." (P5, I)

"My target group is so old that it is hard to introduce technology, especially in combination with their cognitive issues. A smartphone is used more often, but it is a bit of a pickle to use it correctly. People don't understand it." (P10, I)

4.2.2 Knowledge, experience, and proof

All professionals stated that they have not enough knowledge about the opportunities technologies bring. Most professionals have some initial knowledge about VR and how it can be used, but many can only think of purposes they already know, which are mostly related to exposure therapy. A possible explanation for this could be that current educations for professionals pay little attention to the usage of technologies in mental healthcare.

"Every time I'm thinking about anxiety and panic because I know the technologies from such purposes." (P6, I)

"By the way, I wanted to say that in education it is hardly mentioned. For instance in the psychotherapy education that I'm following, it is not included. For example in a lesson about cognitive behavioral therapy, it is quickly mentioned that it is possible to use VR, for example for panic disorders, but the teacher only mentioned it shortly." (P13, I)

When it comes to biofeedback, there seems to be an even greater lack of knowledge: many professionals do not know what kind of devices can measure bio-signals, have no idea how reliable the data is and how they can interpret it, and whether it is even possible to notice treatment effects.

"You wear it around your wrist?" (P1, I)

"I am so new in this, I don't know if you can actually see it, that you see a decrease, or that it is actually a really normal process in which you always keep an increased heart rate, or that you have other measurements. Or if you use it at the beginning or the end of therapy. I have no knowledge about that." (P4, I)

Therefore, they want to get good information about how technologies can be used in treatments. They want to be convinced about the added value: many see potential in using VR and biofeedback in mental healthcare, but nobody has seen proof that it actually improves the quality of their treatment – they only assume that it does. One professional saw absolutely no value in using VR for psychiatric purposes, but claimed that this is caused by not knowing much about possible applications, which resulted in not seeing the usefulness of VR.

"I wouldn't know for which psychiatric disorder I could use it. I can't think of anything. So if you can tell me for which I can use it, then I would be interested and curious." (P7, I)

This means that professionals need some form of proof, which can be either scientific or experience-based, before fully committing to something new. Especially the latter has shown to be a valuable method: during the evaluations of the workshop, many professionals stated that the workshop really helped them to see the added value of VR and biofeedback.

"Depends on the disorder and what we know already. I would be critical. I need a clear context and I want scientific articles proving it has added value. I need that, otherwise I don't know what to think of it." (P13, I)

"I am not 100% convinced. I don't rule it out and I like exploring, but I am someone who needs to be convinced by actually seeing it. If you give me proof, I am completely on board. I just need to experience it, that's important." (P7, E)

"I was very curious how you could use it in practice during treatments, and at the end [of the workshop] I really felt like: yes, it is possible." (P4, E)

4.2.3 Easy to use

Standardized approach

Professionals want enough time to find out how to properly incorporate VR and biofeedback in their treatments. They want to be able to explore the possibilities.

"It is at the expense of the time you have to provide information and to have a dialogue with each other. But that is the novelty, using different methods at the same time. We have to grow, but it is still so early, it needs to integrate. It will take some time, but that's with all new technologies." (P4, I)

However, every professional who sees value in the implementation of novel technologies in mental healthcare stated that lack of time is a big problem. With therapy sessions of 45 to 50 minutes and a total of 8 clients per day, little room is left for something else. This means that, even though they see a lot of positive elements in these technologies, it should be really fast and easy to use, otherwise it is not feasible to apply in practice. Therapy time should not suffer from the implementation of new technologies.

"In practice, it is really busy work. It isn't like I have an hour to prepare a session. Each day I see many clients, so something must be relatively quick to apply, otherwise my session has already ended." (P3, I)

"It shouldn't be used at the expense of therapy time. That's a shame. That sometimes happens with technologies, that you are too busy to see if it all works, which is only a distraction." (P13, I)

Therefore, a standardized approach is mentioned as a possible solution. A standardized VR system, in which the professional can quickly choose from multiple environments and adjust them to add or remove certain components, is the ideal situation described by many professionals. However, this will only work if the interface is extremely simple, otherwise it will only cost more time (and therefore money). If this is still one step too far, most professionals also see use in a specific part of the mental healthcare organization - such as the already existing eLab - at which they can easily order a specific virtual environment to use in therapy sessions.

"We have the eLab that is willing to create a program for me if I have a client with a certain phobia, but it would be even cooler if we had a software system within the organization with programs for different phobias for example. And it would be even better if we could adjust or add components in these programs ourselves." (P6, I)

Implementation support

All professionals stated that they need the right support when incorporating technologies into their treatments. To start, professionals want to have training on how to use the technologies in their therapy.

"You should know beforehand how it works, otherwise it is a little scary to use it because you are afraid to destroy it or to not know how to use it." (P5, E)

"If there is a protocol on how to use it, I need to get to know this and learn how to use it." (P12, I)

Additionally, for the VR and biofeedback devices to be used in therapy sessions, they should be easily available to all professionals that need them. This can be done by having a reservation system in which each professional can request certain timeslots in which they can use the technologies. However, an even better method would be to make the VR and biofeedback devices present in each therapy room and ready to use.

"If the VR headset would be placed at the secretary's desk and you could just grab it or reserve it, than I would definitely use it." (P13, I)

"If it becomes more integrated in therapy and you would have the VR and biofeedback everywhere which makes it possible to use it immediately in a session, then you use it more easily." (P8, I)

Subsequently, professionals want proper support. Whenever something goes wrong, they need to have technical help. This can either be a physical person attending the therapy session or a helpdesk in the building. It would be ideal if the professional could operate the equipment by themselves, but the most important thing is that the technologies work. Otherwise, both professional and client will be frustrated and demotivated, which will result in the technologies being left unused.

"If you introduce something, it needs to work. Otherwise I will quit soon. I don't have much patience." (P11, I)

Last, the VR and biofeedback device should be manageable so that they can be transported. In this way, it is possible for clients to take them home to continue practicing.

"It would be nice to have technology that can be transported, to be able to use the technology at the clients home." (P9, I)

Good reliability

Technologies should be reliable. If it is not, it has no use for the professional. That was also observed during the workshop, in which the biofeedback device (Empatica 4) did not work or gave values that could not be correct. In the evaluations, every professional stated that they saw potential in using biofeedback in combination with exposure therapy in VR, but if the outcomes are not to reliable it only adds a burden to therapies.

"It is a nice idea, but it should be developed further. If the data is not reliable, then you see immediately that it has no use anymore." (P4, E)

"If you believe what it says and it isn't right, it can drive you crazy. So it has to be correct." (P11, I)

4.2.4 Technological innovation

Technological flaws

Technologies still have many flaws, which can have various consequences for the therapy that is conducted. An example was found during the workshop, in which the following was observed. The participant playing the role of the professional was constantly looking at the screen on which the client's view of the virtual environment was displayed, which they used to guide the client through the environment and suggest possible exercises. However, when they found out that the view of the client did not fully correspond with the view they were seeing, it became more difficult to make appropriate suggestions to the client – especially the ones that are based on small gestures, such as looking to the ground in an elevator instead of to the doors. In this case, the inaccuracies made it harder for the professional to apply certain treatment methods they wanted to use.

Subsequently, during the workshop the interface of the technology sometimes faltered and there were also some struggles with the wire that connected the VR HMD to the laptop. Because of this, the client and professional who were conducting the practice scenario became less focused on the therapy. In addition, as mentioned before, the biofeedback device did not work according to plan. Most of the time it did not display any values, or the values that were displayed could not be correct (e.g., a heart rate of 30 bpm).

Furthermore, many participants think that in addition to visual feedback, audile and tactile feedback would increase the realism of the application even more. During the workshop, this was confirmed by other professionals. Participants playing the client stated that while standing in the elevator, they did not get the usual 'belly feeling' caused by the movement of the elevator. In addition, someone also stated that it was weird to see the elevator but not hear it.

"I think that by stimulating more senses, you can make it even more realistic. That's what I think, but I don't know if that's true." (P6, I)

4.3 Other important considerations of VR and biofeedback

During this study, other important considerations of VR and biofeedback were found, which should be taken into account when implementing both technologies in mental healthcare.

4.3.1 Different communication in therapies

In traditional therapies, a client's non-verbal information is often used to detect changes in a person and to start a meaningful conversation about this.

"If I notice in someone's non-verbal reactions that he is very scared, but if you ask him how anxious he feels on a scale from 0 to 10, and he says a 2, than I think: wait a minute, and start discussing this with him." (P3, I)

During the workshop it became obvious that non-verbal communication (such as nodding) is not possible anymore if the client is wearing a VR HMD. This means that the professional needs to find new ways to communicate with their clients.

"What I noticed during the workshop is that it becomes a different way of treating. You are used to support non-verbally and you inspect the client's facial expressions, and now you are using the headset. I need some research to examine what you need to do now: do you need to talk to someone or should he/she just do it alone, or is it a process in which you need to make agreements in which you discuss doing this in steps." (P3, E)

It was noticed that the participants needed some time to get used to the new technologies. VR can give clients the feeling of not being in control because they have no physical grip on the environment anymore. However, after a while the interaction became more natural and most of the participants did not mind that they were not able to see each other, as long as there was enough verbal guidance from the professional.

