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"Now i can see me" designing a multi-user virtual reality remote psychotherapy for body weight and shape concerns

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ABSTRACT

Recent years have seen a growing research interest towards designing computer-assisted health interventions aiming to improve mental health services. Digital technologies are becoming common methods for diagnosis, therapy, and training. With the advent of lower-cost VR head-mounted-displays (HMDs) and high internet data transfer capacity, there is a new opportunity for applying immersive VR tools to augment existing interventions. This study is among the first to explore the use of a Multi-User Virtual Reality (MUVR) system as a therapeutic medium for participants at high-risk for developing Eating Disorders. This paper demonstrates the positive effect of using MUVR remote psychotherapy to enhance traditional therapeutic practices. The study capitalises on the opportunities which are offered by a MUVR remote psychotherapeutic session to enhance the outcome of Acceptance and Commitment Therapy, Play Therapy and Exposure Therapy for sufferers with body shape and weight concerns. Moreover, the study presents the design opportunities and challenges of such technology, while strengths on the feasibility, and the positive user acceptability of introducing MUVR to facilitate remote psychotherapy. Finally, the appeal of using VR for remote psychotherapy and its observed positive impact on both therapists and participants is discussed.

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1. Introduction

In the past two decades, there has been an increasing interest in using Virtual Reality (VR) technology for healthcare applications. VR in psychotherapy can be described as an advanced simulation system that can induce emotional responses in order to manage mental health difficulties (Riva et al., 2000, 2016, 2019; Vincelli, 1999). Recent reviews and meta-analysis demonstrated the effectiveness of applying such systems for the treatment of various anxiety and stress-related disorders (Carl et al., 2019), neurodegenerative diseases (Rose et al., 2018; Schiza et al., 2019) and pain arising from physical and/or mental trauma (Matsangidou, Ang, Sakel et al., 2017).

One of the common behavior therapy techniques applied to the treatment for various psychological problems, and especially those involving fear and anxiety, is Exposure Therapy (ET). Through repeated exposures to a feared stimulus, new learning is achieved regarding the threat, which in turn leads to better management of anxiety and fear (Craske et al., 2014). ET can be applied in various different forms, ranging from "in-vivo" ET where the person is exposed to the actual phobic stimulus

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in a controlled manner, to "imaginal" ET where the stimulus is imagined and exposure occurs to the cognitively-induced images of the feared object. Research has shown that VR-based ET (known as VRET) could be as effective as in-vivo ET (Carl et al., 2019). VR provides an alternative solution to traditional ET by allowing exposure to more ecologically valid stimuli than imaginal ET but at the same time providing a much safer environment than in-vivo ET. Notably, VRET has demonstrated success in the treatment of anxiety, social and general phobias, low self-esteem, and PTSD (Post-Traumatic Stress Disorder; Botella et al., 2017; Chan et al., 2018; Freeman et al., 2017; Lindner et al., 2017; Maples-Keller et al., 2017).

VRET has also been successful in treating obesity and Binge Eating Disorder (Riva, 2011; Riva et al., 2001, 1999, 2000, 2003). In particular, a VR-based intervention resulted in significant modification of participant's body image perception (Cesa et al., 2013; Ferrer-García et al., 2017; Ferrer-Garcia et al., 2019; Manzoni et al., 2016). Body shape and weight dissatisfaction is a hallmark of Eating Disorders (Grillo, 2006). Body image dissatisfaction is a type of cognitive bias (Thompson et al., 1999; Williamson, 1996), associated with the way visual information is processed. Specifically, it is believed to reflect a deficit in the processing and integration of multisensory bodily representations and signals that produce the emotional, visual, tactile, proprioceptive and interoceptive deficits found in many individuals with Eating Disorders (Riva & Dakanalis, 2018; Riva & Gaudio, 2018). It has been argued that cue exposure to critical stimuli in VR (e.g., food or human bodies) can help sufferers reduce the level of anxiety and to disrupt the reconsolidation of negative memories based on conditioned emotional responses (Ferrer-García et al., 2017; Ferrer-Garcia et al., 2019). The benefit of VR exposure can be enhanced with interoceptive exposure (Quero et al., 2013), which helps sufferers, via repeated exposures to the feared bodily sensations to come into contact with these sensations without attempts at avoidance which is known to perpetuate fear. Furthermore, VR seems to help the updating of inaccurate representations of the body. Recent research highlights two different strategies via which this is achieved. In the first, known as "reference frameshifting" (Cesa et al., 2013; Manzoni et al., 2016), the person reexperiences in VR a negative situation related to the body (e.g., teasing) both in first and third person (e.g., seeing and supporting her/his avatar in the VR world). In the second, referred to as "body-swapping" (Keizer et al., 2016; Serino et al., 2018), VR is used to induce the illusory feeling of ownership of a virtual body with a different shape and/or size.

Compared to traditional imaginal ET where the patients' imagination is used to achieve exposure, VRET presents with additional benefits (Botella et al., 1998). The added sense of presence (Eichenberg & Wolters, 2012) helps the user overcome difficulties in imagining fearful and anxiety-provoking scenes (Botella et al., 2004; Otkhmezuri et al., 2019). Presence and immersion are significant but are not the only factors contributing to the success of VRET. VR can enhance therapy outcomes by providing patients with control over their actions and their VR environment, and by giving therapists control over the therapeutic session (Botella et al., 2004; Eichenberg & Wolters, 2012; Glanz et al., 2003; Gregg & Tarrier, 2007; Tarrier et al., 2006). This means that patients are able to experience the therapeutic session "as if" they were in the real environment (totally threatening) and at the same time "as if" they were in a consulting room (totally protected). This makes them feel physically safe and provides a level of confidentiality in the virtual environment (VE). Supported by the therapist, patients are in a position to explore, experience, and react to the situation on their own pace (Botella et al., 2004). VR-based therapy also presents benefits for the therapist, who is able to monitor and control the VE and therefore intervene when necessary (Gregg & Tarrier, 2007). Overall, VR technology has been utilized mostly experimentally in laboratories to study the treatment of certain mental health disorders (Riva et al., 2016) and in the last two years, demonstrated its clinical potential in both their diagnosis and treatment (Riva et al., 2019). VR compares favorably to traditionally delivered existing treatments in anxiety disorders, eating and weight disorders, and a recent meta-analysis (Morina et al., 2015) provides evidence of its long-term effects and transfer to real-world settings.

Up to now, VRET was used in a unidirectional manner. That is, the patient enters into the VR world while the therapist who is usually physically present monitors what is happening in the VE from the outside looking at a computer screen. In contrast to this traditional set up, MUVR is

a remote VR system that allows the patient and therapist to simultaneously be immersed in a VE. This new VR technology has the prospective to support remote therapy sessions, however, its treatment potential has not yet been examined. In comparison to conventional VR psychotherapy, MUVR may have the advantage of providing the patients with an anonymous medium to communicate their inner thoughts and feelings, limiting social stigma, and without removing the availability of a real therapist. This is important in the treatment of conditions such as the eating disorders, where worry about social stigma is one of the main problems that precludes individuals to seek and enter treatment (Lipson et al., 2017). Thus, MUVR could offer a personal private platform for psychotherapy, which could attract and increase therapy engagement. The positive effect of "blind" psychotherapy (i.e., remote technology-based therapy in which the patient and the therapist are not in the same physical space) has been documented by studies that examined blind telephone counseling. These studies report that telephone programs help overcome a few important obstacles in treatment, such as engaging patients who might not be reached by traditional in-person treatment, eliminating travel and waiting time, and allowing more flexible scheduling (Simon et al., 2004). Our conjecture is that VR can do more than telephone-based therapy. For instance, MUVR can generate strong social presence in the therapy session through avatar interaction, enhancing the feeling of togetherness and inducing higher levels of interpersonal trust, a critical requirement for establishing therapeutic alliance (Gorini, 2007; Gorini et al., 2008). Moreover, by allowing the therapist and the patient to share the same virtual world, MUVR enables the therapist to follow and support the patient during the fearful and/or threatening experience. Moreover, a close relationship can be developed between users within virtual worlds, especially when the users verbalize through a virtual game (Henderson & Gilding, 2004; Utz, 2000). This is particularly important as positive outcomes of the therapeutic process are strongly related to the therapeutic relationship or alliance between the therapist and the patient (Flückiger et al., 2018).

