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Virtual Reality in Psychotherapy: Review

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ABSTRACT

Virtual reality (VR) has recently emerged as a potentially effective way to provide general and specialty health care services, and appears poised to enter mainstream psychotherapy delivery. Because VR could be part of the future of clinical psychology, it is critical to all psychotherapists that it be defined broadly. To ensure appropriate development of VR applications, clinicians must have a clear understanding of the opportunities and challenges it will provide in professional practice. This review outlines the current state of clinical research relevant to the development of virtual environments for use in psychotherapy. In particular, the paper focuses its analysis on both actual applications of VR in clinical psychology and how different clinical perspectives can use this approach to improve the process of therapeutic change.

INTRODUCTION

WHAT IS THE FUTURE of psychotherapy? How will future changes impact on psychotherapy, psychologists, and our patients? Recently, a panel of 62 psychotherapy experts using Delphi methodology tried to answer these questions.[1] According to their answers, only 18 out of the 38 therapeutic interventions analyzed were predicted to increase in the next decade. In particular, the use of VR and computerized therapies were ranked third and fifth, preceded only by homework assignments (first), relapse prevention (second), and problem solving techniques (fourth). On the other side, traditional psychotherapy interventions such as hypnosis (32nd), paradoxical interventions (33rd), or dream interpretation (35th) were predicted to drastically diminish.

Even if these data may be provocative to some psychotherapists, there is no doubt that rapid and far-reaching technological advances are changing the ways in which people relate, communicate, and live. Technologies that were hardly used 10 years ago, such as the internet, e-mail, and video teleconferencing, are becoming familiar methods for diagnosis, therapy, education, and training.

However, the possible impact of VR on psychotherapy could be even higher than the one offered by the new communication technologies.[2] In fact, VR is at the same time a technology, a communication interface, and a compelling experience. Because VR could be part of the future of clinical psychology, it is critical to all psychotherapists that it should be defined broadly. To ensure appropriate development of VR applications, clinicians must have a clear understanding of the opportunities and challenges it will provide to professional practice.

The paper tries to outline the current state of clinical research that is relevant to the development of virtual environments for psychotherapy use. In particular, the paper focuses its analysis on both actual applications of VR in clinical psychology and how different clinical perspectives can use this approach to improve the process of therapeutic change.

VR IN PSYCHOTHERAPY: THE PRESENT

Research in the VR field is moving fast.[2,3] If we check the leading psychology database—PSYCINFO—using "virtual reality" as key words,

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we find 996 journal articles listed (quick search query, accessed April 18, 2005). Most of them (371) were written in the last 3 years and include different controlled trials (Table 1).

Shifting our analysis to psychotherapy application, it is easy to find that the most common application of VR in this area is the treatment of phobias. Since the early 1990s, when Hodges and colleagues[4,5] reported on a project that used virtual environments to provide acrophobic patients with fear-producing experiences of heights in a safe situation, VR exposure therapy (VRE) has been proposed as a new medium for exposure therapy.[6] The rationale behind its use is very simple: in VR the patient is intentionally confronted with the feared stimuli while allowing the anxiety to attenuate. Because avoiding a dreaded situation reinforces all phobias, each exposure to it actually lessens the anxiety through the processes of habituation and extinction. Moreover, VRE offers a number of advantages over *in vivo* or imaginal exposure; it can be administered in traditional therapeutic settings, and is more controlled and cost-effective than *in vivo* exposure.

In different controlled studies, VRE was as effective as *in vivo* therapy in the treatment of acrophobia,[7,8] spider phobia,[9] and fear of flying.[10–13] However, in fear of flying treatment, Maltby and colleagues did not find significant differences between VR exposure or attention-placebo group treatment at 6-month follow-up.[13] Other phobias currently under investigation are agoraphobia,[14] claustrophobia,[15] panic disorder with agoraphobia,[16–18] and public speaking disorder.[19,20]

VRE is also used as an alternative to typical imaginal exposure treatment for Vietnam combat veterans with posttraumatic stress disorder (PTSD).[21] Rothbaum and colleagues[22] exposed a sample of 10 combat veterans with PTSD to two virtual environments: a virtual Huey helicopter flying over a virtual Vietnam and a clearing surrounded by jungle. All the patients interviewed at the 6-month follow-up reported reductions in PTSD symptoms ranging from 15% to 67%.

Riva and colleagues[23–25] are using experiential cognitive therapy (ECT), an integrated approach ranging from cognitive-behavioral therapy to VR sessions, in the treatment of eating disorders and obesity. In this approach, VR is mainly used to modify body image perceptions. What is the rationale behind this approach? Different studies show that body image dissatisfaction can be considered a form of cognitive bias.[26,27] The essence of this cognitive perspective is that the central psychopathological concerns of an individual bias the manner in which information is processed. In most cases, this biased information processing occurs automatically. Also, it is generally presumed that the process occurs more or less outside the person's awareness, unless the person consciously reflects upon his or her thought processes (as in cognitive therapy).

According to Williamson and colleagues,[26] body size overestimation can be considered as a complex judgment bias, strictly linked to attentional and memory biases for body-related information: "If information related to body is selectively processed and recalled more easily, it is apparent how the self-schema becomes so highly associated with body-related information. If the memories related to body are also associated with negative emotion, activation of negative emotion should sensitize the person to body-related stimuli, causing even greater body size overestimation."