"It was new and it felt a little uncomfortable." (P1, E)

"You really need to have a good connection with the client, because the client cannot see you while you can see the client. So there needs to be trust between the two." (P1, E)

The changes in the way therapy is conducted can also provide opportunities. For instance, the professional can observe more, since he or she does not have to participate in exercises anymore because the client is doing this by him- or herself in the virtual environment. This provides the opportunity to for instance watch the client's body posture more closely to derive valuable information, which can be used to enhance the interaction between professional and client.

"As a therapist it is also nice to be able to observe more, because normally you have a modeling role in which you need to show the client that you are also doing it, and that role you can still do but you can also observe what happens to a client and not have to participate yourself at the same time. You can make some more space for this, so you can notice things like: 'I can see that this is scary for you, is that right?'" (P2, I)

Remote counseling

When discussing the implementation of VR and biofeedback in therapy sessions, some professionals suggested that it might even be a step towards providing treatment at a distance. Having less physical contact with professionals by following treatment remotely is seen as a possible future perspective.

"I see opportunities in combination with online counseling in general. Now you often have standard timeslots for sessions, in which you mostly discuss the progress in exposure. I think that you can use VR, and the ability to share data, to do more video calling or shorter sessions and more often to see how the treatment is going and if it should be redirected." (P2, I)

One professional even talked about the creation of a virtual program that uses a personalized virtual coach to guide the client, which would allow this professional to focus on other important aspects.

"I would give the client control. The most ideal situation is that I wouldn't have to do it anymore. For instance, a virtual program that can help the client. Then I have time for other things." (P9, I)

4.3.2   The professional's attitude

It was also found that the professionals in this study varied in attitude towards the implementation of those technologies. Some like exploring new technologies and its possibilities and actively discuss this with colleagues, while others find it too much trouble and like to stick with their known therapy methods.

"I want someone to share my experience with. With whom I can talk about what works, what still needs to be developed further, or what is needed at a certain place. Just someone I can discuss things with." (P9, I)

"It takes time, and we need to leave our bastions for it. One person wants to do this, while the other doesn't. There are still people that are having trouble with a computer. They exist. That won't change." (P11, I)

4.3.3   Other purposes

VR can also be used to help people suffering from addiction and aggression by doing exposure exercises to learn to control theses impulses.

"For people with addiction, you can again do exposure I think. Such people avoid bars and parties because then they get urges again. In VR you can simulate everybody around you drinking a beer or taking drugs. Then you can ask them how they feel about that. I think those possibilities are endless." (P6, I)

"To have a practice situation for aggression regulation which approaches reality, in which someone learns to stay in control even though someone says bad things." (P9, I)

In addition, for some disorders it is possible to get treatment in groups. Using VR, clients can work together in smaller groups and help each other, which allows them to learn from each other by actually seeing that others experience fear too and react the same way, making it easier to see perspective and cope with the fear.

"You hand out a few of those VR headsets, and make groups of two or three and ask them to start practicing together in which one guides the other." (P4, I)

Further, for some clients VR can be used as a form of distraction. For instance, for people with dementia it is possible to display a safe image of the past to help people relax, or to help children during scary situations (such as a medical procedure or to change the bandages of burns) by distracting them and thereby making the procedure less painful.

"For people with dementia, I can imagine displaying images of the past, which can calm people down. For instance, watching trusted images of an 'Elfstedentocht'. To make these feel real." (P10, I)

"That's something for psychologists, to decrease children's pain so they can undergo a specific procedure. They use it a lot in the burn center when changing the bandages because that hurts a lot and medication doesn't help for that. They give all those children VR." (P9, I)

Another application of VR that was often mentioned is making simulations to increase empathy. For example, for people close to an individual with a mental disorder, it is often hard to imagine how it is to suffer from psychoses or autism. In addition, it can also be used to show people how their behavior affects others.

"To inform about specific disorders that their nearest and dearest have. An example is for children, because there are parents that get the diagnosis that their child has autism, and that they can see through VR what that exactly means." (P4, I)

"For example in system therapy when there is a fighting divorce, using the VR you can show parents how their children experience this. That would be an example for the future." (P12, I)

VR could also be a good way for staff to continue working on their professional skills. They can practice difficult situations in VR, instead of doing roleplay, which makes these situations more realistic and natural.

"I can see it as a safe practice environment in which you can learn a lot, like how to treat or provide guidance, all kinds of purposes." (P9, I)

Last, one professional saw potential in biofeedback by measuring the effects of medication, by making it possible to find out if certain medication works for a client or not; thereby reducing the amount of unnecessary prescriptions.

"Biofeedback can be used to measure the effects of medication. You can check if relaxing medication helps in stressful situations. So the combination with medicine seems nice, by checking if the medication actually works or if it has no use at all for the client during stressful situations because then you can start reducing the medication." (P12, I)

4.4   Similarities and differences between data collection methods

The aim of the in-depth interviews was to gather information about mental healthcare professionals' opinions regarding the factors that influence the implementation of VR and biofeedback. The aim of the workshop was to observe the interaction between client, therapist, and the technologies VR and biofeedback and get more insights in practical aspects. Subsequently, the aim of the evaluations was to reflect upon the professionals' experiences during the workshop. The analysis of the interviews, workshop, and evaluations discovered the same main themes. However, some preconditions of the professionals got more emphasis in the workshops and some other important considerations were discovered. One precondition that mostly emerged from the workshop was the need for technological innovation, by finding practical issues and limitations of the technologies. Additionally, it turned out that the knowledge, experience, and proof that the professionals were looking for in the interviews were mostly found during the workshop by working with the technologies. Another aspect that was mostly found during the workshop and evaluations is that the way of communication in treatments will change when using VR, since the client and professional are not able to see each other anymore.

During the current study, the combination of the in-depth interviews with the more practical workshop showed to be a valuable combination to investigate which factors influence the implementation of the technologies. In addition, the workshop evaluations that were conducted by phone showed to be an asset to this research method, by allowing the researcher to focus more on topics that have not been addressed during the workshop.

Chapter 5: General discussion

This chapter contains a summary of the current study and the most important results. Subsequently, these findings will be compared to previous work on VR and biofeedback. After this, directions for future research will be described, followed by recommendations for applications and contextual factors. Last, the chapter will finish with a conclusion.

5.1 Principal findings

The aim of this study was to examine which factors influence the implementation of VR and biofeedback by mental healthcare professionals. Since earlier work focused mainly on the effectiveness of VR and biofeedback in academic experiments, the current study focused on the perception of the mental healthcare professional regarding the implementation of VR and biofeedback in clinical practice.

In order to gain a deeper understanding on this topic, in-depth semi-structured interviews and a workshop were conducted with mental healthcare professionals. These professionals had varying job positions (mostly) within a public setting and varying familiarity and practical experience with VR and biofeedback. During this study, three main themes were found: 1) improve current treatments using VR and biofeedback, 2) the professional's preconditions, and 3) other important considerations of VR and biofeedback.

Theme 1: improve current treatments using VR and biofeedback
The first theme describes how VR and biofeedback can improve current treatments, consisting of three points. First, many professionals state that iVET still has practical restraints, which VR can solve by performing exposure exercises in the professional's office. Thereby, VR is seen as an intermediate step to make it possible to apply iVET earlier in the treatment process. Second, current treatments focus mostly on subjective measures, and biofeedback has the ability to provide objective insights in bodily processes. It allows the professional to see how the body reacts during exercises and during treatment, and it makes it easier to discuss progress. Third, the client could get more motivation by using VR to increase treatment accessibility, and using VR and biofeedback to activate the client to do more home exercises and be more proactive.

Theme 2: The professional's preconditions

The second theme describes the professional's preconditions which the technologies have to meet to become accepted in the mental healthcare system. First, it is important that the goal of the treatment is maintained by using VR and biofeedback appropriately and providing well-suited treatments to each client. Second, professionals require more knowledge and experience with the technologies (especially with biofeedback), and they want to proof (scientific or experience-based) that these technologies actually improve treatments. Third, VR and biofeedback need to be easy to use. Professionals want a standardized approach to safe time, implementation support, and the technologies should have a good reliability. Fourth, the technologies need to be innovated further. VR and biofeedback in mental healthcare is still in its infancy, which means that it is accompanied with many technological flaws.

Theme 3: Other important considerations of VR and biofeedback

The third theme summarizes other important considerations of the technologies. First, VR and biofeedback will change the way of communication during therapies since non-verbal communication is no longer possible, which the professional and the client need to get used to. However, these changes might also bring opportunities, and are possibly a step towards more remote counseling in the future. Second, the professional's attitude should also be considered, since there are varying levels of enthusiasm among professionals regarding the implementation of VR and biofeedback. Third, other purposes of VR and biofeedback were mentioned and shortly summarized.

5.2   Comparison with existing literature

Most of the characteristics of the technologies are in line with previous research, described in Chapter 2. Professionals have a positive attitude towards the implementation of VR and biofeedback in mental healthcare, but also addressed preconditions which technologies should meet. In addition, important other considerations of VR and biofeedback were found during the current study.

5.2.1   Improve current treatments using VR and biofeedback

To compare the general findings with the existing literature, the first theme will be discussed, consisting of solving practical restraints of iVET, more objective insights in bodily processes, and motivation for the client.