To the best of our knowledge, only one study so far has investigated the efficiency of VR where a patient and a therapist are engaged in therapeutic sessions using MUVR. However, in that study the patient and the therapist were present in the same physical location. The study investigated the use of VRET for reducing the fear of heights (Krijn et al., 2004) and showed a positive effect on acrophobia and a decrease in user's anxiety which was maintained at a 6-month follow-up.

The present study aims to explore the design opportunities and challenges of introducing MUVR to facilitate remote psychotherapy. The study presents the development of an MUVR program to be utilized as an intervention medium for females at high-risk for developing an Eating Disorder. It also examines the feasibility and acceptability of using VR for remote psychotherapy by therapists and participants at high-risk for developing an Eating Disorder. In particular, the study aimed to tackle the following questions: a) What are the design opportunities and challenges of MUVR for females with body shape and weight concerns deemed to be at high-risk for developing Eating Disorders?, and b) Is the MUVR developed feasible and acceptable for therapists and participants at high-risk for Eating disorders?

2. Muvr co-design process

The research and development team consisted of psychologists with experience in working with Eating Disorders (n = 4; one in each of the following specializations: clinical, cognitive/experimental, developmental/social, and school psychology), and Human-Computer Interaction (HCI) in healthcare experts (n = 3; one in each of the following specializations: engineering/social gaming, computer science graphics, and digital health). The team was thus comprised of experts who were able to cover all the relevant areas for the development of this program (clinical content, system usability and technical development).

Nine design iterations, over a six-month period, were conducted to design and develop the MUVR system (Table 1). Each iteration involved focus groups and/or interviews and/or pilot evaluations to improve the design, including three different representative participants, individuals at high-risk for developing an Eating Disorder. Each pilot evaluation lasted approximately two hours.

Table 1. Co-design – prototype iteration.

Stage	Objectives (Ox.x)	Major Tasks (Tx.x)	Outcomes (Rx.x)
1	O1.1 Create a shared vision of how VR can support Eating Disorders Prevention and Psychotherapy.	T1.1 Conducted a literature review on current prevention and psychotherapeutic practices and technologies for the treatment of Eating Disorders. T1.2 Demonstration of the technological possibilities of VR by HCI Professionals. T1.3 Psychology Professionals developed scenarios/ interventions of use.	R1.1 VR is a promising solution for psychotherapy but MUVR has not been previously tested. R1.2 Individuals at high-risk for eating disorders constitute a group for whom MUVR could be a good therapeutic medium and can constitute the group on which to explore the designing of an MUVR therapeutic environment.
2	O2.1 Articulate how the MUVR remote psychotherapy will be adapted to address psychotherapeutic needs of the chosen group. O2.2. Articulate the User Interface (UI) elements for the MUVR.	T2.1 Refined the scenarios/interventions. T2.2 Developed system requirements. T2.3 Constructed paper and technology prototypes of MUVR remote psychotherapy.	R2.1 Decision on the therapeutic approach and treatment scenarios to be included. R2.2 Identification of the UI elements for the therapist (e.g., navigation process) and the participant (e.g., avatar body shape scales).
3	O3.1 Specify how the therapist and partcipant will interact with the virtual objects and tasks in the MUVR. O3.2 Specify the design factors for the participants' avatar appearance.	T3.1 Internal test of prototypes with a clinical psychologist and a developer. T3.2 Developed and Tested the VE navigation mechanisms: (1) Point and Click Teleportation, (2) Navigation by Hand movement. T3.3 Evaluated remote connectivity. T3.4 Revised the 1st Version of the MUVR. T3.5 Developed and Tested avatar representation (conducted a focus group with representative participants): Photorealistic vs. Cartoonish.	R3.1 Navigation by Hand movement removed due to motion sickness. R3.2 Cartoonish avatar was preferred and selected due to development restrictions (e.g., customization of the avatar's body).
4	O4.1 Specify the design factors for the virtual representation of the objects. O4.2 Execute the Systems Usability for the therapeutic scenarios.	T4.1 Internal test of prototypes with a clinical psychologist, a school psychologist, 2 HCI experts, and a developer. T4.2 Revised the 2ndVersion of the MUVR. T4.3 Developed and Tested virtual objects representation. T4.4 Developed and Tested intervention use scenarios.	R4.1 Cartoonish presentation of the virtual world was selected to match the participants' avatar representation. R4.2 Creations of supporting documents and designs for the intervention use scenarios.
5	O5.1 Create the participant's avatar customization technique.	T5.1 Internal test of prototypes with clinical psychologists (n = 3) and a developer (n = 1). T5.2 Revised the 3rd Version of the MUVR. T5.3 Developed and Tested the UI elements for the participants' avatar customazation. T5.4 Developed and Tested intervention VE (e.g., mirror exposure virtual room).	R5.1 Agreed on the functionality of the UI elements for the participant's avatar body representation. R5.2 Agreed to exaggerate on the participant's avatar body representation to represent extreme ends of body type. R5.3 Cultural adaptions (e.g., skin and hair colors, hair styles).

(*Continued*)

Table 1. (Continued).

Stage	Objectives (Ox.x)	Major Tasks (Tx.x)	Outcomes (Rx.x)
6	O6.1 Specify the interaction mechanisms.	T6.1 Internal test of prototypes with a clinical psychologist, a cognitive psychologist, a school psychologist, 2 HCI experts, & a developer. T6.2 Revised the 4th Version of the MUVR. T6.3 Developed and Tested the body representation and cultural adaptions of the participants avatar. T6.4 Developed virtual interaction mechanisms: (1) Button Hold, (2) Automatic Hold. T6.5 Refined the presentation of the intervention use scenarios by incorporating gamified features to improve participants' engagement.	R6.1 Creation of supporting documents and designs for the intervention use scenarios incorporating gamified features.
7	O7.1 Test and Execute the final application with end-users.	T7.1 End-User test of prototypes with a clinical psychologist, a school psychologist and 2 representative participants.	R7.1 Positive feedback received from both therapists and participants. R7.2 Virtual interaction mechanisms "Button Hold" was preferred by the participants as it imitated natural activity (e.g., close of fist to grab an object). R7.3 Minor issue noted: Difficulty to identify controller's buttons. R7.4 All other minor comments noted.
8	O8.1 Finilize the MUVR application.	T8.1 Revised the 5th Version of the MUVR. T8.2 Virtual representation of the controllers' buttons were colored for visual identification of activity (e.g., red to grab, blue to move, etc.). T8.3 Developed a tutorial to inform the participant of how to use the MUVR.	R8.1 All aspects ready and work well. R8.2 The system deemed ready for testing with end-users.
9	O9.1 Testing and Execution.	T9.1 End-User test of prototypes with a clinical psychologist, a school psychologist and 2 representative participants.	R9.1 Two pilot sessions were carried out to "iron out" further issues with the system design and use scenarios. Only minor issues noted and fixed.