It is very difficult to counter a cognitive bias. In fact, biased information processing occurs automatically, and the subjects are not aware of it. So, for them, the biased information is real. They are not able to distinguish between perceptions and biased cognitions. Moreover, any attempt at convincing them otherwise is usually useless and sometimes produces strong emotional defense. In fact, the denial of the disorder and resistance to treatment are two of the most vexing clinical problems in these pathologies.[28,29]

Given these difficulties, there are two different approaches to the treatment of body image disturbances[27]:

- *Cognitive-behavioral strategies*: This approach is based on assessment, education, exposure, and modification of body image. The therapy both identifies and challenges appearance assumptions and modifies self-defeating body image behaviors.[30–32]
- *Feminist approach*: Feminist therapists usually use experiential techniques, such as guided imagery, movement exercises, and art and dance therapy.[33,34] Other experiential techniques include free-associative writing regarding a problematic body part, stage performance, or psychodrama.[34,35]

Unfortunately, both approaches, even if effective in the long term, require a strong involvement of the patient and many months of treatment.

The use of VR offers two key advantages. First, it is possible to integrate all different methods (cognitive, behavioral, and experiential) commonly used in the treatment of body experience disturbances

TABLE 1. APPLICATIONS OF VIRTUAL REALITY IN PSYCHOTHERAPY: CONTROLLED TRIALS WITH 10 OR MORE PATIENTS RESEARCH AS OF MARCH 9, 2004. SOURCES: PSYCINFO AND MEDLINE.

Authors	*Paper*	*Approach*	*Sample*
Emmelkamp, P.M.G., Bruynzeel, M., Drost, L. & van der Mast, C.A.P.G.	(2001). Virtual reality treatment in acrophobia: , a comparison with exposure *in vivo*. *CyberPsychology & Behavior,* 4:335–339.	Cognitive-behavioral	10 acrophobia patients
Emmelkamp, P.M.G., Krijn, M., Hulsbosch, A.M., de Vries, S., Schuemie, M.J., & van der Mast, C.A.P.G.	(2002). Virtual reality treatment versus exposure in vivo: a comparative evaluation in acrophobia. *Behavior Research and Therapy* 40:509–516.	Cognitive-behavioral	33 acrophobia patients
Garcia-Palacios, A., Hoffman, H., Carlin, A., Furness, T.A., III, & Botella, C.	(2002). Virtual reality the treatment of spider phobia: a controlled study. *Behavior Research and Therapy,* 40:983–993.	Cognitive-behavioral	23 phobics
Maltby, N., Kirsch, I., Mayers, M., & Allen, G.	(2002) Virtual reality exposure therapy for the treatment of fear of flying: a controlled investigation. *Journal of Consulting & Clinical Psychology,* 70: 1112–1118.	Cognitive-behavioral	45 phobics
Optale, G., Munari, A., Nasta, A., Pianon, C., Baldaro Verde, J., & Viggiano, G.	(1997). Multimedia and virtual reality techniques in the treatment of male erectile disorders. *International Journal of Impotence Research* 9:197–203.	Psycho-dynamic	60 patients of male erectile disorders
Riva, G., Bacchetta, M., Baruffi, M., & Molinari, E.	(2001). Virtual reality–based multidimensional therapy for the treatment of body image disturbances in obesity: controlled study. *CyberPsychology & Behavior* 4:511–526.	Experiential-cognitive	28 obese patients
Riva, G., Bacchetta, M., Baruffi, M., & Molinari, E.	Virtual reality–based multidimensional therapy for the treatment of body image disturbances in binge eating disorders: a preliminary controlled study *IEEE Transactions on Information Technology in Biomedicine,* 6:224–234.	Experiential-cognitive	20 binge eating patients

TABLE 1. APPLICATIONS OF VIRTUAL REALITY IN PSYCHOTHERAPY: CONTROLLED TRIALS WITH 10 OR MORE PATIENTS RESEARCH AS OF MARCH 9, 2004. SOURCES: PSYCINFO AND MEDLINE. (*CONTINUED*)

Authors	*Paper*	*Approach*	*Sample*
Riva, G., Bacchetta, M., Cesa, G., Conti, S., & Molinari, E.	(2003). Six-month follow-up of in-patient Experiential-Cognitive Therapy for binge eating disorders. *CyberPsychology & Behavior* 6:251–258.	Experiential-cognitive	36 binge eating patients
Rothbaum, B.O., Hodges, L.F., Kooper, R., Opdyke, D., et al.	(1995). Effectiveness of computer-generated (virtual reality) graded exposure in the treatment of acrophobia. *American Journal of Psychiatry* 152:626–628.	Cognitive-behavioral	17 college students
Rothbaum, B.O., Hodges, L., Smith, S., Lee, J.H., & Price, L.	(2000). A controlled study of virtual reality exposure therapy for the fear of flying. *Journal of Consulting and Clinical Psychology* 68:1020–1026.	Cognitive-behavioral	49 fear of flying patients
Rothbaum, B.O., Hodges, L., Anderson, P.L., Price, L., & Smith, S.	(2002). Twelve-month follow-up of virtual reality and standard exposure therapies for the fear of flying. *Journal of Consulting and Clinical Psychology* 70:428–432.		
Vincelli, F., Anolli, L., Bouchard, S., Wiederhold, B.K., Zurloni, V., & Riva, G.	(2003). Experiential cognitive therapy in the treatment of panic disorders with agoraphobia: a controlled study. *CyberPsychology & Behavior* 6:312–318.	Experiential-cognitive	12 panic disorders with agoraphobia patients
Wiederhold, B.K., Jang, D.P., Kim, S.I., & Wiederhold, M.D.	(2002). Physiological monitoring as an objective tool in virtual reality therapy. *CyberPsychology & Behavior* 5:77–82.	Cognitive-behavioral	36 fear of flying patients, 22 non-phobics
Wiederhold, B.K., Jang, D.P., Kim, S.I., & Wiederhold, M.D.	(2002). A controlled trial comparing physiologicalresponses during virtual reality exposure and imaginal exposure in flight phobics. *IEEE Transactions on Information Technology in Biomedicine* 6:218–223.	Cognitive-behavioral	30 fear of flying patients