First, during the current study, the professionals mentioned VR mostly in combination with exposure therapy, which is in line with the existing literature (Eichenberg & Wolters, 2012; Parsons & Rizzo, 2008; Riva et al., 2016; Rothbaum et al., 1995; Valmaggia et al., 2016). This is not surprising since VR is currently mostly used for exposure purposes. Therefore, the characteristics of VR that can solve practical restraints of iVET were similar to the ones found in the literature (Hartanto et al., 2014; Kampmann et al., 2016; Krijn et al., 2004; Morina et al., 2015; Riva et al., 2010; Rothbaum et al., 1999). However, in the existing literature, VRT is discussed as an alternative to iVET (Riva et al., 2010), while the professionals in this study saw VRT mainly as an intermediate step to apply iVET earlier, since iVET is still seen as the most effective treatment. A reason for this may be that professionals are not familiar enough with the incorporation of VR in treatments, and therefore it is possible that their opinion on this topic will change if they start working with the technology.

Second, professionals stated that they want biofeedback to provide objective insights in bodily processes. Focusing more on social-biofeedback, professionals see this as a valuable tool to monitor treatment progress, which corresponds to benefits described in literature (Clough & Casey, 2011; Lang & McTeague, 2009; Reiner, 2008). However, the professionals added that they would like to use this knowledge to specify which specific stimuli are stressful for a client when conducting exposure therapy in VR. This combination was not found in existing research, which insinuates a gap in the literature that needs further investigation. However, if biofeedback is used in such a way, professionals should be careful for the "Othello's error", as described by Frank (2017). This means that they can always use the bio-data as a reason to start a conversation, but they should be careful with interpreting the information and drawing conclusions. This was also suggested by Schoenberg and David (2014).

Third, according to the professionals that participated in this study, VR increases the motivation of clients by making therapy more accessible, which corresponds to existing literature (Garcia-Palacios et al., 2007; Garcia-Palacios et al., 2001; Riva et al., 2010). Furthermore, the current study also found that VR and biofeedback can be used to activate clients to do more home exercises and to be more proactive, which was mentioned by Reiner (2008).

The comparison between existing literature and the results found in the current study indicate that not only academic research showed added value of incorporating VR and biofeedback in mental healthcare, but mental healthcare professionals see this as well, thereby confirming that both technologies can be used to improve treatments. However, especially when combining VR and biofeedback, professionals have

different ideas about how this combination should be used in clinical practice, showing the importance of the current study.

5.2.2 The professional's preconditions

The second theme describes the professional's preconditions, which are 1) maintain the goal of the treatment, 2) knowledge, experience, and proof, 3) easy to use, and 4) technological innovation. The preconditions of the professionals that were found in the current study and the benefits and challenges of VR and biofeedback retrieved from existing literature are directly linked.

First, existing literature did not mention that the use of technologies should always be in line with the goal of the treatment, which was an important precondition in the current study. An example why this is so important for professionals is the following: according to mental healthcare professionals, applications in which a person's biofeedback influences components in the virtual environment (as is described in e.g., Gaggioli et al., 2014; Gorini et al., 2010; Pallavicini et al., 2009), will only make clients more scared – which is the opposite of the goal they are trying to reach. However, existing literature is focusing mostly on such applications, thereby skipping an important step. Every client and every mental disorder is different, which means a pre-study should be conducted to examine exactly what is needed when treating clients with specific mental disorders before starting a study investigating the combination of two novel technologies for mental healthcare. With this information in mind, researchers should try to develop technologies that enhance treatments, thereby using standard proven treatments methods as a starting point. In addition, there is always a group of clients who are unfit to use VR and/or biofeedback, which is often caused by their disorder: clients with a compulsion disorder might become obsessed with biofeedback, and clients with cognitive disabilities will probably not understand how it works. For the implementation of online counseling suitability was already established as an important factor for professionals (Koufou & Markovic, 2017; Simms et al., 2011), but literature on VR and biofeedback hardly mentions this. A suggested explanation is that academic research is mostly focusing on mental disorders in general. In contrast, professionals are used to look at each specific client personally. Thereby, they can acknowledge characteristics that do not go well together with technologies, which are unable to be seen by researchers in lab settings.

Second, professionals want knowledge on how to use the technologies, which is also mentioned by the existing literature (Eichenberg & Wolters, 2012). In addition, it was also very important for mental

healthcare professionals to have sufficient proof that these technologies can actually contribute to their treatments, like practical proof through experience (such as workshops) or scientific proof included in their education. This is supported by the study of Feijt et al., (2018), which showed that knowledge, experience, and proof all contribute to the amount a professional believes in the added value of technology.

Third, the professionals also want the technologies to be easy to use, by having a standardized approach, implementation support, and good reliability. These were all also addressed in literature (Clough & Casey, 2011; Eichenberg & Wolters, 2012; Lanata et al., 2015; Lisetti & Nasoz, 2004; Liu et al., 2017; Riva, 2009; Schoenberg & David, 2014; Soh et al., 2015). However, Fairclough, (2008) mentioned other disadvantages of biofeedback, such as a time lag between having emotions and physiology and the many-to-many relationships between emotions and physiology, which did not occur during the current study. The reason for this may be because professionals stated to have little knowledge about biofeedback, which makes it difficult to judge more complicated aspects such as these.

Fourth, both the current study as existing literature acknowledged that there are still many challenges that need to be addressed before the implementation of VR and biofeedback is feasible (Clough & Casey, 2011; Dekker & Champion, 2007; Eichenberg & Wolters, 2012; Fairclough, 2008; Merrill & Cheshire, 2017; Riva, 2009; Schoenberg & David, 2014; Yellowlees et al., 2012). There are still practical issues, such as flaws in the interface or devices that do not work (well).

From these preconditions, it can be concluded that by focusing on the perspective of mental healthcare professional, the current study found results that are more closely related to clinical practice. Because of this focus, it became clear that practical implementation factors are most important in the successful deployment of VR and biofeedback, which was also found during similar studies on online counseling (Koufou & Markovic, 2017; Mallen et al., 2005; Perle et al., 2013; Simms et al., 2011).

5.2.3 Other important considerations of VR and biofeedback

The third theme entails other important considerations of the technologies: different communication in therapies, the professional's attitude, and other purposes of VR and biofeedback.

First, an important aspect that was reported during the current study, but was not mentioned in the existing literature, is how VR and biofeedback will change the way of communication in treatments. The client is wearing a VR HMD, through which non-verbal communication becomes impossible and makes it more difficult for the professional to read the client's facial expressions. Therefore, they need to find other

ways to communicate. To start, this can be done by using more verbal communication. Additionally, letting the client wear biofeedback provides the professional with new (physiological) information. It is possible that this new data source can make up for the loss in non-verbal data. Some professionals even suggested to use both technologies for (more) remote counseling in the future. A reason why this aspect was not incorporated in literature, but was found during this study, may be explained by the more practical nature of the current study in which the technologies were tried in a therapeutic setting. In addition, other technological consequences such as simulation sickness (Eichenberg & Wolters, 2012; Valmaggia et al., 2016) and ethical guidelines (Cowie, 2015; Yellowlees et al., 2012) were not mentioned by professionals at all. Since VR and biofeedback are not yet incorporated in clinical practice, the first step for professionals is to implement the technologies, before thinking about further consequences – which might explain the difference between the current study and existing literature.

Second, another important consideration is the professional's attitude. Some professionals are very willing to try VR and biofeedback, while others want to stick with their known traditional therapy methods. The attitude of professionals towards new technologies was also addressed by Ager (as cited in Clough & Casey, 2011) and Feijt et al. (2018), and the current study established that this factor is important in the implementation process of VR and biofeedback too.

Third, other purposes for VR, like relaxation (Kosunen et al., 2016), pain management (Karaman, 2016), and physical rehabilitation (Shema et al., 2014), the ability to create empathy (Swartzlander et al., 2017), and educational purposes (Mantovani et al., 2003) were also mentioned during the interviews. Professionals also added the potential of biofeedback to measure the effect of medication.

The results of this theme showed that the implementation of VR and biofeedback comes with important considerations. This means that further research should be conducted to examine what will happen with therapies when these technologies are incorporated.

5.3   Limitations and directions for future research

The participants of this study mostly worked at GGzE. This organization is already actively pursuing innovation in healthcare, causing many professionals to be more acquainted with VR than professionals of other organizations might have been. Additionally, GGzE is using VR mainly for exposure exercises for clients with anxiety disorders. This purpose of VR in mental healthcare was also mostly mentioned by participants in this study. Based on their already existing knowledge, this might mean that participants are

biased about the usage of VR in mental healthcare. To prevent such biases, future research should include participants from various mental healthcare organizations, with varying levels of knowledge in this field. This can be done using a similar qualitative approach with other participants, or by conducting a quantitative study. Sending out a questionnaire to a larger group of mental healthcare professionals makes it also possible to generalize the findings of the current study.

In addition, the results found during the workshop are also difficult to generalize. The workshop provided valuable insights in the interaction between professionals, clients, and technologies, such as the need for technological innovation and the need for knowledge and experience. However, the workshop was only repeated three times, with a total of 9 participants. This small amount of participants is not representative for all mental healthcare professionals. Therefore, future research should conduct more workshops to see if the same results are found.

During the workshop, the professionals reported that it especially helped to be able to actively interact with the technologies to provide a better idea how they can and should be used in practice. Therefore, another research suggestion is to conduct workshops focusing on the preconditions specified by the professionals in the second theme of the current study. Introducing the professionals with varying possibilities of VR and biofeedback makes it possible to further specify which features are most important for certain treatments (e.g., when a technology is easy to use, or when it is applied in such a way that it fits the goal of the treatment appropriately).