2.1. *Development of the MUVR avatars*

Through team discussions and the co-design process, it was decided that both participants and therapists should be represented in VE as cartoon avatars. Based on user feedback (see Table 1), the therapist was represented as a cartoonish non-anthropomorphic box rather than a realistic figure (see Figure 1). This decision was in line with previous research findings suggesting that the use of animated cartoons could help reduce stress in therapy (Cohen et al., 1997; Lee et al., 2012). Moreover, the research team purported that the use of cartoon avatars in MUVR psychotherapy would provide a degree of anonymity and security for participants.

Regarding the participant avatar a cartoonish anthropomorphic figure was decided upon (see Figure 2). As part of the intervention goals (treatment of individuals who present with high body shape and size concerns), it was decided that participants would have the opportunity to modify the avatar to their likeness (i.e., represent their own body shape and size).

2.2. *Development of the MUVR therapeutic content*

Different VEs were developed to comprise the MUVR Remote Psychotherapy. The content of the VEs developed were based on Acceptance and Commitment Therapy (ACT) values clarification components (Karekla & Nicolaou, 2015) or a Play Therapy approach, and also included the behavioral technique of exposure to one's (in this case the avatar's) body shape (Mirror Exposure technique). Different environments were created for content testing at a later stage of research development, which go beyond the aims of the present paper.

The overall approach to intervention for body shape and weight concerns utilized to create the content of MUVR Remote Psychotherapy was based on ACT (Hayes et al., 2011) and specifically the AcceptME protocol (Karekla & Nicolaou, 2015), which is a digital gamified program for youth with body shape and weight concerns, at-risk for Eating Disorders. The aim of ACT is for the individual to learn to accept their inner thoughts and feelings about troubling situations (including body shape and weight thoughts and emotions), and commit to behavior change, regardless of unwanted internal thoughts and feelings (Hayes et al., 2011; Juarascio et al., 2013; Merwin & Wilson, 2009). In general, ACT emphasizes altering the individual's behaviors rather than shifting attention away from troubling thoughts and feelings (Juarascio et al., 2013).

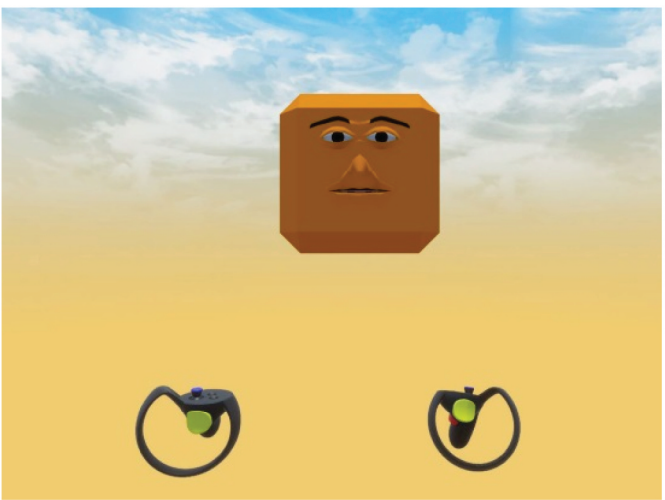

Figure 1. The virtual representation of the therapist in MUVR.

Figure 2. Patient's virtual representation.

For purposes of this project, the component of values was chosen as the motivational force within ACT that provides meaning for behavior change to occur, even in the presence of uncomfortable thoughts and feelings (Gloster et al., 2017; Hayes et al., 2011; Juarascio et al., 2013; Merwin & Wilson, 2009). Two virtual tasks were developed within the MUVR system, where the individual comes into contact with valued life domains and recognizes how actions related to concerns about body shape and weight get in the way of living a valued life.

Figure 3 shows the second task, the values clarification task, where the participant builds their own "life values-based map". The therapist within the MUVR system, located in the same VE as the user, guides the participant to explore what is important to the person. The participant develops a personal life map that allows her to outline her important life valued domains through embodied interactions (i.e., "grabbing and placing"; "grabbing" the valued domain and "placing" it into the blue rings to form the life map). This process provides the participant with clarity as to what is of most importance in their life and links it with behavioral choices (i.e., how to act in everyday life). All intractable objects were highlighted in yellow as soon as the participant/therapist touched them with a VR controller.

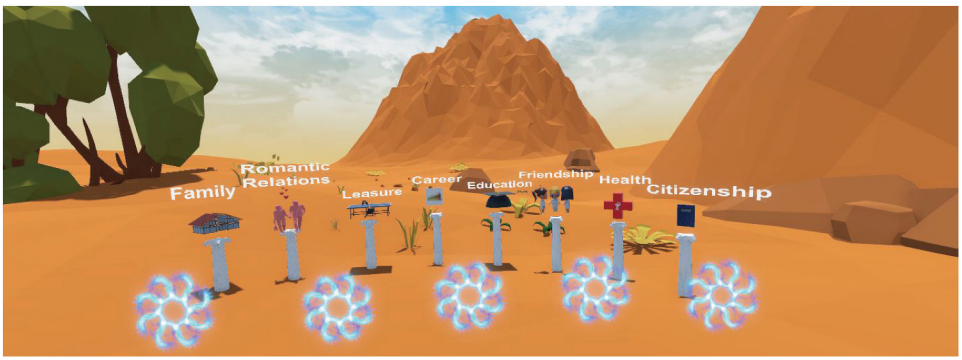

Figure 3. Depiction of valued life areas the participant encounters and can choose from to build their own life map.

Additionally, the VEs created included two game tasks (a virtual painting task and a virtual basketball-type ball-throwing task) based on Play Therapy (PT; Schaefer, 2003). PT is utilized for younger individuals with various difficulties (Leblanc & Ritchie, 2001; Schaefer, 2003), where play is used as a means of helping the person express and communicate thoughts and feelings. Previous research demonstrated the usefulness of PT in reducing impulsivity and enhancing emotion regulation in people suffering from Eating Disorders (Claes et al., 2012; Fagundo et al., 2013; Jiménez-Murcia et al., 2009). The two games included were selected because of their ability to reduce the attentional resources devoted to processing worrisome thoughts (e.g., drawing activities and target reaching – shooting task). Figure 4 shows the virtual coloring game, where the participant was instructed to use the virtual palette (variety of colors and tones provided) and the brush to color inanimate objects.

Another VE created within this MUVR included an Exposure Therapy exercise. The Mirror ET involves confrontation in a mirror to ones' shape and body (in this case a virtual mirror showing the avatar created to depict the participant). The Mirror ET has demonstrated efficacy in reducing negative body-related concerns (Vocks et al., 2007) and leads to improvements in body image among individuals dealing with Eating Disorders and significant concerns about their body shape and size (Hildebrandt et al., 2012). In this MUVR, the participant faces the virtual avatar. The avatar is customized by the participant to match her own physical body. For these purposes, an avatar customization system was developed. This system allows participants to create body shapes using virtual sliders, change clothing, skin tone, as well as hair style and color (see Figure 2).

The Mirror exposure progresses gradually by making the avatar's clothing scantier until the avatar is left only in underwear (see Figure 5). During this process, the participant is asked to look carefully at each part of the body and perform the appropriate adjustments while describing her feelings, thoughts and concerns. Each part of the body, thoughts, and feelings are discussed with the therapist during the whole process. Thus, exposure to ones' body shape and size (via the avatar) occurs with progressively less clothing based on the hierarchy of concerns created by the participant at the beginning of the session.

Overall the full session consisted of three stages: 1) MUVR user tutorial; 2) Starting location where the therapist greets the participant and participants create their virtual avatar; 3) Three VEs (2 ACT values VEs or 2 games, and a Mirror Exposure VE).

Figure 4. Depiction of the virtual coloring activity from the participant's perspective.