within a single virtual experience. Second, VR can be used to induce the patient in a controlled sensory rearrangement that unconsciously modifies his or her bodily awareness (body schema). When we use a VR system, we feel our self-image projected onto the image of the visual cues (i.e., a certain figure or an abstract point, such as a cursors, which moves in accordance with the movement of our own hand) appearing in the video monitor, as a part of or an extension of our own hands.[36] As noted by Iriki and colleagues,[37] "Essential elements of such an image of our own body should be comprised of neural representations about the dimension, posture and movement of the corresponding body parts in relation to the environmental space. Thus, its production requires integration of somatosensory (intrinsic) and visual (extrinsic) information of our own body in space." When this occurs, the information itself becomes accessible at a conscious level[38] and can be modified more easily.

In a case study, a 22-year-old female university student diagnosed with anorexia nervosa was submitted to ECT treatment.[39] At the end of the inpatient treatment, the patient increased her bodily awareness, at the same time reducing her level of body dissatisfaction. Moreover, the patient presented a high degree of motivation to change. Expanding these results, the researchers carried out different clinical trials on female patients[40–43]; 25 patients suffering from binge-eating disorders were included in the first study, 20 in the second, and 18 with obesity in the third. At the end of the inpatient treatments, the patients from each sample significantly modified their bodily awareness. This modification was associated with a reduction in problematic eating and social behaviors.

Optale et al.[44,45] used immersive VR to improve the efficacy of a psychodynamic approach in treating male erectile disorders. In the VE, four different expandable pathways open up through a forest, bringing the patients back into their childhood, adolescence, and teens, when they started to get interested in the opposite sex. Different situations are presented with obstacles that the patient has to overcome to proceed. VR environments are here used as a form of controlled dreams allowing the patient to express in a non-verbal way transference reactions and free associations related to his sexual experience. General principles of psychological dynamisms, such as the difficulty with separations and ambivalent attachments, are used to inform interpretive efforts.

The obtained results—30 out of 36 patients with psychological erectile dysfunction and 28 out of 37 patients with premature ejaculation maintained partial or complete positive response after 6-month follow up—show that VR hastens the healing process and reduces dropouts. Moreover, Optale et al. used positron emission tomography (PET) scans to analyze regional brain metabolism changes from baseline to follow-up in patients treated with VR.[46] The analysis of the scans showed different metabolic changes in specific areas of the brain connected with the erection mechanism.

WHAT IS VR?

As we have just seen, the rationales behind the use of VR in psychotherapy are very different. What is the common link between them, and what is the future of VR in psychotherapy? Our attempt to identify a possible answer starts from a broader question: what is VR?

Since 1986, when Jaron Lamier used the term for the first time, VR has been usually described as a collection of technological devices: a computer capable of interactive three-dimensional (3D) visualization, a head-mounted display, and data gloves equipped with one or more position trackers. The trackers sense the position and orientation of the user, and report that information to the computer that updates (in real time) the images for display.

For instance, Rubino et al.,[47] McCloy and Stone,[48] and Székely and Satava,[49] in their reviews about the use of VR in health care, share this vision: "VR is a collection of technologies that allow people to interact efficiently with 3D computerized databases in real time using their natural senses and skills."[48]

However, when we shift our attention to behavioral sciences, we find a different vision: VR is described as "an advanced form of human–computer interface that allows the user to interact with and become immersed in a computer-generated environment in a naturalistic fashion."[50]

In fact, psychologists use specialized technologies—head-mounted displays, tracking systems, earphones, gloves, and sometimes haptic feedback—to provide a new human–computer interaction paradigm. In VR, users are no longer simply external observers of images on a computer screen, but are active participants within a computer-generated 3D virtual world.[51]

Bricken[52] identifies the core characteristic of VR in the inclusive relationship between the participant and the virtual environment, where direct experience of the immersive environment constitutes communication. According to this position, VR can be considered as the leading edge of a general evolution of present communication interfaces such as

television, computer, and telephone,[53,54] whose ultimate goal is the full immersion of the human sensorimotor channels into a vivid and global communication experience.[55]

This position better clarifies the actual role of VR in psychotherapy and the common link between the different clinical applications presented: VR is an advanced communication interface based on interactive 3D visualization, able to collect and integrate different inputs and data sets in a single real-like experience.

What distinguishes VR from other media or communication systems is the sense of *presence*.[56] What is presence? Even if usually presence is defined as the "sense of being there"[57] or as the "feeling of being in a world that exists outside of the self,"[58] it is now widely acknowledged that presence should be treated as a neuropsychological phenomenon.[54,56,59–65] In particular, Riva and Waterworth described presence as a defining feature of self, related to the evolution of a key feature of any central nervous system[58]: the embedding of sensory-referred properties into an internal functional space. More specifically, without the emergence of the sense of presence, it is impossible for the nervous system to differentiate between an external world and the internal one. If, in simple organisms, this differentiation involves only a correct coupling between perceptions and movements, in humans it also requires the shift from meaning-as-comprehensibility to meaning-as-significance.