In addition, it is also interesting to investigate if professionals are more willing to use VR and biofeedback if they have experienced the technologies themselves (as was suggested by participants in the current study) in comparison with professionals who did not get a chance to try these.

When conducting workshops, it should be mentioned that a few participants reported that it was difficult to do a practice situation and play an anxious client with claustrophobia if you are not really anxious. This means that in future research it might be more valuable to provide practice situations with demonstrations that are a little scary to almost everyone to make them more natural (e.g., a simulation in which a person gets stuck in an elevator, or running into a big bear in the woods).

Further, it was also found that most professionals see a lot of potential in using biofeedback in mental healthcare, but are not as familiar with this technology as they are with VR. Unfortunately, the biofeedback device that was used during the workshop did not work (well), making it relatively useless in the practice scenario. Even though, many professionals stated they still saw lots of potential in having

information about bodily signals and were curious to find out how it would work and which physiological measures would be useful. Therefore, an important next step would be to do a follow-up study with mental healthcare professionals, in which the focus is purely on how biofeedback should be implemented in clinical practice. This study should contain different biofeedback devices, measuring various bio-signals, and different interfaces displaying the bio-data. By doing this, it is possible to examine which physiological measures professionals desire, how they should be visualized, and whether it is even feasible to distract valuable information from the bio-data to provide more targeted help.

In addition, in the current study professionals reported that biofeedback can also possibly be used to monitor treatment progress. This raises the question if it is possible to make treatments more effective if the client's biofeedback is measured at the beginning and ending of every therapy session, which might therefore also be an interesting topic to address.

Furthermore, since many professionals in the current study stated that they are positive about the combination of VR and biofeedback, this should be examined further. Such a study can investigate if this combination in fact has added value in comparison with using both technologies separately, and how this combination should look like.

One of the aspects that was found during the current study was that technologies are not suitable for all clients. Future research might want to dig deeper into which characteristics matter when determining if a technology has potential to help. Professionals now mentioned that some clients are probably unfit to use VR or biofeedback. Perhaps, investigating what makes a client unsuitable for a technology gives the ability to adapt technologies in such a way that even the unfit individuals become fit for the usage of technology in mental healthcare (e.g., making it usable for people with less cognitive abilities). By doing this, professionals who are now skeptical about the implementation of technologies for certain clients might be more willing to use these if they see that their client's characteristics are taken into account.

Another possibility for future research is an investigation into the interaction between technologies, professional, client, and therefore therapy methods. It might be interesting to find out if the implementation of VR and biofeedback actually changes therapies. For instance, in the comparison with existing literature, the current study showed that professionals see VR as an intermediate step before conducting iVET. It might however be interesting to examine if professionals still see VR in this way after using it for a while. Now it is just a means to an end to apply iVET earlier, but it might be possible that the implementation of VR changes therapy methods in such a way that iVET becomes redundant.

In addition, the current study also found that VR changes the way of communication in therapies because non-verbal communication is no longer possible. This means that professionals need to communicate more verbally with their client, or they need another measure to gain information about their client's well-being. Biofeedback can possibly replace this loss by providing the professional with physiological information about their client. Developments such as these might have consequences for the way treatments are conducted by professionals. What these consequences will be is also an important topic to examine.

Furthermore, the usage of biofeedback and VR outside of therapy was often mentioned, since conducting exercises at home is part of the treatment process. However, the current study found that it is often difficult to motivate clients to do home exercises. It might be therefore be interesting to examine whether clients are actually more motivated to practice outside of therapy using biofeedback and VR for their home exercises, and if this increases the effectiveness of the treatments.

Another question related to the usage of technologies outside of therapy is the advent of remote counseling, which was mentioned as potential future possibility. Future research can examine how VR and biofeedback can change counseling from a distance, and how remote counseling can change mental healthcare.

5.4 Recommendations

Based on the findings in the current study and literature, recommendations can be made for applications and contextual factors.

5.4.1 Recommendations for applications

It was found that the main advantage of VR is to perform exercises in the professional's office, while the main advantage of biofeedback is to provide objective insights in bodily processes. Therefore, it is recommended that VR and biofeedback are applied on different occasions during the therapeutic process (see Figure 2). Psychological treatments have three phases: 1) the diagnosis, 2) the therapeutic work, and 3) evaluating the effectiveness (Unoka, n.d.). VR should be used for the second phase, as a mean to perform for instance exposure exercises. Biofeedback should be used throughout the whole process, facilitating two different purposes. First, it can be used to monitor treatment progress by assisting the diagnosis in phase 1 to gain insights in the maladaptive responses of the client, checking how the therapeutic work affects the

client in phase 2, and eventually evaluating the effectiveness of the treatment in phase 3. Second, biofeedback can also be used to assist in phase 2, by measuring the client's bodily responses during exercises, thereby making it possible for the professional to provide more targeted help.
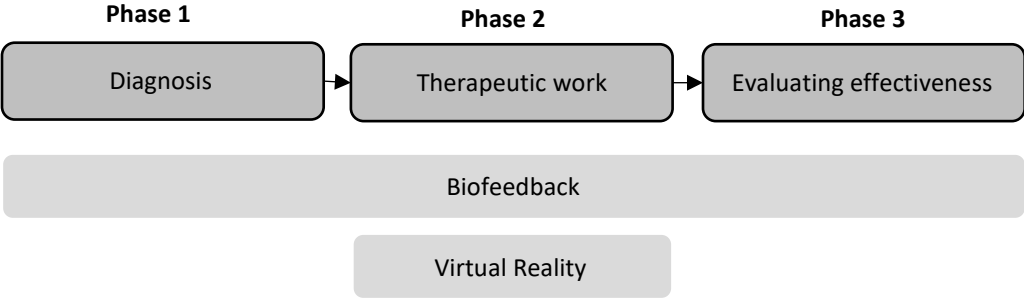
Phase 1		Phase 2		Phase 3
Diagnosis	→	Therapeutic work	→	Evaluating effectiveness

Biofeedback

Virtual Reality

Figure 2. Illustration of Virtual Reality and biofeedback in different phases in psychological treatment

Phase 2: therapeutic work

When zooming in on the second phase of psychological treatment – therapeutic work – a certain combination of VR and biofeedback in clinical practice can be recommended. Based on section 4.1.2, professionals need to see bio-data that is already interpreted for them, making it possible to quickly assess their client's stress level. Therefore, it is recommended that there is a screen available in the treatment room on which the professional can see exactly what the client sees, but in addition also sees a bar displaying biofeedback, which is coloring green when the client is totally relaxed and red when the client is totally stressed out. Subsequently, the professional can use this knowledge to compare the client's view with the client's bodily signals to get a better understanding of what triggers the fear. Hereafter, it is up to the professional to decide if it is best to talk about these findings during the exercises, or show the client graphs of their bodily signals (in combination with the view) afterwards. It is expected that the implementation of VR and biofeedback in such a way will increase the quality of the treatment by making it possible for the professional to make treatments more targeted. However, a critical side note should be made. As was seen during the workshop, biofeedback devices are not always reliable. Additionally, problems like the time lag between having certain emotions and the corresponding physiological changes, movement errors, many-to-many relationships – as described by Fairclough (2008) – should be taken into account by the professional. Current biofeedback devices should therefore only be used as a guideline for the professional; to start a meaningful conversation with the client and explore what (and if) this information about bodily signals means (anything).

5.4.2   Recommendations for contextual factors

Recommendations for contextual factors will be given based on the established preconditions of professionals.

Increase technological awareness

To start, it is recommended that technological awareness is increased. This should be done in two ways. First, more workshops should be conducted in which mental healthcare professionals are introduced to the possibilities of VR and biofeedback, so that they can try these out for themselves. In this way, they become acquainted with the technologies and see its opportunities. This will, according to the professionals who participated in this study, increase enthusiasm and willingness to use. Additionally, it will also provide more insights in practical limitations (such as the necessity of having in addition to visual feedback in some cases also audile and tactile feedback), and in considerations when using the technologies (such as change in communication during therapies caused by the inability to communicate non-verbally). The second way to increase technological awareness is providing professionals with the appropriate training on the usage and implementation of the technologies. VR and biofeedback should get more attention in the education of students who are studying to become mental healthcare professionals. This will ensure both the knowledge, experience, and proof that professionals need to eventually make VR and biofeedback standard in clinical care. In addition, for mental healthcare professional who are already working, courses should be developed in which professionals learn everything they need to know about the technologies.

User-friendly human-technology interaction

Professionals need technologies that are quickly and easy to use; they need a user-friendly human-technology interaction. This means that it is recommended that obtaining the needed technological materials for a treatment should be made as simple as possible. One way to do that is by making it easier for professionals to place an order to get certain materials. For example, GGzE has an eLab which focuses on innovations in mental healthcare (GGzEi, n.d.). It should be possible for a professional to easily fill in a form to request a certain VR practice environment at for instance the eLab, and have access to it within a few days. In addition, professional need technological support. Using technologies is not their core business, which means that there should be a helpdesk available if problems with the technologies occur. This helpdesk can either be physically present in their building or digitally through telephone, but professionals need the confidence that they will be helped instantly when something goes wrong. Easy access to

technological material and technical support can both be provided by for instance the eLab, but this would mean that the capacity of engineers who are able to make virtual environments and manage the equipment should increase to realize this in practice – which means that the organization should invest in innovation.