Figure 5. Depiction of four stages of mirror exposure from the participant's perspective.

3. Methods

3.1. *Ethics*

The study was approved by the National Bioethics Committee (REF: EEBK/EP/201305). All participants signed an informed consent prior to study commencement. No compensation was provided to participants and therapists. Participants could receive course credit if this was offered by their professors.

3.2. *Participants*

Participants were recruited through convenience sampling from undergraduate classes at the University. Only females were recruited in this study as Eating Disorders phenomenology presents differently between the sexes (Stanford & Lemberg, 2012). One hundred and thirty women aged between 18 to 25 years, completed online screening questionnaires (Eating Disorder Diagnostic Scale (EDDS) and Weight Concerns Scale (WCS); see section 3.4).

Participants scoring above a symptom composite cutoff score of 16.5 (n = 34) on the EDDS, were considered to present as either high-risk for the development of an Eating Disorder or with

a possible Eating Disorder (Krabbenborg et al., 2012) and were referred to the university counseling services for a full diagnostic mental health assessment. Based on the EEDS criteria, 10 individuals were judged as possible to have Anorexia Nervosa (n = 2) or Bulimia Nervosa (n = 8), and this was corroborated by the clinical assessment. Three more participants were diagnosed with Anorexia and/or Bulimia Nervosa based on the clinical assessment. All 13 participants with the possible diagnosis of Eating Disorders were excluded from the study and were offered services at the university counseling clinic. The remaining participants who did not meet criteria for an Eating Disorder but were considered at high risk were invited to participate in the VR part of the study. Seven participants declined participation, thus the final sample included 14 females deemed to be at high-risk for developing an Eating Disorder within the next four years. None of the participants had undergone any form of cognitive behavior therapy in the past.

Their mean age was 20 years (M = 19.93, SD = 1.77), with a mean weight 64.36 kg (SD = 10.68) range from 47.30 kg to 86.00 kg while the participants mean Body Mass Index (BMI) was 24.25 kg (SD = 3.23). We also measured the size of the Arm (M = 23.64, SD = 2.65), Waist (M = 78.19, SD = 12.16), Hips (M = 100.5, SD = 9.42) and Thighs (M = 64.86, SD = 6.16). All participants reported normal or corrected-to-normal vision (so as to ensure visual ability within the VR) and none reported any disability that could affect the use of the VR technology. Participants were assigned to each version using counterbalancing.

Seven therapists were recruited to lead the sessions. Each therapist led at least two MUVR Remote Psychotherapy sessions. The therapists were graduate students in clinical (n = 3) or school psychology (n = 4). All therapists were trained to the approach and the specific protocol by an expert ACT trainer (>10 hours of training offered), who supervised their practice. They were also trained in the use of the VR and underwent the same tutorial as participants.

3.3. *Study design and procedure*

The study design emerged from rigorous discussions among the co-design team that comprised of experts in their respective fields (psychology/psychotherapy, working with Eating Disorders and HCI in healthcare (see section 2 for details on the co-design process).

Recruited participants and therapists (see section 3.2) were placed in two separate rooms within the same building (approximately 50 meters apart) and never met face-to-face. Upon arrival at the laboratory (participants room), participants were greeted by a study researcher (not the therapist) and had their weight, body mass, and height measured. These measurements were used to calculate the participants' BMI using the formula: BMI = Kg/m^2. The BMI provided an indication of whether the participant was underweight, overweight, or of normal weight. Next, participants proceeded with the MUVR therapeutic session and were reassured that they had the option to stop the session at any time.

The participant was then fitted with the VR Head-Mounted Display (HMD) and was instructed to first follow a tutorial of about 25 minutes in order to become familiar with the use of the VR system and the interaction devices. Then, the participant and the therapist were introduced within the VR system. Both participant and therapist appeared in a neutral VE in front of the virtual avatar (Figure 2). In this VE, the therapist greeted the participant and asked her to customize the virtual avatar according to her look (body shape and size, skin tone and hair color and shape). After setting up the avatar, both the participant and therapist were "teleported" to the first intervention VE. Upon completion, they were teleported to the second intervention VE and finally to the last mirror exposure VE (see Figure 6 for the MUVR session procedure). Throughout the process, qualitative observational notes and video/audio recordings were captured by two researchers (one located in the room with the participant and another located with the therapist).

The MUVR therapeutic session lasted approximately one hour. Upon completion, both participant and therapist (in separate rooms) were asked to complete post-session questionnaires and a semi-structured interview was conducted by the researchers. Overall, the entire trial lasted approximately two hours.

Figure 6. Experimental MUVR session procedure.

3.4. *Instruments*

3.4.1. *Screening questionnaires*

Eating Disorder Diagnostic Scale (EDDS; Stice et al., 2000) is a self-report scale consisting of 22 statements based on DSM-IV criteria for assessing Eating Disorders symptoms. Items are assessed in a variety of formats, as determined by the nature of the question including a 6-point Likert scale (1 = not at all to 6 = extremely), yes/no responses and frequency ratings from 1 to 14. The EDDS was used to identify individuals at high-risk and those who possibly meet the criteria for an Eating Disorder diagnosis. A symptom composite cutoff score of 16.5 was used to reflect the best trade-off of the EDDS symptom composite score regarding the determination of the presence or absence of eating pathology. The scale was found to have high test-retest reliability *(r = .87;* Stice et al., 2000).

Weight Concerns Scale (WCS; Killen et al., 1996, 1994) is a five statement self-report scale assessing the participant's risk for developing an Eating Disorder in the next four years. Items are assessed on a 4-point, a 5-point, and a 7-point Likert scale (1 = lower rate, and 4–7 = highest rate). A cutoff of 52 points was used to separate individuals with high (≥ 52 points) or low likelihood (< 52 points) of developing Eating Disorders (Killen et al., 1994). Previous studies (e.g., Killen et al., 1996) reported adequate reliability (Cronbach's alpha > .7). The WCS was used to identify participants at high-risk for developing an Eating Disorder in the future.

3.4.2. *VR experience assessment questionnaires*

Two questionnaires were completed by both therapists and participants so as to capture the level of usability, presence and immersion: (1) **System Usability Scale (SUS**; Brooke, 1996) is a 10-statement self-report scale used to evaluate satisfaction and usability of the system. It is rated on a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. (2) **Presence** (Nichols et al., 2000) is a 6-item self-report scale used to evaluate: a) the sense of "being there" in the scenarios as compared to being in a place in the real world, b) how much the scenarios became the dominant reality, and c) the extent to which participants remembered the scenarios as a place visited rather than as a computer-generated text or image. Presence was rated on a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree.

3.4.3. *Qualitative assessment*

Detailed **Observation Notes** were taken by two researchers during the MUVR session, a psychologist and an HCI in healthcare. One researcher was located in the room with the therapist and another was located with the participant. The goal of these observations was to classify the interactions and behavioral responses toward the MUVR experience. This was done to identify the design opportunities and challenges, which can be useful for future MUVR development and utilizations.

Semi-structured interviews were conducted at the end of the MUVR session by the two researchers. The interviews were conducted with the aim of exploring participants' experience with VR regarding technology acceptance, the impact of MUVR on the user, and the emotional or behavioral reactions during the session. In particular, the interviews with the participants focused on three main areas: (a) General Experience (e.g., "How easy/hard did you find the systems use? Explain."); (b) Attitudes toward the MUVR session (e.g., "What did you like/dislike about the VR session?"); and (c) Reactions toward the virtual intervention compared to traditional practices (e.g.,

"What did you think about this experience? Do you think it is similar to traditional face-to-face interventions? Do you have a preference for VR vs. face-to-face interventions?").