Meaning-as-comprehensibility refers to the extent to which the event fits with our view of the world (e.g., as just, controllable, and nonrandom), whereas meaning-as-significance refers to the value or worth of the event for us.[66] Following this point, contributions to the intensity of the sense of presence come from three layers of the self recently defined by Damasio[67]: proto self, core self, and autobiographical self. The more the three layers are integrated (focused on the same events), the stronger the intensity of the presence feeling. This means that, between two equally stimulating virtual environments, humans are more present in the one more relevant to their own goals.

VR IN PSYCHOTHERAPY: THE NEXT STEPS

How is it possible to change a patient? Even if this question has many possible answers according to the specific psychotherapeutic approach, in general change comes through an intense focus on a particular instance or experience[68]: by exploring it as much as possible, the patient can relive all of the significant elements associated with it (i.e., conceptual, emotional, motivational, and behavioral) and make them available for a reorganization of his or her perspective.

Within this general model, we have the insight-based approach of psychoanalysis, the schema-reorganization goals of cognitive therapy, the functional analysis of behavioral activation, the interpersonal relationship focus of interpersonal therapy, or the enhancement of experience awareness in experiential therapies.

What are the differences between them? According to Safran and Greenberg,[69] behind the specific therapeutic approach we can find two different models of change: bottom-up and top-down. Bottom-up processing begins with a specific emotional experience and leads eventually to change at the behavioral and conceptual level, whereas top-down change usually involves exploring and challenging tacit rules and beliefs that guide the processing of emotional experience and behavioral planning. These two models of change are focused on two different cognitive systems, one for information transmission (top-down) and one for conscious experience (bottom-up), both of which may process sensory input.[70] The existence of two different cognitive systems is clearly shown by the dissociation between verbal knowledge and task performance: people learn to control dynamic systems without being able to specify the nature of the relations within the system, and they can sometimes describe the rules by which the system operates without being able to put them into practice.

Even if many therapeutic approaches are based on just one of the two change models, a therapist usually requires both.[68] Some patients seem to operate primarily by means of top-down information processing, which may then prime the way for corrective emotional experiences. For others, the appropriate access point is the intensification of their emotional experience and their awareness of both it and related behaviors. Finally, different patients who initially engage therapeutic work only through top-down processing may be able, later in the therapy, to make use of bottom-up emotional processing.

In this situation, a critical advantage can be provided by the sense of presence provided by VR. As we have seen before, the sense of presence is strictly related to all the three layers of self recently identified by Damasio.[67] Using it accordingly, it is possible to target a specific cognitive system without any significant change in the therapeutic approach. For instance, behavioral therapists may use a virtual environment for activating

the fear structure in a phobic patient through confrontation with the feared stimuli; a cognitive therapist may use VR situations to assess situational memories or disrupt habitual patterns of selective attention; experiential therapists may use VR to isolate the patient from the external world and help him or her in practicing the right actions; psychodynamic therapists may use virtual environments as complex symbolic systems for evoking and releasing affect.

In fact, VR can also be described as an advanced imaginal system: an experiential form of imagery that is as effective as reality in inducing emotional responses.[71–73] As outlined by Baños et al.,[74] the VR experience can help the course of the therapy for "its capability of reducing the distinction between the computer's reality and the conventional reality." In fact, "VR can be used for experiencing different identities and . . . even other forms of self, as well." The possibility of structuring a large amount of real-like or imaginary controlled stimuli and, simultaneously, of monitoring the possible responses generated by the user of the virtual world offers a considerable increase in the likelihood of therapeutic effectiveness, as compared to traditional procedures.[54] As noted by Glantz et al.[75]: "One reason it is so difficult to get people to update their assumptions is that change often requires a prior step—recognizing the distinction between an assumption and a perception. Until revealed to be fallacious, assumptions constitute the world; they seem like perceptions, and as long as they do, they are resistant to change." Using the sense of presence induced by VR, it is easier for the therapist to develop real-like experiences demonstrating to the patient that what looks like a perception (e.g., the body image distortion) is produced by his or her mind. Once this has been understood, individual maladaptive assumptions can then be challenged more easily.

Moreover, patients usually accept very well the use of VR. In a recent study, Garcia-Palacios et al. compared the acceptance of one-session and multisession *in vivo* exposure versus multi-session VR exposure therapy.[76] More than 80% of the sample preferred VR to *in vivo* exposure.

Finally, VR can play an important role in psychotherapy as a particular form of supportive technique, contributing to the therapist–patient relationship as well as enhancing the therapeutic environment for the patient. Even if supportive techniques are more common in psychodynamic approaches, they are widely used in different treatments.[77] In general, they are considered as supportive as the following techniques[77,78]:

- Demonstration of support, acceptance, and affection toward the patient
- Emphasis on working together with the patient to achieve results
- Communication of a hopeful attitude that the goals will be achieved
- Respect of the patient's defenses
- Focus on the patient's strengths and acknowledgment of the growing ability of the patient to accomplish results without the therapist's help

Using VR, it is possible for the patient to manage successfully a problematic situation related to his or her disturbance. By creating a synthetic environment in which the patient is likely to feel more secure, VR may enable the patient to express thoughts and feelings that are otherwise too difficult to discuss, thereby increasing the degree of closeness between the patient and therapist. Using VR in this way, the patient is more likely not only to gain an awareness of his or her need to do something to create change but also to experience a greater sense of personal efficacy.

