Cybertherapy
Internet and Virtual Reality as Assessment and Rehabilitation Tools for Clinical Psychology and Neuroscience
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14 The future of Cybertherapy: Improved options with advanced technologies

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Abstract: Cybertherapy is a field that is growing rapidly due to today's technology and information boom. Virtual reality and advanced technologies have been used successfully to in a variety of healthcare issues, including treatment of anxiety disorders and phobias, treatment of eating and body dysmorphic disorders, neuropsychological assessment and rehabilitation and distraction during painful or unpleasant medical procedures. The novel applications of these technologies yield many advantages over traditional treatment modalities, and the disadvantages that accompanied the first trials of virtual reality are quickly being addressed and eliminated. Virtual reality peripherals such as data gloves, physiological monitoring and Internet worlds are swiftly demonstrating their usefulness in cybertherapy applications. Future directions for research include improvements of objective measures of efficacy such as fMRI and physiological monitoring devices, and investigations are being carried out to determine if virtual reality and advanced technologies can be used to treat a broader scope of disorders, including depression, schizophrenia, drug addiction, and autism.

1. Introduction

Cybertherapy can be defined as the use of advanced technologies, such as the Internet or virtual reality, as an adjunct to traditional forms of therapy. Technology can provide visual and auditory stimulus that may be otherwise difficult to generate, creating a new environment in which to engage in therapy. Though only a major area of study for just over a decade, Cybertherapy is quickly becoming an accepted and validated method for the treatment of many different healthcare concerns.

Cybertherapy has lead to significant progress in the treatment of anxiety disorders and phobias, eating and body dysmorphic disorders, neuropsychological assessment and rehabilitation, and distraction during painful or unpleasant medical procedures. Numerous clinicians are actively investigating the use of advanced technologies in other areas of mental health, including using virtual environments for addiction disorders, stress management, depression, schizophrenia, sex offender therapy, social skills training, attention deficit disorder, and many others.

1.1 Benefits of Cybertherapy

Virtual Reality-Enhanced Cognitive Behavioral Therapy (VR-CBT) offers many advantages over traditional treatment for an abundance of disorders. It can reduce the

length of treatment, reduce relapse rates and is often more effective than traditional forms of therapy. By providing a variety of stimuli such as 3D visual, binaural audio, vibratory, tactile and olfactory in an immersive and sometimes interactive manner, virtual reality enhances the therapeutic experience, especially in treatments that traditionally involve imagination.

VR-CBT requires, on average, 8-12 sessions to treat specific phobias. It has been shown in controlled studies to work more effectively with phobias than imaginal therapy (visualization) and as effectively as in vivo (real-life) therapy. Recidivism rates can be reduced and therapeutic effectiveness can be enhanced by adding physiological monitoring and feedback to VR-CBT. Results from a three-year follow up analysis of data from a fear of flying study controlled study [1] indicate that VR-CBT with physiological monitoring results in lower relapse rates than VR-CBT alone.

Virtual reality can also offer new options to patients who are unable to utilize imaginal therapy due to difficulties engaging with a situation, or who are resistant to in vivo treatment due to extreme phobias and anxiety. It is recognized that there is a large percentage of the population (over 80%) that cannot visualize effectively (the anxiety response to a situation is not activated). In addition, many of those suffering from panic or anxiety do not feel that they can approach their feared situation in real life. Virtual reality offers an intermediary step between these two situations. Patients who are resistant or unable to engage with an imagined version of their fear can no longer avoid engagement when presented with the virtual stimulus. However, those who are too afraid to confront a situation in real life are able to practice first in a virtual environment. Through the use of virtual reality, patients have another option for treatment that avoids some of the limitations of traditional forms of therapy.

1.2 Obstacles in the Application of Cybertherapy

There are, nevertheless, a number of concerns related to the use of advanced technologies for healthcare purposes that clinicians must take into consideration. These can include cost, the technological capability of the therapist, side effects in some patients, insufficient realism and presence level in the virtual environment, and the problem of obtaining objective measurements of desensitization.

Until recently, the cost of equipment to treat anxiety disorders topped $150,000, a considerable and sometimes prohibitive cost for most clinicians. However, the development of powerful personal computers (PCs) has reduced the cost dramatically.

Some current virtual reality systems are available for an overall cost of $5,000, including a computer system with updated graphics card and an inexpensive head mounted display (HMD). This cost may still be prohibitive for some individual therapists, but it is certainly a drastic change from the expense of initial systems, and costs are continuing to decline. Though augmenting virtual reality systems with devices such as data gloves is still quite expensive and can add a significant level of complexity to an office-based system, these devices are not always necessary. Additions such as smell, heat, wind or breeze (for driving or heights environments, for example) are effective and do not require a significant investment. Higher end systems, such as the CAVE and Immersadesk, run simulations that require significant technical support and are not yet practical for the therapist's office.