The interviews with the therapists aimed to capture their reflections about their observations of the participants using MUVR as well as their professional opinion on the usability and suitability of VR to support remote psychotherapy in a simulated environment designed and personalized with an eye on optimizing therapeutic benefits. The interviews focused on three main areas: (a) Usability Evaluation (e.g., "Did you find the VR use simple/difficult? Explain."); (b) Attitudes toward the MUVR (e.g., "What thoughts/emotions emerged for you during the session? How does it compare with face-to-face treatment?"); and (c) Reflections on the participants (e.g., "What are your observations regarding the participant and their engagement, acceptability, likeability of the system?"). To ensure the reliability of the interviews, the same questions were asked more than once and sometimes in a different format.

3.5. *Apparatus*

Two Oculus Rift[1] VR HMD systems, one for the therapist and one for the participant, were used to stream the audial and visual content. The Oculus Touch Controllers were used as interactivity devices to allow the users to navigate through the VE. Each system was paired to two Oculus Sensors that captured the user's physical position and movements and incorporated them into the VE. The Oculus Rift tracks the head movement to present the correct virtual-world image to the eyes (LaValle et al., 2014), and it analyzes the user's head movement in real-time to control the view. This results in natural interactions between the user and the VE, leading to high levels of presence and immersion (Desai et al., 2014). The HMD includes an adjustable head strap that sets the hands free for the controllers. The combined weight of the HMD (470 grams) and controllers (169 grams/per controller) is 808 grams, which facilitates comfortable use for extended periods.

The VR system was developed using Unity3D 5[2] and SteamVR. The 3D models (human body and the VE) were created in Adobe Fuse CC[3] and Maya[4] version 2016, enhanced by Unity Assets.[5] In order to create a sense of embodiment, we used the Oculus Rift controllers to synchronize the movement of the avatar in the virtual space, reflecting the movement of the user in the physical space. The buttons on the Oculus Rift controller were marked in the virtual environment with different colors to improve the identification of each corresponding task (e.g., we associated the red button with object grabbing). Moreover, Salsa Lip-Sync RandomEyes[6] version 1.5.5 and Photon Voice[7] version 1.16 were integrated to allow the synchronous verbal communication between the therapist and the participant. Audio dialogue files were processed in real time to automate the lip synchronization process and animate the avatar's facial expression. Photon Unity Networking[8] version 1.91 was used to implement multiuser capability (up to 20 simultaneous users).

The VR content was streamed to an external laptop screen, mirroring the users' real-time virtual interactions and allowing the two researchers to observe silently the procedure. The Open Broadcaster Software 23.0.1 was used as a video screen recorder to record the virtual session, the interactions and the discussion between the therapist and the participant. Two Dictaphones were used when interviewing the therapists and the participants, and 2 separate laptops were used to answer the questionnaires by both participants and therapists.

[1] https://www.oculus.com/rift/
[2] www.unity3d.com/unity.
[3] www.adobe.com/products/fuse/features.html.
[4] www.autodesk.com/education/free-software/maya.
[5] https://assetstore.unity.com.
[6] https://assetstore.unity.com/packages/tools/animation/salsa-with-randomeyes-16944.
[7] https://assetstore.unity.com/packages/tools/audio/photon-voice-45848.
[8] https://assetstore.unity.com/packages/tools/network/photon-unity-networking-free-1786.

3.6. *Analysis plan*

The qualitative data were analyzed using a thematic analysis method that allows for the identification, interpretation, and report of patterns within datasets (Braun & Clarke, 2006). Team researchers coded and classified the information into themes so as to answer the research questions. The thematic analysis was carried out on data from the interviews and the observation notes made by the researchers. To ensure the reliability of the observation notes, video recordings of each session were transcribed and compared. Quotes that illustrate the findings were taken from transcribed interviews and video recordings. The quantitative data analyzes were carried out using SPSS version 26. Data are reported as Means (M) and Standard Deviations (SD).

4. Results

4.1. *Eating disorder diagnostic scale (EDDS) and weight concerns scale (WCS)*

The EDDS was used to identify individuals who possibly meet criteria for an Eating Disorder diagnosis. Participants scoring above a symptom composite cutoff score of 16.5 on the EDDS were considered to be at high-risk for the development of an Eating Disorder (Krabbenborg et al., 2012). The average EDDS score for our sample was 30.64 (SD = 15.36). The WCS inventory identifies the possibility of participants developing an Eating Disorder in the following four years. The average WCS score in this sample was 71.07 (SD = 13.89).

4.2. *System usability and presence*

The overall System Usability Scores (SUS) for both participants (78.93%) and therapists (84.96%) indicated high rates of system usability, with an average score of 81.5%. High rates of presence (max score of 7) were also reported by both participants (M = 4.71, SD = .99) and therapists (M = 5.76, SD = 0.6), average score was 5.15 (SD = 0.95).

4.3. *Interviews and observations*

To explore how MUVR was used by participants and therapists and to identify design challenges and opportunities, an in-depth thematic analysis was carried out. The qualitative thematic analysis suggested four core themes and ten subthemes (Figure 7): (1) "Virtual Reality Experience"; (2) "Real vs Unreal"; (3) "Interactions in Virtual Environments" and (4) "Remote Psychotherapy".

4.3.1. *Virtual reality experience*

This theme concerns the general relationships between the users and the VR technology and consists of three subthemes: (1) Technology Acceptability; (2) Technology Skepticism; and (3) Opportunities Generated.

(1) ***Technology Acceptability.*** Supporting the quantitative analysis of SUS and Presence, the interviews suggested that, in general, both therapists and participants indicated being open to using MUVR therapy in the future.

The therapists found the system useful in facilitating therapy and user-friendly.

> *"I found the system very easy to use, and in general, the graphics were nice and helped the participant to work with her body image"* [T1, 6, 3].[9] *"I can see myself using this system in the future to run more therapeutic sessions and I trust that once I get used to the system, my use of the sessions will improve a lot […] "This was my first use*

[9]Data source: Int = Interview or Obs = Observation; *P* = Participant or T = Therapist; interview number.

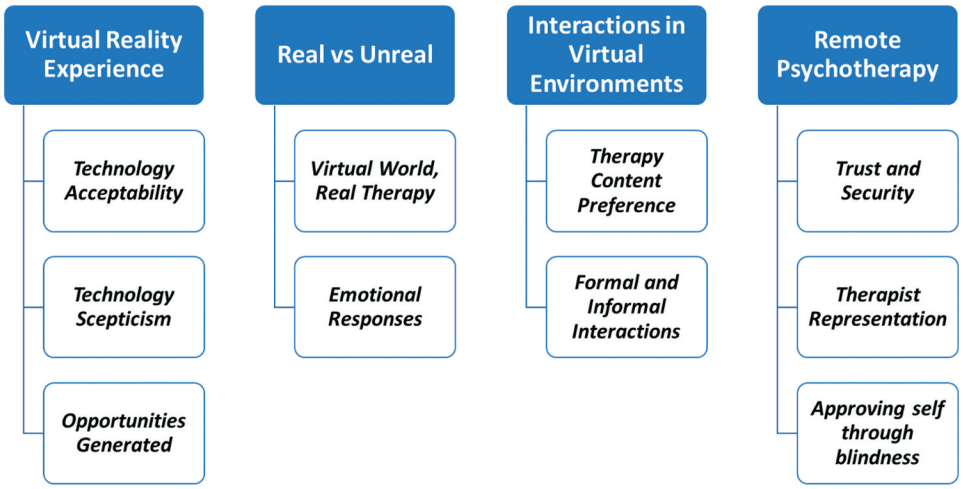

Figure 7. Thematic scheme presentation.

of VR to run a psychotherapeutic session and so I was very concentrated to use the system correctly, this might have affected a bit negatively my performance during the session" [Int: T2, 5].