Another recommendation regarding this topic that is more focusing on the long-term perspective would be to have a standardized VR software system. In this system, professionals should be able to choose a certain virtual environment with a simple click of the mouse and make small changes like adding or removing certain elements, if desired. Such a system would make it possible for the professional to control and manipulate the practice situation, and thereby customize therapy to each individual. However, it is recommended that the equipment should have an interface that speaks for itself. If it is not simple enough or if it does not work, it will become too much of a burden to use it. How such an interface must look like can best be explained with an example of an interface for anxiety treatments. The most ideal situation is that the professional has a library including different practice situations for different phobias. If the professional wants to use the VR with someone with arachnophobia (fear of spiders), it should be possible to adjust the spider's appearance and/or behavior, by making it bigger or smaller, adding other spiders, or adjusting its movements. All in relation to the client's fears. However, although the development of VR is going rapidly (Anthes, Garcia-Hernandez, Wiedemann, & Kranzlmuller, 2016), it still takes a lot of time to customize a virtual environment to the needs of an individual (Baños et al., 2009; Riva, 2009). Standardized VR software is not yet available (Clough & Casey, 2011), and it will probably take years before such a system is developed and functions well enough to be implemented in mental healthcare. However, if it is realized someday, it will probably transform the way treatments are conducted in mental healthcare.

Implementation freedom for professionals

To make implementation of technologies possible, it is recommended that professionals are given more time to adapt to these changes in mental treatments. They need time to try out the possibilities, find their own way of using it, and discuss problems and solutions with colleagues. Professionals should be able to choose whether they want to use VR, biofeedback, both, or none at all. The main goal of providing therapy is to help clients with mental problems. If professionals are enthusiastic about the possibilities the technologies bring, it is well recommended to use the technologies. However, if professionals feel no need to use them then they should not have to. It is up to the professional to determine if the usage of VR and/or biofeedback adds value in a treatment.

5.5 Conclusion

The current study used a mixed-method design with a qualitative approach by conducting in-depth semi-structured interviews, a workshop, and workshop evaluations with mental healthcare professionals to examine which factors influence the implementation of VR and biofeedback. Whereas earlier work focused mainly on the effectiveness of VR and biofeedback in academic experiments, the current study focused on the perception of mental healthcare professionals in clinical practice. Three main themes emerged. The first theme discussed how VR and biofeedback can improve current treatments in three ways: 1) solving practical restraints of iVET, 2) providing objective insights in bodily processes, and 3) motivating the client. However, in order for these technologies to be successfully deployed, the second theme described four preconditions addressed by the professionals: 1) maintain the goal of the treatment, 2) knowledge, experience, and proof, 3) easy to use, and 4) technological innovation. The third and last theme described three other important considerations of VR and biofeedback: 1) different communication in therapies, 2) the professional's attitude, and 3) other purposes. Based on these findings, it is recommended to increase technological awareness, to have a user-friendly human-technology interaction, and give professionals implementation freedom.

During this study, it was confirmed by mental healthcare professionals that VR and biofeedback can add value to treatments. In addition, many characteristics of the technologies found in the literature were also recognized and supported in the current study. Although many professionals are positive towards the implementation of VR and biofeedback in mental healthcare, caution was discovered in their attitudes. The usage of technologies is not the core business of a mental healthcare professional. Their preconditions showed that mostly practical factors are important: VR and biofeedback should be working and ready to use. However, currently the technologies are not meeting these preconditions. This means that more effort is needed to satisfy the needs of professionals, which could in the end facilitate successful implementation of VR and biofeedback in mental healthcare.

References

Alonso, J., Angermeyer, M. C., Bernert, S., Bruffaerts, R., Brugha, T. S., Bryson, H., ... Vollebergh, W. A. M. (2004). Prevalence of mental disorders in Europe: Results from the European Study of the Epidemiology of Mental Disorders (ESEMeD) project. *Acta Psychiatrica Scandinavica*, *109*(420), 21–27. https://doi.org/10.1111/j.1600-0047.2004.00327.x

Ann, R., & Parrish, R. O. Z. (2008). Treatment and Management. *Developmental-Behavioral Pediatrics: Evidence and Practice*, 203–280. https://doi.org/10.1016/B978-0-323-04025-9.50011-8

Anthes, C., Garcia-Hernandez, R. J., Wiedemann, M., & Kranzlmuller, D. (2016). State of the art of virtual reality technology. *2016 IEEE Aerospace Conference*, 1–19. https://doi.org/10.1109/AERO.2016.7500674

Anthes, C., García-Hernández, R. J., Wiedemann, M., & Kranzlmüller, D. (2016). State of the Art of Virtual Reality Technology. *2016 IEEE Aerospace Conference, At Big Sky, Montana, United States*, 19. https://doi.org/10.1109/AERO.2016.7500674

ATLAS.ti. (n.d.). What is ATLAS.ti? Retrieved July 13, 2018, from https://atlasti.com/product/what-is-atlas-ti/

Baños, R. M., Botella, C., Guillen, V., García-Palacios, A., Quero, S., Bretón-López, J., & Alcañiz, M. (2009). An adaptive display to treat stress-related disorders: EMMA's world. *British Journal of Guidance and Counselling*, *37*(3), 347–356. https://doi.org/10.1080/03069880902957064

Baños, R. M., Guillen, V., Quero, S., García-Palacios, A., Alcaniz, M., & Botella, C. (2011). A virtual reality system for the treatment of stress-related disorders: A preliminary analysis of efficacy compared to a standard cognitive behavioral program. *International Journal of Human Computer Studies*, *69*(9), 602–613. https://doi.org/10.1016/j.ijhcs.2011.06.002

Bateman, A., Brown, D., & Pedder, J. (2010). *Introduction to Psychotherapy. An Outline of Psychodynamic Principles and Practice* (4th ed.). East Sussex: Routledge.

Beatty, J., & Legewie, H. (2013). *Biofeedback and behavior*. New York, NY: Springer Science & Business Media.

Bersak, D., McDarby, G., Augenblick, N., McDarby, P., McDonnell, D., McDonald, B., & Karkun, R. (2001). Intelligent Biofeedback Using an Immersive Competitive Environment. In *Designing Ubiquitous Computer Games Workshop*.

Bradley, M. M., & Lang, P. J. (2007). Emotion and Motivation. In J. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *The Handbook of Psychophysiology* (3rd ed., pp. 581–607). New York, NY: Cambridge University Press.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Cacioppo, J. T., Tassinary, L. G., & Berntson, G. G. (2007). Psychophsiological Science: Interdisicplinary Approaches to Classic Questions About the Mind. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *The Handbook of Psychophysiology* (3rd ed., pp. 1–16). New York, NY: Cambridge University Press.

Clough, B. A., & Casey, L. M. (2011). Technological adjuncts to enhance current psychotherapy practices: A review. *Clinical Psychology*

Review, *31*(3), 279–292. https://doi.org/10.1016/j.cpr.2010.12.008

Cowie, R. (2015). Ethical Issues in Affective Computing. In R. A. Calvo, S. D'Mello, J. Gratch, & A. Kappas (Eds.), *The Oxford Handbook of Affective Computing* (pp. 334–348). New York, NY: Oxford University Press.

Dekker, A., & Champion, E. (2007). Please Biofeed the Zombies: Enhancing the Gameplay and Display of a Horror Game Using Biofeedback. In *Proceedings of DiGRA 2007 Conference* (pp. 550–558). https://doi.org/10.1.1.190.1500

Eichenberg, C., & Wolters, C. (2012). Virtual Realities in the Treatment of Mental Disorders: A Review of the Current State of Research. In *Virtual Reality in Psychological, Medical and Pedagogical Applications* (pp. 35–64). InTech. https://doi.org/10.5772/50094

Ekman, P. (1992). *Telling lies: Clues to deceit in the marketplace, politics, and marriage*. New York, NY: WW - Norton & Company. https://doi.org/10.1007/978-3-319-13945-6

Empatica. (2018). E4 wirstband from empatica. Retrieved March 2, 2018, from https://www.empatica.com/research/e4/

Fairclough, S. H. (2008). Fundamentals of physiological computing. *Interacting with Computers*, *21*(1–2), 133–145. https://doi.org/10.1016/j.intcom.2008.10.011

Falconer, C. J., Rovira, A., King, J. A., Gilbert, P., Antley, A., Fearon, P., … Brewin, C. R. (2016). Embodying self-compassion within virtual reality and its effects on patients with depression. *British Journal of Psychiatry Open*, *2*(1), 74–80. https://doi.org/10.1192/bjpo.bp.115.002147

Feijt, M. A., De Kort, Y. A. W., Bongers, I. M., & IJsselsteijn, W. A. (2018). Perceived Drivers and Barriers to the Adoption of eMental Health by Psychologists: The Construction of the Levels of Adoption of eMental Health Model. *Journal of Medical Internet Research*, *20*(4). https://doi.org/10.2196/jmir.9485.

Francis, J. J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M. P., & Grimshaw, J. M. (2010). What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychology and Health*, *25*(10), 1229–1245. https://doi.org/10.1080/08870440903194015

Frank, L. E. (2017). Ethics & Affective Computing [Powerpoint slides]. Retrieved from Eindhoven University of Technology, Psychophysiology and Affective Computing. Canvas: https://canvas.tue.nl.