VR can be employed as a supportive technique at the onset of treatment to create an atmosphere in which the patient feels stable, which in turn allows treatment to progress. Alternatively, it may be used in the course of treatment should a crisis occur, enabling the patient to overcome the situation responsible for halting further improvement. In general, VR can be used throughout treatment to foster a positive therapeutic alliance and as a trigger for a broader empowerment process. In psychological literature, empowerment is considered a multifaceted construct reflecting the different dimensions of being psychologically enabled, and is conceived of as a positive additive function of the following three dimensions[79]:

- *Perceived control*: This includes beliefs about authority, decision-making skills, availability of resources, and autonomy in the scheduling and performance of work.
- *Perceived competence*: This reflects role-mastery, which, besides requiring the skillful accomplishment of one or more assigned tasks, also requires successful coping with non-routine role-related situations.
- *Goal internalization*: This dimension captures the energizing property of a worthy cause or exciting vision provided by the organizational leadership.

VR is a special, sheltered setting where patients can start to explore and act without feeling threat-

ened. In this sense, the virtual experience is an "empowering environment" that therapy provides for patients. As noted by Botella and colleagues,[80] nothing the patient fears can "really" happen to them in VR. With such assurance, they can freely explore, experiment, feel, live, and experience feelings and/or thoughts. VR thus becomes a very useful intermediate step between the therapist's office and the real world.

CONCLUSION

As we have seen, in the last 5 years there has been a steady growth in the use of VR in clinical psychology due to advances in information technology and a decline in costs.[2] However, several barriers still remain.

The first is the lack of standardization in VR devices and software. The PC-based systems, while inexpensive and easy-to-use, still suffer from a lack of flexibility and capabilities necessary to individualize environments for each patient.[81] To date, very few of the various VR systems available are interoperable. This makes their use difficult in contexts other than those in which they were developed.

The second is the lack of standardized protocols that can be shared by the community of researchers. If we check the two clinical databases, we can find only five published clinical protocols: for the treatment of eating disorders,[24] fear of flying,[82,83] fear of public speaking,[84] and panic disorders.[16]

The third is the costs required for the set-up trials. As we have just seen, the lack of interoperable systems added to the lack of clinical protocols force most researchers to spend a lot of time and money in designing and developing their own VR application: many of them can be considered "one-off" creations tied to a proprietary hardware and software, which have been tuned by a process of trial and error. According to the European funded project VEPSY Updated,[85] the cost required for designing a clinical VR application from scratch and testing it on clinical patients using controlled trials may range between 150,000 and 200,000 US$. Finally, the introduction of patients and clinicians to virtual environments raises particular safety and ethical issues.[86] In fact, despite developments in VR technology, some users still experience health and safety problems associated with VR use. It is however true that, for a large proportion of VR users, these effects are mild and subside quickly.[87]

Significant efforts are still required to move VR into commercial success and therefore routine clinical use. It is clear that building new and additional virtual environments is important so that therapists will continue to investigate applying these tools in their day-to-day clinical practice.[88] In fact, in most circumstances, the clinical skills of the therapist remain the key factor in the successful use of VR systems. Here, VR can have a role both as supportive technique and for targeting a specific cognitive system without any significant change in the therapeutic approach.

Finally, communication networks have the potential to transform virtual environments into shared worlds in which individuals, objects, and processes interact without regard to their location. In the future, such networks will probably merge VR and telemedicine applications, allowing us to use VR for such purposes as distance learning and e-therapy.

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REFERENCES

1. Norcross, J.C., Hedges, M., & Prochaska, J.O. (2002). The face of 2010: a Delphi poll on the future of psychotherapy. *Professional Psychology: Research and Practice* 33:316–322.
2. Riva, G. (2002). Virtual reality for health care: the status of research. *CyberPsychology & Behavior* 5:219–225.
3. Rizzo, A.A., Wiederhold, B., Riva, G., et al. (1998). A bibliography of articles relevant to the application of virtual reality in the mental health field. *CyberPsychology & Behavior* 1:411–425.
4. Hodges, L.F., Rothbaum, B.O., Kooper, R., et al. (1995). Virtual environments for treating the fear of heights. *IEEE Computer* 28:27–34.
5. Hodges, L.F., Bolter, J., Mynatt, E., et al. (1993). Virtual environments research at the Georgia Tech GVU Center. *Presence, Teleoperators, and Virtual Environments* 2:234–243.
6. Rothbaum, B.O., Hodges, L., & Kooper, R. (1997). Virtual reality exposure therapy. *Journal of Psychotherapy Practice & Research* 6:219–226.
7. Emmelkamp, P.M., Bruynzeel, M., Drost, L., et al. (2001). Virtual reality treatment in acrophobia: a comparison with exposure *in vivo*. *CyberPsychology & Behavior* 4:335–339.