Participants also expressed a positive attitude toward the system. Their statements also emphasized the need for familiarization with user interfaces prior to therapy. Specifically, they stated that the tutorial included in MUVR was crucial in improving technology acceptability.

"I found myself feeling comfortable using the system. It was easy for me to memorize all the buttons because of the tutorial. I was able to interact naturally with the VR system, the objects and the therapist" [Int: P1, 1].

(2) ***Technology Skepticism***. Even though most participants responded positively toward the VR experience, researchers observed that some individuals were anxious over its use and faced substantial difficulties with the VR. Fearful, tensed and worried/agonized reactions were observed in particular in participants who reported unfamiliarity with VR. The therapists also expressed that they believed some of the participants were very stressed at the beginning of the session because of the VR technology.

"I felt that she was quite tense, and for sure she was skeptical about the VR use. She was very introverted but, during the games, something magical happened, she started to enjoy the VR and engage with the activities. She was interacting with me and at the same time, she was revealing her worrisome thoughts" [Int: T1, 14].

Three participants refused to respond to the therapist at the beginning of the virtual therapy. Specifically, they referred to the therapist in an impersonal way, as if the therapist were not a human being but an object ("something") and sought help and reassurance from the researcher who was physically present in the room with them. One of these participants was especially stressed and asked the researcher in the room for help.

"I am so scared, I don't want to touch the virtual object. I am scared, I don't want to move from my spot, I might get hurt"; "Oh God, something is talking to me, is this normal? [Referring to the Therapist Avatar] Oh My God! [Researcher's name] Do I have to reply to this?"; "I am lost. I am in the middle of nowhere, I am in a desert. [Researcher's name] did you lose me? I don't know where I am!" [Obs: P10].

However, the participants initial hurdle and skeptical attitude were quickly overcome through the virtual interactions and none of them chose to end the session.

"At the beginning of the session I got frustrated and stressed but during the activities […] for example, the basketball game, I got relaxed. I felt closer to the therapist, I started trusting her. During the games, she was hearing me illustrating my problem very kindly and responded to my worries appropriately. […] I mean her words; her statements were very straightforward, she made me think of myself in a way I haven't thought of me before. To be honest, I was not expecting it, but via this VR therapy, I got that much help that I feel that I was the one who gained from this rather than your research. This research helped me so much, the experiment on its own was my reward. Thank you" [Int: P10, 10].

(3) ***Opportunities Generated.*** Therapists reported that participants engaged well with the virtual therapy experience, expressing their thoughts and emotions and trying to accept their body-related concerns.

"I felt that the participant was sharing with me her troubling thoughts and emotional concerns. I can surely say that at the beginning of the Exposure Therapy she got frustrated about the way she looks […] her voice was breaking, and I could observe a tremulous voice, but as time passed, she started being more confident. She was engaging with the exposure and accepting her looks […] I think at the end of our session, she was pretty optimistic about herself, her body and the future" [Int: T3, 9].

Participants stated that the intervention helped them to accept their body image. When asked to provide general feedback about the MUVR remote psychotherapy, most participants focused on their resulting positive attitudes toward their bodies.

"Via this VR app, I was able to create my "true" self. Through this process, I felt capable enough to see and create my body accurately. I started creating a large body figure, but through the app and the whole process, I realized that I was overreacting. At the end of the process, I was able to create an avatar similar to my body. Some parts of my body are still bothering me but not that much anymore. I am not that strict and judgmental with myself now. I feel that this is myself and myself -the avatar that I am looking at is a normal person. It was like all of these years I was looking at myself, but I wasn't seeing myself, I never concentrated and focused on what my body really looks like. This VR app did it. For the first time, I realized that the idea I have about my body is different from my actual body" [Int: P6, 6, 1].

4.3.2. *Real vs Unreal*

This theme describes the interplay between what is real and what is virtual, and how it impacts on therapy. Two subthemes were identified: (1) Virtual World, Real Therapy; and (2) Emotional Responses.

(1) ***Virtual World, Real Therapy***. A key design challenge was to ensure that the therapy experience provided in MUVR is believable. Therapists reported that via MUVR, the participants were able to experience a realistic therapy environment, where the therapist was able to observe and intervene when necessary.

"I think that this kind of technology-based therapy is very useful for people who are dealing with any kind of phobia since it provides the therapist and the participant with many options to accurately experience the phobic situation. During this session, the participant was not only able to observe, discuss and shape her body, but she was also able to share this image with me. Which placed me in the position to help her to deal with her troubling thoughts" [Int: T4, 10].

Participants supported the notion that MUVR can provide a realistic experience especially through the discussion they had with the therapist, during which the participants not only reacted emotionally but also referred to their online avatar as if it were their physical self.

"The mirror phase made me uncomfortable. It was a realistic experience, I was feeling like I was looking directly at myself in a real mirror and that was kind of disturbing" [Int: P9, 9]. *"I don't want to remove my clothes. I feel that I will be embarrassed to be close to naked in front of you, in front of another person"* [Obs: P8].

A key observation that showed that the VR system provided a realistic experience for the participants was the avatar customization activity. From the existing literature, it is known that many people dealing with Eating Disorder symptoms tend to overestimate their body shape and proportions (Bruch, 1974). Participants indeed tended to create a much bulkier virtual body figure compared to their real body size (Figure 8). Interestingly, when the therapist asked the participant to explain the similarities between the way they looked and the way their avatar looked, they all said that this is exactly what their real body looks like. This further suggests that participants were able to engage with the virtual avatar as if it were their own body and created a realistic therapy experience.

(2) ***Emotional Responses***. As part of the therapeutic relationship, it is important that the patient exhibits emotions in response to content being discussed and therapy offers a safe and supportive environment for this to occur. Participants stated that the process was emotionally challenging. Nine out of fourteen participants described the exposure as emotion-eliciting, yet at the end they reported finding it very helpful.

"*I felt uncomfortable in front of the VR Mirror. Trying to create yourself – not who you want to be but who you really are is not just uncomfortable, it's miserable […] However, I really – really liked it. It was a great experience and it helped me a lot, it helped me to understand several things about myself and my body and all the concerns I have. I enjoyed it and it made me think, […] it made me think a lot*" [Int: P12, 12].

Interestingly it was observed that the therapist was not only able to interpret correctly the participants' emotions but was also able to respond properly. We believe this is partly because the VR was designed using gamification principles that aided in establishing a game-like feel to the program and a friendly relationship between the two users (therapist and participant).

Figure 8. Left: Picture of the participant. Right: Avatar created by the same participant to represent her body shape and size.

"*Playing games made me feel closer to the therapist, it was like we bonded, like having fun with a friend. This helped me to trust her and feel that I can share my emotions and thoughts with her. She was not a therapist, she was a friend with whom I had some fun and shared some thoughts and emotions, a friend that counselled me*" [Int: P10, 10].

4.3.3. *Interactions in virtual environments*

This theme captures various issues regarding interactions in the virtual environment and potential design directions. Two subthemes emerged: 1) Therapy Content Preference, and 2) Formal and Informal Interactions.

(1) ***Therapy Content Preference***. Given the diversity of participants' personal backgrounds and interests, it is not surprising to observe variations in the level of engagement across participants. The therapists suggested that individual differences may affect the MUVR therapy and that the type of the included activities should be in line with the participants' interests.

"My personal observation is that the use of playful or game-like activities within the psychotherapy process promotes a sense of trust and understanding between the therapist and the participant in such environments, even for highly anxious individuals. However, the type of virtual game should be in line with the participants interests since some individuals seemed to benefit more from coloring activities, whereas others were interested more in active types of games such as basketball" [Int: T1, 5].