Gaggioli, A., Pallavicini, F., Morganti, L., Serino, S., Scaratti, C., Briguglio, M., … Riva, G. (2014). Experiential virtual scenarios with real-time monitoring (interreality) for the management of psychological stress: A block randomized controlled trial. *Journal of Medical Internet Research*, *16*(7). https://doi.org/10.2196/jmir.3235

Garcia-Palacios, A., Botella, C., Hoffman, H., & Fabregat, S. (2007). Comparing Acceptance and Refusal Rates of Virtual Reality Exposure vs. In Vivo Exposure by Patients with Specific Phobias. *CyberPsychology & Behavior*, *10*(5), 722–724. https://doi.org/10.1089/cpb.2007.9962

Garcia-Palacios, A., Hoffman, H. G., Kwong See, S., Tsai, A., & Botella, C. (2001). Redefining Therapeutic Success with Virtual Reality Exposure Therapy. *CyberPsychology & Behavior*, *4*(3), 341–348. https://doi.org/10.1089/109493101300210231

Gergely, G., & Watson, J. S. (1999). Early Socio-Emotional Development: Contingency Perception and the Social-Biofeedback Model. *Early Social Cognition: Understanding Others in the First Months of Life*, 101–136. https://doi.org/10.1111/j.1365-2214.1992.tb00355.x

GGzE. (n.d.-a). Ervaringsdeskundigen. Retrieved June 6, 2018, from https://www.werkenbijggze.nl/portal-vervolgpagina/ervaringsdeskundigen

GGzE. (n.d.-b). Waar staan we voor? Retrieved July 18, 2018, from https://www.ggze.nl/over-ggze/waar-staan-we-voor

GGzEi. (n.d.). eLab. Retrieved June 27, 2018, from https://www.ggzei.nl/innovatie/elab

Gorini, A., Pallavicini, F., Algeri, D., Repetto, C., Gaggioli, A., & Riva, G. (2010). Virtual reality in the treatment of generalized anxiety disorders. *Studies in Health Technology and Informatics*, *154*, 39–43. https://doi.org/10.3233/978-1-60750-561-7-39

Gruzelier, J., & Egner, T. (2004). Physiological self-regulation: Biofeedback and neurofeedback. In A. Williamon (Ed.), *Musical Excellence: Strategies and Techniques to Enhance Performance* (pp. 197–219). London: Oxford University Press. https://doi.org/10.1093/acprof

Hartanto, D., Kampmann, I. L., Morina, N., Emmelkamp, P. G. M., Neerincx, M. A., & Brinkman, W. P. (2014). Controlling social stress in virtual reality environments. *PLoS ONE*, *9*(3). https://doi.org/10.1371/journal.pone.0092804

Heim, C., & Nemeroff, C. B. (1999). The impact of early adverse experiences on brain systems involved in the pathophysiology of anxiety and affective disorders - A chronobiological analysis The Impact of Early Adverse Experiences on Brain Systems Involved in the Pathophysiology of Anxiety a. *Society of Biological Psychiatry*, *46*, 1509–1522.

Jerald, J. (2016). *The VR Book: Human-Centered Design for Virtual Reality*. Morgan & Claypool Publishers.

Kampmann, I. L., Emmelkamp, P. M. G., Hartanto, D., Brinkman, W. P., Zijlstra, B. J. H., & Morina, N. (2016). Exposure to virtual social interactions in the treatment of social anxiety disorder: A randomized controlled trial. *Behaviour Research and Therapy*, *77*, 147–156. https://doi.org/10.1016/j.brat.2015.12.016

Karaman, D. (2016). Virtual Reality and Pain Management. *International Journal of Health Sciences and Research*, *6*(12), 288–291.

Kersten - van Dijk, E. (2017). Psychophysiology & Affective Computing [Powerpoint slides]. Retrieved from Eindhoven University of Technology, Psychophysiology and Affective Computing. Canvas: https://canvas.tue.nl.

Kessler, R. C., & Greenberg, P. E. (2002). The economic burden of anxiety and stress disorders. *Neuropsychopharmacology: The Fifth Generation of Progress*, *67*, 981–992.

Kosunen, I., Salminen, M., Järvelä, S., Ruonala, A., Ravaja, N., & Jacucci, G. (2016). RelaWorld: Neuroadaptive and Immersive Virtual Reality Meditation System. In *Proceedings of the 21st International Conference on Intelligent User Interfaces - IUI '16* (pp. 208–217). https://doi.org/10.1145/2856767.2856796

Koufou, I., & Markovic, D. (2017). E-Therapy: The Psychotherapists' Perspective - A Phenomenological Enquiry. *Journal of Psychotherapy and Counselling Psychology Reflections*, *2*(1), 25–31.

Krijn, M., Emmelkamp, P. M. G., Olafsson, R. P., & Biemond, R. (2004). Virtual reality exposure therapy of anxiety disorders: A review. *Clinical Psychology Review*, *24*(3), 259–281. https://doi.org/10.1016/j.cpr.2004.04.001

Lanata, A., Valenza, G., Nardelli, M., Gentili, C., & Scilingo, E. P. (2015). Complexity Index From a Personalized Wearable Monitoring System for Assessing Remission in Mental Health. *IEEE Journal of Biomedical and Health Informatics*, *19*(1), 132–139. https://doi.org/10.1109/JBHI.2014.2360711

Lang, P. J., & McTeague, L. M. (2009). The anxiety disorder spectrum: Fear imagery, physiological reactivity, and differential diagnosis. *Anxiety Stress Coping*, *22*(1), 5–25. https://doi.org/10.1080/10615800802478247.The

Larson, E. B., Feigon, M., Gagliardo, P., & Dvorkin, A. Y. (2014). Virtual reality and cognitive rehabilitation: A review of current outcome research. *NeuroRehabilitation*, *34*(4), 759–772. https://doi.org/10.3233/NRE-141078

Lee, J., Kim, J.-K., & Wachholtz, A. (2015). The benefit of heart rate variability biofeedback and relaxation training in reducing trait anxiety. *Korean Journal of Health Psychology*, *20*(2), 391–405. https://doi.org/10.17315/kjhp.2015.20.2.002

Lehrer, P. M. (2017). Heart rate variability biofeedback and other psychophysiological procedures as important elements in psychotherapy. *International Journal of Psychophysiology*. https://doi.org/10.1016/j.ijpsycho.2017.09.012

Li, A., Montaño, Z., Chen, V. J., & Gold, J. I. (2011). Virtual reality and pain management: current trends and future directions. *Pain*, *1*(2), 147–157. https://doi.org/10.2217/pmt.10.15.Virtual

Lindner, P., Miloff, A., Hamilton, W., Reuterskiöld, L., Andersson, G., Powers, M. B., & Carlbring, P. (2017). Creating state of the art, next-generation Virtual Reality exposure therapies for anxiety disorders using consumer hardware platforms: design considerations and future directions. *Cognitive Behaviour Therapy*, *46*(5), 404–420. https://doi.org/10.1080/16506073.2017.1280843

Lisetti, C. L., & Nasoz, F. (2004). Using Noninvasive Wereable Computers to Te recognize human emotions from Physiological signals. *EURASIP Journal on Advances in Signal Processing*, *11*, 1672–1687. https://doi.org/10.1155/S1110865704406192

Lisetti, C., Pozzo, E., Lucas, M., Hernandez, F., Silverman, W., Kurtines, B., & Pasztor, A. (2009). Second Life, Bio-Sensors, and Exposure Therapy for Anxiety Disorders. *Annual Review of Cybertherapy and Telemedicine*, 19–21. https://doi.org/10.3233/978-1-60750-017-9-19

Liu, Y., Pharr, M., & Salvatore, G. A. (2017). Lab-on-Skin: A Review of Flexible and Stretchable Electronics for Wearable Health Monitoring. *ACS Nano*, *11*(10), 9614–9635. https://doi.org/10.1021/acsnano.7b04898

Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Reger, G. M. (2011). mHealth for Mental Health: Integrating Smartphone Technology in Behavioral Healthcare. *Professional Psychology: Research and Practice*, *42*(6), 505–512. https://doi.org/10.1037/a0024485

Maarsingh, B. M., Martin Abello, K., & Bos, J. (2017). *"Stressjam", a mindset game changer? A pilot study*.

Mallen, M. J., Vogel, D. L., & Rochlen, A. B. (2005). *The Practical Aspects of Online Counseling: Ethics, Training, Technology, and Competency. The Counseling Psychologist* (Vol. 33). https://doi.org/10.1177/0011000005278625

Mantovani, F., Castelnuovo, G., Gaggioli, A., & Riva, G. (2003). Virtual Reality Training for Health-Care Professionals. *Cyberpsychology& Behavior*, *6*(4), 389–395. https://doi.org/10.1089/109493103322278772

Marshall, C., & Rossman, G. B. (1995). *Designing qualitative research* (2nd ed.). Thousand Oaks, California: SAGE Publications.