8. Emmelkamp, P.M., Krijn, M., Hulsbosch, A.M., et al. (2002). Virtual reality treatment versus exposure *in vivo*: a comparative evaluation in acrophobia. *Behaviour Research & Therapy* 40:509–516.
9. Garcia-Palacios, A., Hoffman, H., Carlin, A., et al. (2002). Virtual reality in the treatment of spider phobia: a controlled study. *Behavior Research and Therapy* 40:983–993.
10. Rothbaum, B.O., Hodges, L., Smith, S., et al. (2000). A controlled study of virtual reality exposure therapy for the fear of flying. *Journal of Consulting & Clinical Psychology* 68:1020–1026.
11. Rothbaum, B.O., Hodges, L., Anderson, P.L., et al. (2002). Twelve-month follow-up of virtual reality and standard exposure therapies for the fear of flying. *Journal of Consulting & Clinical Psychology* 70: 428–432.
12. Wiederhold, B.K., Jang, D.P., Gevirtz, R.G., et al. (2002). The treatment of fear of flying: a controlled study of imaginal and virtual reality graded exposure therapy. *IEEE Transactions on Information Technology in Biomedicine* 6:218–223.
13. Maltby, N., Kirsch, I., Mayers, M., et al. (2002). Virtual Reality Exposure Therapy for the treatment of fear of flying: a controlled investigation. *Journal of Consulting & Clinical Psychology* 70:1112–1118.
14. North, M.M., North, S.M., & Coble, J.R. (1996). Effectiveness of virtual environment desensitization in the treatment of agoraphobia. *Presence, Teleoperators, and Virtual Environments* 5:127–132.
15. Botella, C., Baños, R.M., Perpiña, C., et al. (1998). Virtual reality treatment of claustrophobia: a case report. *Behaviour Research & Therapy* 36:239–246.
16. Vincelli, F., Choi, Y.H., Molinari, E., et al. (2001). A VR-based multicomponent treatment for panic disorders with agoraphobia. *Studies in Health Technology and Informatics* 81:544–550.
17. Vincelli, F., Choi, Y.H., Molinari, E., et al. (2000). Experiential cognitive therapy for the treatment of panic disorder with agoraphobia: definition of a clinical protocol. *CyberPsychology & Behavior* 3:375–385.
18. Vincelli, F., Anolli, L., Bouchard, S., et al. (2003). Experiential cognitive therapy in the treatment of panic disorders with agoraphobia: a controlled study. *CyberPsychology & Behavior* 6:312–318.
19. North, M.M., North, S.M., & Coble, J.R. (1998). Virtual reality therapy: an effective treatment for phobias. *Studies in Health Technology and Informatics* 58: 112–119.
20. Lee, L.M., Ku, J.H., Jang, D.P., et al. (2002). Virtual reality system for treatment of the fear of public speaking using image-based rendering and moving pictures. *CyberPsychology & Behavior* 5:191–195.
21. Rothbaum, B.O., Hodges, L., Alarcon, R., et al. (1999). Virtual reality exposure therapy for PTSD Vietnam Veterans: a case study. *Journal of Traumatic Stress* 12:263–271.
22. Rothbaum, B.O., Hodges, L.F., Ready, D., et al. (2001). Virtual reality exposure therapy for Vietnam veterans with posttraumatic stress disorder. *Journal of Clinical Psychiatry* 62:617–622.
23. Riva, G., Bacchetta, M., Baruffi, M., et al. (1998). Experiential cognitive therapy: a VR-based approach for the assessment and treatment of eating disorders. In: Riva, G., Wiederhold, B., & Molinari, E. (eds.), *Virtual environments in clinical psychology and neuroscience: methods and techniques in advanced patient–therapist interaction*. Amsterdam: IOS Press, pp. 120–135.
24. Riva, G., Bacchetta, M., Cesa, G., et al. (2001). Virtual reality and telemedicine based experiential cognitive therapy: rationale and clinical protocol. In: Riva, G., Galimberti, C. (eds.), *Towards CyberPsychology: mind, cognition and society in the Internet age*. Amsterdam: IOS Press, pp. 273–308.
25. Riva, G., Bacchetta, M., Cesa, G., et al. (2003). Six-month follow-up of in-patient experiential-cognitive therapy for binge eating disorders. *CyberPsychology & Behavior* 6:251–258.
26. Williamson, D.A. (1996). Body image disturbance in eating disorders: a form of cognitive bias. *Eating Disorders* 4:47–58.
27. Thompson, J.K., Heinberg, L.J., Altabe, M., et al. (1999). *Exacting beauty: theory, assessment and treatment of body image disturbance*. Washington, DC: American Psychological Association.
28. Vitousek, K.B., & Orimoto, L. (1993). Cognitive-behavioral models of anorexia nervosa, bulimia nervosa, and obesity. In: Dobson, K.S., & Kendall, P.C. (eds.), *Psychopathology and cognition*. San Diego: Academic Press, pp. 191–243.
29. Vitousek, K.B., Watson, S., & Wilson, G.T. (1998). Enhancing motivation for change in treatment-resistant eating disorders. *Clinical Psychology Review* 18:391–420.
30. Cash, T.F. (1995). *What do you see when you look in the mirror? Helping yourself to a positive body image*. New York: Bantam Books.
31. Cash, T.F. (1997). *The body image workbook: an eight-step program for learning to like your looks*. Oakland, CA: New Harbinger.
32. Rosen, J.C. (1996). Improving body image in obesity. In: Thompson, J.K., (ed.), *Body image, eating disorders and obesity*. Washington, DC: American Psychological Association, pp. 425–440.
33. Wooley, S.C., & Wooley, O.W. (1985). Intensive outpatient and residential tratment for bulimia. In: Garner, D.M., & Garfinkel, P.E., (eds.), *Handbook of psychotherapy for anorexia and bulimia*. New York: Guilford, pp. 120–132.
34. Wooley, S.C. (1995). Feminist influences on the treatment of eating disorders. In: Brownell, K.D., & Fairburn, C.G. (eds.), *Eating disorders and obesity: a comprehensive handbook*. New York: Guilford, pp. 294–298.
35. Kearney-Cooke, A., & Striegel-Moore, R. (1994). Treatment of childhood sexual abuse in anorexia nervosa and bulimia nervosa: a feminist psychodynamic approach. *International Journal of Eating Disorders* 15:305–319.