Efforts to increase realism or presence, such as by using airline or automobile seats or by adding tactile augmentation, require custom designs and are therefore products of ingenuity and tenacity on the part of individual researchers.

The operation of PC-based virtual reality programs does require basic computer skills, and the therapist must be willing to invest time to learn these basic operations. Assembling systems requires knowledge of computer peripheral devices and how to appropriately

interface with computers. There are several key technical issues that need to be addressed as research in virtual reality treatment continues. Some patients report that controlling the environment through either the keyboard or mouse is not intuitive and sometimes inhibits immersion in the environment. In addition, since there is no uniform standard for the development of virtual reality software or interfaces, developers use a variety of different software programs, graphics cards, sound cards, etc. This requires that a separate computer system be available for each environment, a prerequisite that most private clinicians cannot afford. In addition, because of the variety of software and hardware utilized, some virtual environments crash with other systems or contain bugs that may inhibit therapeutic efficacy.

Another concern that arises with virtual reality therapy is that a small percentage of the population suffers side effects associated with virtual reality exposure. This cluster of symptoms is called cybersickness, and symptoms can include motion sickness, oculomotor problems, and migraines. Borderline patients, who often have attachment issues, may also fare poorly in virtual reality environments that allow less contact with the therapist, though this can be overcome by using environments where the therapist can enter as an avatar or speak to the patient during exposure. More research needs to be completed to determine appropriateness of virtual reality treatment for individuals with special needs. Although there were initial concerns related to using virtual reality for treatment of schizophrenia, these have not materialized. Four groups who are actively using virtual reality for assessment and treatment have found that issues related to confusion over “virtual worlds” and “real worlds” seem manageable in high functioning schizophrenics [2, 3, 4, 5].

Regarding treatment efficacy, it has been found that virtual reality environments may not seem realistic enough for certain patients because some graphics still have a notable cartoon-like aspect and may not effectively evoke the fear response necessary for desensitization in some groups of patients. Improved and variable scenarios are also needed to increase real-life applicability for the patient. However, this concern has been somewhat lessened by the recent research on presence, which indicates that a highly realistic environment may not be necessary, and, in some cases, may not even be optimal for effective therapy.

While it is clear that self-report measures do not produce the desirable level of accuracy for measurement of treatment effectiveness, and can be colored by a variety of patient and event-specific confounds, it has been shown that heart rate variability, skin conductance, and EEG are useful analogs of absorption and presence. Many therapists who perform traditional treatments such as imaginal exposure or systematic desensitization currently use physiological monitoring. Studies have reported that when the phobic patient’s fear structure is activated, autonomic arousal (such as increased heart rate or sweat gland activity) occurs. Physiological monitoring helps to determine if the patient's fear structure is activated and, thus, open to change. It also indicates if the patient is getting "too" aroused (which could indicate flooding), which is not desirable. Finally it shows if the patient has become desensitized to a certain aspect of the phobic scenario and should be encouraged to move on to the next level of the fear hierarchy. A high level of presence and immersion seems to be correlated with faster movement through therapy, a higher level of therapeutic success, and from preliminary data, less recidivism [1].

At present, two systems are necessary to both present visual stimuli and measure physiology. We hope to create future systems that will combine both tasks into an easy-to-use product that makes this form of therapy easier to deliver. An integrated system incorporating a virtual world and physiological monitoring may allow real-time data analysis to occur. The ultimate goal may be to have virtual reality systems that are driven by the patient's own physiology. This will likely include intelligent software that would automatically control the level of difficulty the patient experiences in achieving desired

parameters in training. Newer and less invasive methods to measure patient physiology need to be developed as the current methods are intrusive to some patients and may affect their levels of immersion in the virtual environment.

In summary, it must be acknowledged that the use of virtual reality in the area of mental health is still in its infancy. To further proceed and become a recognized part of therapy, more controlled studies are needed to determine if virtual reality does indeed provide for quicker, cheaper, more efficient treatment.

2. Future Directions

2.1 New Technological Devices

Some virtual reality researchers are investigating the possibility of delivering virtual environments for therapeutic purposes over the Internet, to counteract some of the aforementioned complications of in-office virtual reality therapy. Internet dissemination would allow therapists easy access to new virtual environments and would provide them with a broader selection of options for use in therapy. In addition, therapists would have access to the latest versions of the software, quickly obtaining programming changes to fix glitches in their systems. The possibility of offering virtual reality services to patients (under therapist supervision) in the home has already become a reality, but this practice has yet to become widespread. Internet treatment may become a great asset for some populations, such as patients with agoraphobia or social phobia who have difficulty leaving their homes. Other patients could benefit from occasional Internet-based "booster" sessions after successful completion of therapy for a specific phobia. In addition, Internet-based support may enhance quality of life in those with cancer, AIDS or Alzheimer's who are not always able to venture out to obtain the needed social support.