McCann, R. A., Armstrong, C. M., Skopp, N. A., Edwards-Stewart, A., Smolenski, D. J., June, J. D., … Reger, G. M. (2014). Virtual reality exposure therapy for the treatment of anxiety disorders: An evaluation of research quality. *Journal of Anxiety Disorders*, *28*(6), 625–631. https://doi.org/10.1016/j.janxdis.2014.05.010

Menon, V., Rajan, T., & Sarkar, S. (2017). Psychotherapeutic applications of mobile phone-based technologies: A systematic review of current research and trends. *Indian Journal of Psychological Medicine*, *39*(1), 4. https://doi.org/10.4103/0253-7176.198956

Merrill, N., & Cheshire, C. (2017). Trust Your Heart: Assessing Cooperation and Trust with Biosignals in Computer-Mediated Interactions. *CSCW '17 Proceedings of the ACM 2017 Conference on Computer Supported Cooperative Work*, 2–12. https://doi.org/10.1145/2998181.2998286

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: A sourcebook* (2nd ed.). Thousend Oaks, CA: Sage Publications.

Morina, N., IJntema, H., Meyerbröker, K., & Emmelkamp, P. M. G. (2015). Can virtual reality exposure therapy gains be generalized to real-life? A meta-analysis of studies applying behavioral assessments. *Behaviour Research and Therapy*, *74*, 18–24. https://doi.org/10.1016/j.brat.2015.08.010

Pallavicini, F., Algeri, D., Repetto, C., Gorini, A., & Riva, G. (2009). Biofeedback, Virtual Reality and Mobile Phones in the Treatment of Generalized Anxiety Disorder (GAD): a Phase-2 Controlled Clinical Trial. *Journal of CyberTherapy & Rehabilitation*, *2*(4), 315–327.

Parsons, T. D., & Rizzo, A. A. (2008). Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: A meta-analysis. *Journal of Behavior Therapy and Experimental Psychiatry*, *39*(3), 250–261. https://doi.org/10.1016/j.jbtep.2007.07.007

Perle, J. G., Langsam, L. C., Randel, A., Lutchman, S., Levine, A. B., Odland, A. P., … Marker, C. D. (2013). Attitudes Toward Psychological Telehealth: Current and Future Clinical Psychologists' Opinions of Internet-Based Interventions. *Journal of Clinical Psychology*, *69*(1), 100–113. https://doi.org/10.1002/jclp.21912

Pot-Kolder, R., Veling, W., Counotte, J., & Van der Gaag, M. (2018). Anxiety Partially Mediates Cybersickness Symptoms in Immersive Virtual Reality Environments. *Cyberpsychology, Behavior, and Social Networking*, *21*(3), cyber.2017.0082. https://doi.org/10.1089/cyber.2017.0082

Price, M., Mehta, N., Tone, E. B., & Anderson, P. L. (2011). Does engagement with exposure yield better outcomes? Components of presence as a predictor of treatment response for virtual reality exposure therapy for social phobia. *Journal of Anxiety Disorders*, *25*(6), 763–770. https://doi.org/10.1016/j.janxdis.2011.03.004

Rapaport, M. H., Clary, C., Fayyad, R., & Endicott, J. (2005). Quality-of-Life in Depressive and Anxiety Disorders. *American Journal of Psychiatry*, *162*(6), 1171–1178. https://doi.org/10.1176/appi.ajp.162.6.1171

Rector, N. (2010). *Cognitive-behavioural therapy. An information guide. Centre for Addiction and Mental Health*. Canada: Centre for Addiction and Mental Health.

Reiner, R. (2008). Integrating a portable biofeedback device into clinical practice for patients with anxiety disorders: Results of a pilot study. *Applied Psychophysiology Biofeedback*, *33*(1), 55–61. https://doi.org/10.1007/s10484-007-9046-6

Riva, G. (2009). Virtual reality: an experiential tool for clinical psychology. *British Journal of Guidance & Counselling*, *37*(3), 337–345. https://doi.org/10.1080/03069880902957056

Riva, G., Baños, R. M., Botella, C., Mantovani, F., & Gaggioli, A. (2016). Transforming experience: The potential of augmented reality and virtual reality for enhancing personal and clinical change. *Frontiers in Psychiatry*, *7*, 1–14. https://doi.org/10.3389/fpsyt.2016.00164

Riva, G., Raspelli, S., Algeri, D., Pallavicini, F., Gorini, A., Wiederhold, B. K., & Gaggioli, A. (2010). Interreality in Practice: Bridging Virtual and Real Worlds in the Treatment of Posttraumatic Stress Disorders. *Cyberpsychology, Behavior, and Social Networking*, *13*(1), 55–65. https://doi.org/10.1089/cyber.2009.0320

Rothbaum, B. O., Hodges, L. F., Kooper, R., Opdyke, D., Williford, J. S., & North, M. (1995). Effectiveness of Computer-Generated (Virtual Reality) Graded Exposure in the Treatment of Acrophobia. *The American Journal of Psychiatry*, *152*(4), 626–628.

Rothbaum, B. O., Hodges, L., & Smith, S. (1999). Virtual reality exposure therapy abbreviated treatment manual: Fear of flying application. *Cognitive and Behavioral Practice*, *6*(3), 234–244. https://doi.org/10.1016/S1077-7229(99)80081-9

Schoenberg, P. L. A., & David, A. S. (2014). Biofeedback for Psychiatric Disorders: A Systematic Review. *Applied Psychophysiology and Biofeedback*, *39*(2), 109–135. https://doi.org/10.1007/s10484-014-9246-9

Schoonenboom, J., & Johnson, R. B. (2017). How to Construct a Mixed Methods Research Design. *Kolner Zeitschrift Fur Soziologie Und Sozialpsychologie*, *69*, 107–131. https://doi.org/10.1007/s11577-017-0454-1

Schwartz, M. S., & Andrasik, F. (2017). *Biofeedback: A practitioner's guide* (4th ed.). New York, NY: Guilford Publications.

Segal, R., Bhatia, M., & Drapeau, M. (2011). Therapists' Perception of Benefits and Costs of Using Virtual Reality Treatments. *Cyberpsychology, Behavior, and Social Networking*, *14*(1–2), 29–34. https://doi.org/10.1089/cyber.2009.0398

Seland, G. (2006). System Designer Assessments of Role Play as a Design Method: A Qualitative Study. In *Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles* (pp. 222–231). Oslo. https://doi.org/10.1145/1182475.1182499

Shema, S. R., Brozgol, M., Dorfman, M., Maidan, I., Sharaby-Yeshayahu, L., Malik-Kozuch, H., … Mirelman, A. (2014). Clinical Experience Using a 5-Week Treadmill Training Program With Virtual Reality to Enhance Gait in an Ambulatory Physical Therapy Service. *Physical Therapy*, *94*(9), 1319–1326. https://doi.org/10.2522/ptj.20130305

Simms, D. C., Gibson, K., & O'Donnell, S. (2011). To use or not to use: Clinicians' perceptions of telemental health. *Canadian Psychology*, *52*(1), 41–51. https://doi.org/10.1037/a0022275

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual

environments. *Presence: Teleoperators and Virtual Environments*, *6*(6), 603–616. https://doi.org/10.1162/pres.1997.6.6.603

Soh, P. J., Vandenbosch, G. A. E., Mercuri, M., & Schreurs, D. M. M.-P. (2015). Wearable Wireless Health Monitoring. *IEEE Microwave Magazine*, *16*(4), 55–70. https://doi.org/10.1109/MMM.2015.2394021

Steffen, P. R., Austin, T., Debarros, A., & Franklin, B. (2017). Treating Chronic Stress to Address the Growing Problem of Depression and Anxiety: Biofeedback and Mindfulness as Simple, Effective Preventive Measures. *Policy Insights from the Behavioral and Brain Sciences*, *4*(1), 64–70. https://doi.org/10.1177/2372732216685333

Stoppa, M., & Chiolerio, A. (2014). Wearable electronics and smart textiles: A critical review. *Sensors*, *14*(7), 11957–11992. https://doi.org/10.3390/s140711957

Swartzlander, B., Dyer, E., & Gugliucci, M. R. (2017). We Are Alfred: Empathy Learned Through a Medical Education Virtual Reality Project. *Library Services Faculty Posters.*

Torous, J., & Roberts, L. W. (2017). The Ethical Use of Mobile Health Technology in Clinical Psychiatry. *The Journal of Nervous and Mental Disease*, *205*(1), 4–8. https://doi.org/10.1097/NMD.0000000000000596

Turbyne, C., de Koning, P., & Denys, D. (2017). mHealth in Mental Healthcare: the Application of Mobile Head-mounted Displays. *Journal of Technology in Behavioral Science*, *2*(3–4), 107–108. https://doi.org/10.1007/s41347-017-0020-8

Unoka, Z. (n.d.). Stages of Psychotherapy Process [Powerpoint slides]. Retrieved from http://semmelweis.hu/pszichiatria/files/2014/02/02_Stages-of-Psychotherapy-Process.pptx

Valmaggia, L. R., Latif, L., Kempton, M. J., & Rus-Calafell, M. (2016). Virtual reality in the psychological treatment for mental health problems: An systematic review of recent evidence. *Psychiatry Research*, *236*, 189–195. https://doi.org/10.1016/j.psychres.2016.01.015

Veerbeek, M., Knispel, A., & Nuijen, J. (2014). *GGZ in tabellen 2013- 2014.* Utrecht.

Yellowlees, P. M., Holloway, K. M., & Parish, M. B. (2012). Therapy in Virtual Environments — Clinical and Ethical Issues. *Telemedicine and E-Health*, *18*(7), 558–564. https://doi.org/10.1089/tmj.2011.0195

Yucha, C. B., & Montgomery, D. (2008). *Evidence-based practice in biofeedback and neurofeedback. Faculty Publicatons (N)*. Las Vegas. https://doi.org/10.1017/CBO9781107415324.004

Zone, R. (2014). *Stereoscopic Cinema and the Origins of 3-D Film, 1838-1952*. The University Press of Kentucky.