36. James, K.H., Humphrey, G.K., & Goodale, M.A. (2001). Manipulating and recognizing virtual objects: where the action is. *Canadian Journal of Experimental Psychology* 55:111–120.
37. Iriki, A., Tanaka, M., Obayashi, S., et al. (2001). Self-images in the video monitor coded by monkey intraparietal neurons. *Neuroscience Research* 40:163–173.
38. Baars, B.J. (1988). *A cognitive theory of consciousness*. New York: Cambridge University Press.
39. Riva, G., Bacchetta, M., Baruffi, M., et al. (1999). Virtual reality based experiential cognitive treatment of anorexia nervosa. *Journal of Behavioral Therapy and Experimental Psychiatry* 30:221–230.
40. Riva, G., Bacchetta, M., Baruffi, M., et al. (2000). Virtual reality–based experiential cognitive treatment of obesity and binge-eating disorders. *Clinical Psychology and Psychotherapy* 7:209–219.
41. Riva, G., Bacchetta, M., Baruffi, M., et al. (2000). Virtual reality environment for body image modification: a multidimensional therapy for the treatment of body image in obesity and related pathologies. *CyberPsychology & Behavior* 3:421–431.
42. Riva, G., Bacchetta, M., Baruffi, M., et al. (2001). Virtual reality–based multidimensional therapy for the treatment of body image disturbances in obesity: a controlled study. *CyberPsychology & Behavior* 4:511–526.
43. Riva, G., Bacchetta, M., Baruffi, M., et al. (2002). Virtual-reality–based multidimensional therapy for the treatment of body image disturbances in binge eating disorders: a preliminary controlled study. *IEEE Transactions on Information Technology in Biomedicine* 6:224–234.
44. Optale, G., Munari, A., Nasta, A., et al. (1997). Multimedia and virtual reality techniques in the treatment of male erectile disorders. *International Journal of Impotence Research* 9:197–203.
45. Optale, G., Chierichetti, F., Munari, A., et al. (1999). PET supports the hypothesized existence of a male sexual brain algorithm which may respond to treatment combining psychotherapy with virtual reality. *Studies in Health Technology and Informatics* 62:249– 251.
46. Optale, G., Chierichetti, F., Munari, A., et al. (1998). Brain PET confirms the effectiveness of virtual reality treatment of impotence. *International Journal of Impotence Research* 10:suppl. 1, 45.
47. Rubino, F., Soler, L., Marescaux, J., et al. (2002). Advances in virtual reality are wide ranging. *British Medical Journal* 324:612.
48. McCloy, R., & Stone, R. (2001). Science, medicine, and the future. Virtual reality in surgery. *British Medical Journal*. 323:912–915.
49. Székely, G., & Satava, R.M. (1999). Virtual reality in medicine. *BMJ* 319:1305.
50. Schultheis, M.T., & Rizzo, A. A. (2001). The application of virtual reality technology in rehabilitation. *Rehabilitation Psychology* 46:296–311.
51. Riva, G., Molinari, E., & Vincelli, F. (2002). Interaction and presence in the clinical relationship: virtual reality (VR) as communicative medium between patient and therapist. *IEEE Transactions on Information Technology in Biomedicine* 6:198–205.
52. Bricken, W. (1990). *Virtual reality: directions of growth* (HITL Technical Report No. R-90-1). Seattle: University of Washington.
53. Riva, G., & Mantovani, G. (2000). The need for a socio-cultural perspective in the implementation of virtual environments. *Virtual Reality* 3:32–38.
54. Riva, G., & Davide, F. (eds.). (2001). *Communications through virtual technologies: identity, community and technology in the communication age*. Amsterdam: IOS Press. Available: <www.emergingcommunication. com/ volume1.html>.
55. Biocca, F., & Levy, M.R. (eds.). (1995). *Communication in the age of virtual reality*. Hillsdale, NJ: Lawrence Erlbaum Associates.
56. Riva, G., Davide, F., & IJsselsteijn, W.A. (eds.). (2003). *Being there: concepts, effects and measurements of user presence in synthetic environments*. Amsterdam: IOS Press. Available: <www.emergingcommunication.com/ volume5.html>.
57. Steuer, J.S. (1992). Defining virtual reality: dimensions determining telepresence. *Journal of Communication* 42:73–93.
58. Riva, G., & Waterworth, J.A. (2003). Presence and the self: a cognitive neuroscience approach. *Presence-Connect* [On-line]. Available: <http://presence. cs.ucl.ac.uk/presenceconnect/articles/Apr2003/jwworthApr72003114532/jwworthApr.html>.
59. Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): speculations on the role of presence in virtual environments. *Presence* 6:603–617.
60. Slater, M. (2002). *Siggraph 2002 course notes on understanding virtual environments: immersion, presence and performance*. San Antonio, TX: ACM–Siggraph.
61. Waterworth, J.A., & Waterworth, E.L. (2001). Focus, locus, and sensus: the three dimensions of virtual experience. *CyberPsychology & Behavior* 4:203–213.
62. Mantovani, G., & Riva, G. (1999). "Real" presence: how different ontologies generate different criteria for presence, telepresence, and virtual presence. *Presence, Teleoperators, and Virtual Environments* 8:538–548.
63. Schubert, T., Friedman, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators, and Virtual Environments* 10: 266–281.
64. Zahoric, P., & Jenison, R. L. (1998). Presence as being-in-the-world. *Presence, Teleoperators, and Virtual Environments* 7:78–89.
65. Waterworth, J.A., & Waterworth, E.L. (2003). The meaning of presence. *Presence-Connect* [On-line]. <http://presence.cs.ucl.ac.uk/presenceconnect/articles/Feb2003/jwworthFeb1020031217/jwworthFeb.html>.
66. Janoff-Bulman, R., & Frantz, C.M. (1997). The impact of trauma on meaning: From meaningless world to meaningful life. In: Power, M., & Brewin, C.R. (eds.), *The transformation of meaning in psychological therapies*. New York: Wiley, pp. 91–106.