Exciting new methods are allowing for the introduction of real digitized images into the virtual world. A digital photo can be added to a virtual world using readily available, inexpensive digital cameras (Microsoft sells an inexpensive digital camera for about $30).

Some of the more expensive and advanced digital cameras are able to provide a 360-degree view of the surrounding environment, adding tremendous flexibility to the construction of virtual environments. As a result of advances in the entertainment and consumer products arena, adding digitized representations of real-world environments is now within reach of individual users.

These techniques have the potential to help treat Attention Deficit Disorder, Social Anxiety Disorder, and Public Speaking Anxiety. By including photographs of a child's actual classroom, the therapist can work with them to improve concentration skills during tests and assignments. In addition, working with photographs of classmates, co-workers or family members, patients can develop social skills in the safety of a Virtual Environment before attempting interaction in an Internet world or the real world. Incorporating photographs into VEs can also help to create a realistic audience for a patient to practice giving a presentation, repeating the exercise until the activity is no longer frightening.

Other promising peripheral devices exist, for example, the "data glove" and the "force-feedback" glove. The data glove is a flexible glove with tracking and movement sensors that is worn on the hand. It allows for tactile interactions in the virtual environment, giving the user the ability to grasp and manipulate virtual objects. This technology can be used to help desensitize patients to disturbing tactile stimuli, to distract them from an unpleasant medical procedure, or to increase presence in a virtual environment.

Force-feedback is a much more complex "glove" that simulates surface features and textures in the virtual world. In picking up or pushing a heavy virtual object, the force-

feedback glove produces a resistance that reinforces the user's perception that a heavy object has been encountered. A number of applications for this glove are under investigation, including rehabilitation therapy and range of motion exercises for patients with injuries or disabilities and treatment of repetitive behaviors in Obsessive Compulsive Disorder patients. However, these systems are expensive, and, thus far, no large clinical trials have been implemented using this technology.

Future developments in virtual reality technology will include systems that allow the therapist to accompany the patient into the virtual world. To a certain extent this can currently be accomplished through the use of Internet-based virtual worlds. In an Internet virtual world, both patient and therapist log on to a particular website and adopt a preferred "avatar," a virtual representation that allows the user anonymity. Through their avatars, the therapist and client can explore different worlds offered on the website or interact with other visitors who have adopted their own avatars. One use of these Internet-based virtual worlds is in the treatment of social phobia. After practicing with the therapist in a closed system, the client can visit a virtual world populated by other avatars, initiate conversations, and obtain feedback from other avatars in real time audio through the use of a simple microphone. Internet-based virtual worlds are also currently being used in the treatment of agoraphobia to expose the patient to unfamiliar worlds different than those the clinician can provide in the office setting.

In addition, as video games continue to improve in realism and flexibility, they are offering new tools for psychotherapy. The current version of "Midtown Madness" by Angel Studios/Microsoft is an inexpensive off-the-shelf video game that is currently being used for driving simulation at the VRMC. Other clinics are also beginning to use this system with positive results [6]. These driving simulations apply to a wide variety of social, medical, and psychological performance applications including rehabilitation, fear desensitization and skill assessment. Another video game, "Half-life," by Valve software, offers a fully-mouse-driven 360-degree realistic world, parts of which might be useful for treating war-related PTSD. In addition, modules for specific videogames that are available through the Internet (such as Max Payne) are easily adaptable, and such things as spiders and other creatures can be programmed into the world to help treat phobias and other anxiety disorders [7].

Recently, new virtual reality hardware is being developed that is compatible with functional Magnetic Resonance Imaging (fMRI) machines. These new head mounted displays allow researchers to observe the brain in action through fMRI. Several studies have been completed using this new hardware, including one by Graham et al [8] that examined navigation skills in a virtual reality environment, and a second study examined subjects' sense of presence in immersive virtual environments [9]. In addition, a presentation at the CyberTherapy 2004 conference will discuss the results of a study to examine the brains of nicotine-dependent subjects through fMRI use during virtual reality cue exposure [10]. This new concept has countless applications including investigation into which areas of the brain are activated during specific tasks and what differs between normal brains and those with mental disorders.

2.2 New Applications

As technology advances, and more disorders are being effectively treated through the utilization of these developments, research continues into ways in which the boundaries of cybertherapy can be expanded. One interesting new development in the field is the use of virtual environments for special education purposes. Brown and others at the Virtual Reality Applications Research Team (VIRART) are developing the Learning in Virtual Environments program (LIVE) a new experiential and communication tool at a special

school in Nottingham. They are measuring how skills learned in a virtual world transfer to the real world [11].