Participants' statements largely supported this observation.

"In general, my stress levels are high, and several worrying thoughts are troubling me a lot. During the VR coloring game, I concentrated on the virtual coloring and this distracted me from my anxious thoughts. In the end, it made me feel much calmer. I would like to do this activity on a regular basis, I believe it will help me to calm" [Int: P5, 5]. "I don't want to move to the next task, but since I have no other option, I have to agree … Let's move, however, if I could I would have chosen to stay here for much longer, but I understand, there are other tasks and we have to move on" [Int: P14, 14].

(2) ***Formal and Informal Interactions***. As the therapists alluded to, the use of games and gamification components in this MUVR helps to situate psychotherapy in an informal context, and as a result lessens the "authority" of the therapist.

"During the games, she was interacting more naturally with me … I got a second role, I was not only her therapist, I was her friend as well […] In some cases she was less concentrated on our talk, but generally this made her much more talkative and a lot less worried about the way she had to express herself" [T4, 14].

"I feel that exercising is offering […] my basketballs are gone, I need extra balls [Therapist fills the tray with balls] is offering you a good quality of life […] can you give me some more balls? I really liked this task even though I didn't reach the target [giggles] I really liked it, oh thank you for the balls, so I was saying that exercising is helping me to maintain a good quality of life […]." [Obs: P14].

Notably, this informal interaction was not observed when participants experienced the more traditional therapeutic techniques, during which they tended to behave and interact with the therapist in a more formal manner.

"*I think during the values exercises […] the participants were behaving more […] let's say more formally. They were behaving similarly to a face-to-face therapy. This time I had just one role, I was their therapist. […] And they were taking their time to form their phrases correctly, […] they were less spontaneous*" [Int: T4, 11].

"*Please allow me to move into the virtual space so as to have a full view of all the virtual world*" [Obs: P12]. "*In general, the VR helped me to recognise my emotions toward myself. It made me think about my values and the important things in my life but in a fun and entertaining way* [Int: P11, 11].

4.3.4. *Remote psychotherapy*

This theme presents the advantages and new possibilities of VR technology as an anonymous platform to facilitate remote psychotherapy. Three subthemes emerged: 1) Trust and Security, 2) Therapist Representation, and 3) Approving self through blindness.

(1) ***Trust and Security***. One of the most important findings was that all seven therapists and 11 (out of 14) participants reported having experienced a sense of trust and security. The therapists observed emotional and personal information disclosure by the participants, while the participants described the process as being safe, which helped them disclose information about themselves, as well as their thoughts and feelings.

"*I feel that the VR remote psychotherapy allows the participant to express her emotions more freely. Not being able to be seen makes her comfortable to disclose emotions and ideas about her body shape that trouble her. I feel that this kind of psychotherapy will be more suitable than face-to-face psychotherapy for the introverted individual*" [Int: T7, 11].

The findings pointed to "two levels of safety" perceived by the participants. On one level, VR provided an insulated world shielding the participants from the "messy outside world they are struggling to cope with." The "second level of safety" refers to the protection of the private and personal emotional space of the participant. For instance, participants liked the fact that the therapist could not physically see their true self:

"*I felt that the virtual environment was a safe and protected space where only the two of us exist*" [Int: P1, 1]. "*I liked that the therapist was not able to see me and therefore she was not judging me because of how I look. I was my avatar and that was a safety net for me*" [Int: P13, 13].

(2) ***Therapist Representation***. In the virtual environment, the therapist was presented as a computerized cartoon "cube"-looking avatar and not as a realistic human figure. This was a design decision made during the iterative co-design process. This was well accepted by both the participants and the therapists.

"*Well, I was positively impressed by the participants' reactions. Some of them were initiating the talk as if I was not their therapist or even a human being. One of the participants actually said to me: Oh, you are so cute!*" [Int: T6, 13].

"*It was easier to express my feelings because the therapist was just a cute cube, she had no human face and therefore she could not judge me. It was like talking to myself. I could be myself without feeling threatened, without being worried about what she is thinking about me. I feel that this was the most important part of this psychotherapy. I was free to be myself. I was free to be my ideas. I was free to be me. If the therapist was standing next to me, I wouldn't be able to express my emotions, my worries, my concerns. I would have been more reserved*" [Int: P13, 13].

(3) ***Approving self through blindness***. One of the most vital findings of the study was that all therapists and eight (out of 14) participants expressed that the VR session was very useful because of the lack of face-to-face communication.

"*I felt that being located in another room and especially not being able to see how her body looked like was a big relief for her, and not just for her, but for many participants. I felt that in general the participants were communicating their fears and thoughts freely without restrictions, and without being worried of what I might think of them*" [Int: T1, 6].

"*I know how I look, and even though everyone else is telling me differently, this is what I see that I trust. I liked being in VR, where the therapist was listening to me, without being able to see me, and therefore without being able to judge and project her beliefs about how I look on me. Someone eventually was listening to me, was paying attention to my emotions, to the way I see myself*" [Int: P5, 5].

5. Discussion and conclusion

The key aim of this study was to develop and investigate the potential for using MUVR for remote psychotherapy. This paper examined the acceptability of MUVR among therapists and participants (individuals found to be at high-risk for developing an Eating Disorder). MUVR is an innovative medium for psychotherapeutic interventions that allows for the physical separation of therapist and patient, providing thus more 'comfortable' openness by the patients. We found that the participants reacted positively to the virtual therapy, liked the environment, the therapist, and the tasks included in the MUVR.

Addressing the first research question about design opportunities and challenges of MUVR, our study showed that the virtual representation of the therapist was important. It was interesting that the co-design process indicated that the preferred representation for the therapist avatar was a cartoonish cube. This cartoonish cube seemed to support openness and turned out to be a successful approach. Participants claimed that a human figure connotates judgmental behavior, whereas a cartoonish representation is less stress-provoking and further enhances the feeling of trust and a positive relationship with the therapist. Therefore, designers of VR remote psychotherapy should not only focus on the virtual presentation of the VE and the avatar design for participants but should also consider the design of the therapist avatar. Animated cartoon-like elements, as opposed to photorealistic representations, should be considered by designers. Notably, similar observations have been made in previous research showing that the use of animated cartoons reduced stress and anxiety when expose in virtual environments (Cohen et al., 1997; Lee et al., 2012; Matsangidou et al., 2019), this finding was even validated by Electrocardiography Conformation (Matsangidou, Mauger et al., 2020). Yet, in certain situations cartoonish non-human figures may not be preferred, as reported by a digital smoking cessation study for sexual and gender minority young adults (Watson et al., 2019). Therefore, further research on the optimal design of therapist avatars within digital environments is needed; this research could examine for example, what types of designs work better for which problems or types of populations.

Furthermore, we noted that remote communication was enhanced, and a supportive relationship was created via informal and playful collaborative activity in MUVR. The importance of this finding should not be understated since a plethora of past studies have shown that empathic responses toward negative feelings (e.g., sadness) are of major importance for patient recovery (Burns & Nolen-Hoeksema, 1992; Ellis, 1962; Gladstein, 1984; Hackney, 1978; Luborsky et al., 1986; Marcia, 1987; Paul & Beernink, 1967). Our findings suggest that a well-designed, gamified MUVR can facilitate a friendly and playful discussion enhanced by specific interventions, allowing participants to express their emotional concerns freely, and enabling the therapist to understand and support their concerns.