67. Damasio, A. (1999). *The feeling of what happens: body, emotion and the making of consciousness*. San Diego: Harcourt Brace.
68. Wolfe, B.E. (2002). The role of lived experience in self- and relational observation: a commentary on Horowitz. *Journal of Psychotherapy Integration* 12:147–153.
69. Safran, J.D., & Greenberg, L.S. (1991). *Emotion, psychotherapy, and change*. New York: Guilford.
70. Brewin, C.R. (1989). Cognitive change processes in psychotherapy. *Psychological Review* 96:379–394.
71. North, M.M., North, S.M., & Coble, J.R. (1997). Virtual reality therapy for fear of flying. *American Journal of Psychiatry* 154:130.
72. Vincelli, F. (1999). From imagination to virtual reality: the future of clinical psychology. *CyberPsychology & Behavior* 2:241–248.
73. Vincelli, F., Molinari, E., & Riva, G. (2001). Virtual reality as clinical tool: immersion and three-dimensionality in the relationship between patient and therapist. *Studies in Health Technology and Informatics* 81:551– 553.
74. Baños, R.M., Botella, C., & Perpiña, C. (1999). Virtual reality and psychopathology. *CyberPsychology & Behavior* 2:283–292.
75. Glantz, K., Durlach, N.I., Barnett, R.C., et al. (1997). Virtual reality (VR) and psychotherapy: opportunities and challenges. *Presence, Teleoperators, and Virtual Environments* 6:87–105.
76. Garcia-Palacios, A., Hoffman, H.G., See, S.K., et al. (2001). Redefining therapeutic success with virtual reality exposure therapy. *CyberPsychology & Behavior* 4:341–348.
77. Barber, J.P., Stratt, R., Halpering, G., et al. (2001). Supportive techniques: are they found in different therapies? *Journal of Psychotherapy Practice & Research* 10:165–172.
78. Luborsky, L. (1984). *Principles of psychoanalitic psychotherapy*. New York: Basic Books.
79. Menon, S.T. (1999). Psychological empowerment: definition, measurement, and validation. *Canadian Journal of Behavioural Science* 31:161–164.
80. Botella, C., Perpiña, C., Baños, R.M., et al. (1998). Virtual reality: a new clinical setting lab. *Studies in Health Technology and Informatics* 58:73–81.
81. Riva, G. (ed.). (1997). *Virtual reality in neuro-psychophysiology: cognitive, clinical and methodological issues in assessment and rehabilitation*. Amsterdam: IOS Press. Available: <http://www.cybertherapy.info/pages/book1.htm>.
82. Klein, R.A. (1999) Treating fear of flying with virtual reality exposure therapy. In: VandeCreek, L., & Jackson, T. L., (ed)., *Innovations in clinical practice: A source book, Vol. 17*. Sarasota: Florida, U.S., pp. 449–465.
83. Rothbaum, B.O., Hodges, L., & Smith, S. (1999). Virtual reality exposure therapy abbreviated treatment manual: Fear of flying application. *Cognitive & Behavioral Practice*. 6:234–244.
84. Botella, C., Baños, R.M., Villa, H., et al. (2000). Telepsychology: Public speaking fear treatment on the internet. *CyberPsychology and Behavior*. 3:959–968.
85. Riva, G., Alcañiz, M., Anolli, L., et al. (2001). The VEPSY Updated project: Virtual reality in clinical psychology. *CyberPsychology and Behavior*. 4:449–455.
86. Durlach, N.I., & Mavor, A.S.E. (1995). *Virtual reality: scientific and technological challenges*. Washington, D.C.: National Academy Press. Online: http://www.nap.edu/books/0309051355/html/index.html.
87. Nichols, S., & Patel, H. (2002). Health and safety implications of virtual reality: a review of empirical evidence. *Applied Ergonomics*. 33:251–271.
88. Riva, G., Wiederhold, B., Molinari, E., (eds.). (1998). *Virtual environments in clinical psychology and neuroscience: Methods and techniques in advanced patient-therapist interaction*. Amsterdam: IOS Press. Online: http://www.cybertherapy.info/pages/book2.htm.

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