Other exciting developments in virtual reality include studies into how people interact in virtual worlds. The Collaborative Virtual Environments (COVEN) project, funded by the European Commission, focuses on the development of shared or collaborative virtual environments, bringing together expertise from human factors, networked virtual reality, computer graphics, human computer interaction, and telecommunications infrastructure. COVEN looks at network requirements for the support of such shared virtual worlds [12].

In addition, Bobick and others from MIT are collaborating to produce The KidsRoom, "a perceptually-based, interactive, narrative playspace for children" [13]. In this world, sound effects, music, narration, light, and images are used to transform a normal child's bedroom into a fantasy land where children are guided through a reactive adventure story" [13].

Along the same lines, Pandzic, Capin, Thalmann, & Thalmann [14] from the MIRALab-CUI are creating the Virtual Life Network (VLNET), a group that studies how humans react and interact with virtual worlds and attempts to devise more naturalistic methods for this interaction. In this setting, autonomous virtual actors can be introduced into the environment for any variety of tasks or purposes. Slater devised a series of experiments where three individuals who had never met were required to collaborate in order to carry out tasks in the virtual environment [15]. Group dynamics and interpersonal interaction were observed, with many human emotions (i.e. embarrassment) being generated from the required interaction.

Another new area of research for Virtual Reality in healthcare is the treatment of substance abuse through cue exposure [16, 17]. In this application, craving cues are presented to the patient in a virtual environment. This causes arousal in the patient, which eventually subsides through repetition of exposure. Virtual reality offers an advantage over traditional means of exposure (photographs, video or real life) because it is realistic enough to evoke a response in the patient, but does not allow the opportunity for them to succumb to temptation.

Virtual reality is also currently being investigated to improve quality of life for those suffering from chronic or terminal illness, such as cancer. Some patients suffer great anxiety and distress due to nausea, vomiting, and other chemotherapy-related side effects, and as a result prematurely discontinue treatment, delay treatment, or receive smaller dosages of chemotherapy. If a patient experiences side effects during chemotherapy, they are likely to begin developing anticipatory anxiety associated with each subsequent treatment. Though certain studies have shown videogames, relaxation, and guided imagery to be helpful in reducing distress and serving as a distraction technique [18, 19], these interventions are not effective for all patients. A study by Hoffman et al [20] demonstrates that the immersive, interactive nature of virtual reality enables more individuals to remain engaged and distracted from pain than videogames.

A study performed by Schneider & Workman [21] used VR exposure to reduce anxiety in children during their chemotherapy procedure, with eighty-two percent of the participants indicating that chemotherapy completed during VR was not as distressing as previous treatments without VR. Self-report measures of anxiety and distress were also greatly reduced. A follow-up study by Schneider et al. [22] that involved women receiving chemotherapy for treatment of breast cancer also found VR to be an effective intervention during chemotherapy.

A virtual environment developed by Giuseppe Riva of the Istituto Auxologico Italiano to treat eating disorders has also now been adapted to treat obesity. The environment allows patients to experience their body shape in a different context, providing

the ability to morph and view their bodies as a separate entity. This alternate mode of engagement with body image and food has resulted in effective weight loss and body image satisfaction. In several studies, obese patients fare better with virtual reality treatment then traditional cognitive-behavioral and nutritional treatment [23].

In developing new virtual reality tools, it is important to keep several concepts in mind. Existing therapeutic concepts should form the basis for the construction of virtual worlds. Virtual reality technology must be understood in light of existing science and established paradigms. The application of virtual reality in relation to existing therapeutic approaches and a consideration of the costs of using this technology need to be central in assessing the clinical applications of virtual reality. Multi-disciplinary teams of experts can be very helpful in the development and delivery of virtual reality systems.

3. Conclusion

The future of virtual reality therapy includes treatment of a wide variety of disorders aside from those currently treated such as anxiety disorders and phobias, eating and body dysmorphic disorders, neuropsychological assessment and rehabilitation, and distraction from medical procedures. Future areas may consist of treatment of addictions, depression, attention deficit disorder, stress management, and social skills training. Web-based resources for virtual reality practitioners are currently available and are in continuous development. Input on such topics as clinical protocols, equipment updates and purchases, ethical issues, and the newest research findings can be easily accessed using the Internet.

Training for virtual reality therapists may also become available through the Internet, making it possible for interested individuals throughout the world to participate.

Virtual reality therapy has made initial progress in treating a variety of mental health disorders, but there is more work to be done in a number of areas including the development of easy to use and more affordable hardware and software, the development of objective measurement tools applicable with virtual reality technology, the issue of side effects for some patients, and more controlled studies to evaluate the strength of virtual reality therapy in comparison to traditional therapies. Wider dissemination of the technology will encourage the industry to develop tools in response to user needs.

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