Appendix A: Topic lists

A.1 Topic list in-depth interviews

General

1. Wat is uw naam en leeftijd?
2. Wat is uw huidige functie?
3. Hoelang vervult u deze al?
4. Wat voor soort behandelingen past u toe in uw werk?
5. Welke technologieën gebruikt u tijdens uw werk?
6. Welke technologieën gebruikt u thuis? (Smartphone, laptop, smart TV, smart lighting etc.)

Virtual Reality

7. *Bent u bekend met het gebruik van Virtual Reality in de geestelijke gezondheidszorg?*
   a. *Nee:* Ik zal uitleggen waarvoor het gebruikt kan worden.
   b. *Ja:* Heeft u het ooit zelf gebruikt in uw therapie?
      i. *Nee:* Weet u waarvoor het wordt ingezet?
      ii. *Ja:* Waarvoor heeft u het ingezet?
8. Zou u VR in uw therapie willen gebruiken? Waarom wel/niet?

Stelt u zich voor dat u VR in uw therapie moet gaan toepassen.
9. Wat zijn volgens u problemen die (kunnen) ontstaan? Wat werkt juist goed (denkt u)?

Biofeedback

Ik wil nu graag een andere technologie met u bespreken, namelijk biofeedback.
10. *Bent u bekend met het gebruik van biofeedback in de geestelijke gezondheidszorg?*
    a. *Nee:* Ik zal uitleggen waarvoor het gebruikt kan worden.
    b. *Ja:* Heeft u het ooit zelf gebruikt in uw therapie?
       i. *Nee:* Weet u waarvoor het wordt ingezet?
       ii. *Ja:* Waarvoor heeft u het ingezet?
11. Zou u biofeedback in uw therapie willen gebruiken? Waarom wel/niet?

Stelt u zich voor dat u biofeedback in uw therapie moet gaan toepassen.
12. Wat zijn volgens u problemen die (kunnen) ontstaan? Wat werkt juist goed (denkt u)?

Virtual Reality & biofeedback

We hebben het nu over de toepassing van twee verschillende technologieën gehad binnen de geestelijke gezondheidszorg. Stel, VR en biofeedback moet samen toegepast gaan worden in uw therapie.

13. Hoe denkt u dat deze twee technologieën gebruikt gaan worden?
14. Wat is uw mening over deze combinatie?

Ik zou nu graag een situatie willen schetsen waarin u al een tijd VR gebruikt in uw therapie. Deze vorm van therapie zal vanaf nu Virtual Reality Therapie (VRT) worden genoemd. Op een gegeven moment wordt u gevraagd om ook biofeedback apparatuur te gaan gebruiken, binnen deze therapie.

15. Denkt u dat biofeedback toegevoegde waarde heeft binnen de VRT? Waarom wel/niet?
16. Hoe vindt u dat biofeedback gebruikt zou moeten worden binnen de VRT?
17. Kunt u hier voorbeelden bij noemen?

Stel dat alles mogelijk is.

18. Hoe zou u biofeedback het liefst gebruiken in VRT?

Naar aanleiding van dit gesprek:

19. Denkt u dat biofeedback de VRT effectiever zal maken? Waarom wel/niet?
20. Zou u het gaan gebruiken in uw therapie?
    a. Nee: Wat houdt u tegen? Wat zou er moeten veranderen?
    b. Ja: Waarom zou u het willen gebruiken?
21. Wat zou er voor nodig zijn om u te ondersteunen bij de inzet van VR en biofeedback (bijvoorbeeld: tools, kennis, cliënten, financiële middelen etc.)
22. Ziet u ook nog andere mogelijkheden van VR en biofeedback in de GGZ?

23. Wilt u verder nog iets kwijt?

A.2 Topic list workshop evaluations

- Wat vond u van de opzet van deze workshop waarbij u zowel Virtual Reality als biofeedback hebt gebruikt?

- Kwamen de verwachtingen die u van de workshop had overeen met uw werkelijke ervaringen?

- Wat vond u van de toevoeging van het biofeedback apparaat tijdens de workshop?

- Ziet u hier mogelijkheden mee? Waarom?

- Zou u zelf met Virtual Reality en biofeedback willen gaan werken?
  - Ja: Wat zou er nodig zijn om dit ook daadwerkelijk te gaan doen?
  - Nee: Wat zou er moeten veranderen om dit wel te willen?

- Denkt u dat de vorm van behandelen zal veranderen als u Virtual Reality en biofeedback gaat gebruiken in een therapie?

- Wilt u verder nog iets kwijt?

Appendix B: Summary

In the Netherlands more people are struggling with a mental disorder, which are difficult to live with. Therefore, it is vital that people suffering from mental disorders are properly supported by the mental healthcare sector, to help them cope with their symptoms and improve the quality of their daily lives substantially. Incorporating Virtual Reality (VR) and biofeedback in psychological treatments has the potential to make the treatments of mental disorders more effective. VR is mainly used for exposure therapy, in which a person is confronted with stimuli they perceive to be stressful or scary in a virtual environment, and learns how to cope with them. Biofeedback provides a person with information about their bodily signals (e.g., heart rate) which they can use to change their behavior to influence these signals (e.g., doing breathing exercises) and feel better.

The aim of this study was to examine which factors influence the implementation of VR and biofeedback by mental healthcare professionals. Although there are various studies that have shown the potential effectiveness of VRT and biofeedback, the incorporation of VR and biofeedback is mainly assessed in academic experiments. This means that there is a gap between research and practice. Therefore, the current study focused on the perception of mental healthcare professionals to gain more practical knowledge about the implementation of VR and biofeedback in clinical practice. This is done by establishing if professionals see added value in the incorporation of VR and biofeedback in their treatments, and if the characteristics of the technologies are recognized and supported by professionals. Additionally, it was also important to get a deeper understanding of how professionals want to apply VR and biofeedback in their treatment, what is needed to implement both technologies, and what their attitude is towards them. It was also interesting to examine how VR and biofeedback might change current treatment forms. To achieve this, the study used a mixed-method design with a qualitative approach by conducting in-depth semi-structured interviews, a workshop, and workshop evaluations with respectively thirteen, nine, and seven mental healthcare professionals. The participants had varying job positions (mostly) within a public setting and varying familiarity and practical experience with VR and biofeedback.

The results consisted of three main themes. The first theme discussed how VR and biofeedback can improve current treatments in three ways:

1) VR can solve practical restraints of in Vivo Exposure Therapy (iVET) by performing exposure exercises in the professional's office, thereby being an intermediate step to apply iVET earlier in the treatment process.

2) Biofeedback provides objective insights in bodily processes to allow the professional to see how the body reacts during exercises and during treatment.

3) Motivating the client by using VR and biofeedback to increase treatment accessibility, do more exercises, and be more proactive.

However, in order for these technologies to be successfully deployed, the second theme described four preconditions addressed by the professionals:

1) Maintain the goal of the treatment by using VR and biofeedback appropriately and providing well-suited treatments to each client.

2) Professionals require more knowledge and experience with the technologies, and they want proof that these technologies actually improve treatments.

3) VR and biofeedback need to be easy to use, by having a standardized approach to safe time, implementation support, and good reliability.

4) The technologies need to be innovated further, since there are still many technological flaws.

The third and last theme described three other important considerations of VR and biofeedback:

1) VR and biofeedback will change the way of communication during therapies since non-verbal communication is no longer possible.

2) The professional's attitude should also be considered since there are varying levels of enthusiasm among professionals regarding the implementation of VR and biofeedback.

3) Other purposes of VR and biofeedback, such as VR for impulse control, group therapies, distraction, empathy education, and biofeedback for measuring the effect of medication.

The mixed-method design of the current study in which in-depth interviews, focusing on opinions and inner beliefs, were combined with a more practical workshop in which a role play was conducted, showed to be a valuable combination to investigate which factors influence the implementation of VR and biofeedback. In addition, the workshop evaluations that were conducted by phone allowed the researcher to reflect upon the participant's experiences during the workshop and focus more on topics that had not yet been addressed. However, it also has to be noted that the sample size was limited, and that the participants of the current study were mainly working for the same organization. A study with more participants, from various mental healthcare organizations, could make it possible to generalize the findings of this research.

During the current study, it was confirmed by mental healthcare professionals that VR and biofeedback can add value to treatments. In addition, many characteristics of the technologies found in the

literature were also recognized and supported in the current study. Although many professionals are positive towards the implementation of VR and biofeedback in mental healthcare, caution was discovered in their attitudes. The usage of technologies is not the core business of a mental healthcare professional. Their preconditions showed that mostly practical factors are important: VR and biofeedback should be working and ready to use. However, currently the technologies are not meeting these preconditions. This means that more effort is needed to satisfy the needs of professionals, which could in the end facilitate successful implementation of VR and biofeedback in mental healthcare.

Based on these findings, recommendations can be made. Technological awareness should be increased by conducting more workshops in which mental healthcare professionals are introduced to VR and biofeedback, and to provide professionals with appropriate training on its usage and implementation. Further, the human-technology interaction should be user-friendly; they should have easy access to technological materials and technical support. Finally, professionals should have implementation freedom by getting time to find out if and how they want to use VR and biofeedback in their treatments.