Our results point to the importance of enhanced presence and immersion provided by the VR system. This is in line with previous research that suggested that VRET can create an emotional and intense experience. Past research indicated that if participants experience the virtual environment as if it were real, and the therapist is able to intervene and help regulate emotional responses, this could result in improvements on the outcomes of the therapeutic session (Botella et al., 2004; Eichenberg & Wolters, 2012; Glanz et al., 2003; Gregg & Tarrier, 2007; Tarrier et al., 2006). However, it should be noted that previous studies only employed VR sessions where the therapist was in the same physical space as the participant and a physical relationship was first established between them. Interestingly, in our study, therapists and participants never met face-to-face, yet participants appeared to be able to build a therapeutic relationship with the therapist, establish a sense of trust and security, and communicate their emotional states appropriately. In some cases, participants indicated that this was an advantage as it removed any feelings of being judged by a therapist for their appearance, and thus allowed them to express themselves more freely. Similarly, the therapist was not only able to interpret correctly participants' emotions but could also respond properly. This may in part be due to people's general familiarity with online communication in recent years stemming from the

popularity of technologies such as Skype. As hypothesized, MUVR may present with the advantage of providing patients with an anonymous non-threatening and non-judgmental platform to communicate their inner thoughts and feelings, without however removing the availability of a real therapist. Therefore, MUVR can be an alternative and a more advanced solution to other therapeutic modes of delivery, such as telephone-based therapy, that have been demonstrated by past research to be highly effective (Berger, 2017; Brenes et al., 2011; Mohr et al., 2005; Simon et al., 2004). We believe that MUVR could be potentially even more beneficial due to the immersion of the participant in a realistic and safe space, an aspect that cannot be easily simulated by other digital technologies such as telephone and video conferencing. This, however, needs to be further examined in the future in studies with larger samples and other disorders and conditions.

Despite the observed benefits of immersive VR, we must be cautious of the potential negative side effects of presence brought by it. For example, in the current study we observed phobic reactions in some participants which is in line with previous findings suggesting that phobias, anxiety and level of presence, are correlated. Indeed, it seems that enhanced presence may increase anxiety in highly anxious individuals (Robillard et al., 2003), since presence considers to be a psychological state in which the person is not able to vitalize the experience (Lee, 2004). It is, therefore, possible that the increased level of anxiety and phobic reactions of some of our participants during the MUVR session was caused by high levels of presence. Indeed, both therapists and participants reported experiencing high levels of presence in this study. Even though the participants knew that this was a VR simulation and not a real-life scenario, they tended to behave as if it was completely real (Slater), which led to the triggering of phobic or embarrassing reactions such as being unconformable about removing the avatar's clothes during exposure. Interestingly, despite strong feelings of stress or fear, none of the participants chose to end the session prematurely and instead proceeded to complete the whole MUVR trial. This can in part be attributed to the degree of social presence experienced. Social presence via a communication medium has been defined as the degree of being present and able to determine the way people interact and communicate (Lowenthal, in press). Overall, presence in VR may act as a double-edged sword, an issue which needs to be considered carefully in VR design for psychotherapy. For purposes of exposure to one's worries about body shape and size however, the ability to exhibit anxious reactions and experience high levels of presence, may elicit new learning that helps shape new experiences (Craske et al., 2014).

5.1. *Design implications*

The work presented in this study provides a foundation for future research related to MUVR psychotherapy, going beyond past work which has focused on single-user VR or co-located VR therapy experience. Crucially, we identified some key design issues, pointing to the benefits and potential pitfalls of using MUVR in real-world therapy sessions. We believe that these issues and their implications can potentially be translated to and examined with other mental health conditions, such as anxiety problems, provided that the characteristics, preferences, and skills of participants are taken into account. Having said that, it is important to note that the content of the therapy should be designed to account for specific therapeutic requirements relating to the different problems. Apart from ensuring high level of usability design of the system, designers of MUVR need to: (a) consider conflicting design requirements on VR presence/immersion (e.g., high level of immersion to enhance the therapeutic relationship vs. high anxiety-inducing immersive world); (b) balance private and social space design in VR to ensure that participants can feel safe with emotional disclosure and at the same time feel secure knowing the therapist is "there" with them when needed; (c) design activities that can strengthen the bond between therapists and participants including games and fun activities; and (d) accommodate for different participant preferences and therapeutic needs, allowing the therapists to customize the therapy pathway as they see fit.

6. Limitations

Our study had methodological strengths and limitations. Strengths included the involvement of end-users, both therapists and participants deemed at high-risk for developing an Eating Disorder, in the development of the MUVR system. The qualitative approach was also a strength: interview data from both therapists and participants were very valuable in gaining an in-depth understanding of this relatively novel intervention throughout the development process. This person-based approach is recommended when developing digital health-related applications and interventions (Karekla et al., 2019; Yardley et al., 2015).

Limitations include the running of a single-site trial. Though the qualitative interview data provided valuable information, conclusions may not be generalizable to other samples or populations. Prior experience with VR was not assessed in either therapists or participants, which can constitute an extraneous variable affecting outcomes. Also, participants were asked to express whether they prefer face-to-face or the MUVR intervention, however prior experiences with therapy were not assessed, thus participants may not have had direct experiences to be able to choose face-to-face over MUVR. Finally, this study did not evaluate the effectiveness of the intervention, which leads to the need of future research to formally examine this.

7. Future directions

The purpose of the present study was to present the design process and examine the appeal of using VR for remote psychotherapy on therapists and participants at high-risk for developing an Eating Disorder. Future research should proceed to examine the effectiveness and efficacy of this approach both for individuals at high-risk for developing eating disorders and for other populations, mental health problems (e.g., anxiety) and individuals with an actual eating disorder diagnosis. The potential of remote psychotherapy within a VR environment and having a non-co-located therapist, provides unique opportunities not only for individuals who suffer from eating related difficulties, but for other problems where embarrassment or stigma may be involved (e.g., social anxiety, sexual disfunctions etc). The application of MUVR for such additional conditions should be explored in the future.

As part of the development process of this project, various psychotherapeutic VE were created whose comparative effectiveness needs to be formally examined in future trials. We found that participants reacted positively to the virtual therapy, reporting a reduction in the occurrence of troubling thoughts. However, we did not design this study to specifically examine the effectiveness or efficacy of the therapeutic approach, thus formal trials should be planned for the future. Future studies should also take into consideration extraneous variables, such as prior experiences with therapy or with VR, before drawing firm conclusions about the utility of MUVR psychotherapy.

8. Conclusion

This paper presented with several novelties and innovations for VR approach to treatment. The key motivation for this study was to investigate the potential for using VR to support multi-user remote psychotherapy. Our results showed that MUVR can be a viable medium for the treatment of individuals at high-risk for developing an Eating Disorder. In addition, this study demonstrated the acceptability and feasibility of using VR for remote psychotherapy by therapists and participants. Indeed, both therapists and participants found this type of remote psychotherapy useful, as it allowed the participant to comfortably disclose emotions and ideas about her body shape and weight, and accept the intervention including the difficult parts of engaging in exposure to feared stimuli (e.g., via the mirror exposure exercise). The use of a cartoon like avatar for the therapist seems to further support openness, yet this needs to be further explored in future research. Embodying traditionally face-to-face intervention techniques in a playful and gamified virtual world, also constitutes an innovation in this study. Particularly the embodiment of the mirror exposure exercise, where the participant was able to create

and adjust the avatar to resemble themselves provides new opportunities for the treatment of eating and other similar disorders. Notably, when participants were asked to engage in the mirror exposure exercise, they reported high levels of presence and felt as if they were really being exposed to their own bodies. Overall, high levels of presence and immersion were achieved throughout the MUVR session, making it a feasible medium for advancing the delivery of psychotherapy.

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