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## ETHICAL ISSUES FOR THE USE OF VIRTUAL REALITY IN THE PSYCHOLOGICAL SCIENCES

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Virtual reality (VR) has undergone a transition in the past few years that has taken it out of the realm of expensive toy and into that of functional technology. Although media hype may have oversold VR’s potential during the early stages of the technology’s development, a uniquely suited match exists between the assets available with VR technology and applications in the psychological sciences. Virtual environments (VEs) have been developed that are now demonstrating effectiveness in a number of areas in clinical psychology and neuropsychology. These applications have shown promise for addressing: fear reduction with phobic clients (Rothbaum, Hodges & Kooper, 1997), stress management in cancer patients (Schneider & Workman, 1999), reduction of acute pain during wound care and physical therapy with burn patients (Hoffman, Doctor, Patterson, et.al., 2000), body image disturbances in patients with eating disorders (Riva, Bacchetta, Baruffi, et. al., 1999), navigation and spatial training in children with motor impairments (Stanton, Wilson, Foreman & Duffy, 2000), functional skills in persons with central nervous system (CNS) dysfunction (Brown & Stewart, 1996) and in the assessment (and in some cases, rehabilitation) of attention (Rizzo, Buckwalter, Bowerly, et.al., 2000), memory (Brooks et al., 1999), spatial skills (McComas, Pivik & Laflamme, 1998; Rizzo et al., 2001a) and executive cognitive functions (Pugnetti et al., 1998) in both clinical and unimpaired populations. These efforts are no small feat in light of the technological challenges and funding hurdles that many of these researchers have faced in the development of this emerging technology. Also, the clinical and research targets chosen for these applications reflect an informed appreciation for the assets that are available with VR technology by clinicians/developers initially designing and using systems in this area. These initiatives give hope that the 21<sup>st</sup> century will be ushered in with new and useful tools to advance these areas that have long been mired in the methods of the past. Continuing advances in VR technology in the future will also allow for broader human use in the general population for a variety of purposes including, training, education, entertainment and for possible self-help therapy. However, as with any application of a new technology, many unanswered questions exist that will require advance thoughtful consideration of the ethical issues relevant for its use. This is especially important in the psychological sciences where research and clinical application with human participants and patient populations requires rational determination of the possible risks and benefits. As well, larger pragmatic and societal issues for general VR use need to be addressed from our position as

psychologists who are concerned about and have a professional-scientific interest in issues relevant to general human experience and its impact on mental health. The present chapter will begin by describing the basics of what VR technology involves and how it may provide assets for assessment, rehabilitation, and treatment purposes in clinical psychology and neuropsychology. A brief overview will then follow that details some of the ethical issues relevant for its safe and effective clinical/research use during these early stages of VR application development with an eye towards larger societal issues that could have considerable relevancy as the technology evolves.

### **Virtual Reality: Definitions and Relevance**

Virtual Reality can be generally defined as "...a way for humans to visualize, manipulate, and interact with computers and extremely complex data." (Aukstakalnis & Blatner, 1992). In essence, VR can be viewed as an advanced form of human-computer interface that allows the user to "interact" with, and become "immersed" within a computer generated VE in a more intuitive and naturalistic fashion. This is achieved via the integration of real-time computer graphics and a variety of sensory input devices. The believability of the virtual experience or sense of "presence" is supported by employing such specialized technology as head-mounted displays (HMDs), tracking systems, earphones, gesture-sensing gloves, interaction/navigational devices and sometimes haptic-feedback devices. The most commonly used, is a combination of a HMD and tracking system which allows delivery of computer-generated images and sounds in any virtual scene, that corresponds to what the individual would see and hear, if the scene were real. Other methods, incorporating 3D projection walls and rooms (known as CAVES), as well as basic flatscreen computer systems have been used to create interactive scenarios for assessment, treatment and rehabilitative purposes. Methods for navigation and interaction such as data gloves, joysticks, 3D mice, treadmills and some high-end "force feedback" mechanisms that can provide tactile feedback have also been developed. However, challenges in existing interface design for navigation and operation still need to be addressed before a level of VE interaction is achieved that is truly intuitive and naturalistic. This will be of particular concern for persons with CNS impairments and as well for other clinical populations. For example, in order for persons with cognitive impairments to be in a position to benefit from a VR rehabilitation application, they must be capable of learning how to navigate and interact within the environment. Many modes of VE navigation (data-gloves, joy sticks, space balls, etc.), while easily mastered by unimpaired users, could present problems for those with cognitive or sensorimotor difficulties. Even if patients are capable of using a VR system at a basic level, the extra non-automatic cognitive effort required to operate in a VE may serve as a distraction and limit the assessment and rehabilitation process. In this regard, Psotka (1995) hypothesizes that facilitation of a "single egocenter" found in highly immersive interfaces serves to reduce "cognitive overhead" and thereby enhances information access and learning. This is one area that needs attention in the current state of affairs for VR applications designed for clinical populations.

In spite of the technical challenges that currently exist for VR application development, systems currently in use are advancing new methodologies for psychological purposes. What makes VR application development in the psychological sciences so distinctively important and appealing is that it represents more than a simple linear extension of existing computer technology for human use. VR offers the potential to deliver systematic human testing, training and treatment environments, that allow for the precise control of complex dynamic 3D stimulus

presentations, within which sophisticated behavioral recording is possible. When combining these assets within the context of functionally relevant, ecologically valid VEs, a fundamental advancement emerges in how human cognition and behavior can be studied, assessed, treated and/or rehabilitated (see Schultheis & Rizzo, 2001 for a detailed discussion of VR assets). In this regard, much like an aircraft simulator serves to test and train piloting ability, VEs can be developed to present simulations that assess and treat human cognitive and behavioral processes under a range of conditions that are not easily controllable in the real world. The rationales for VR applications in neuropsychological assessment, cognitive rehabilitation and general clinical psychology will be briefly detailed in the next sections in order to put these assets into context prior to a discussion of the ethical issues that are relevant to consider in the use of VR with humans.

It is expected that with continuing advances in the underlying enabling technologies (i.e., engineering, computer science, human factors, etc.), more usable, useful, and accessible VR systems could be developed that uniquely target a wide range of physical, emotional, social, cognitive and psychological human issues and research questions. These developments have also resulted in more financially accessible low-cost PC-driven VR systems with greater sophistication and responsiveness. Such advances in both technology and access are allowing for more widespread application of VR technology in psychological research and clinical areas. However, with this emerging increase in access, the potential for uninformed and serious misapplication of the technology with particularly vulnerable clinical populations is looming. As the technology evolves, potent VE tools will become more readily available to professionals for research and clinical purposes, some of whom may not have the qualifications or expertise to deliver professional services in the area that the tool was designed to address. In addition, a growing number of VR scenarios will eventually become accessible to the general public via recorded media forms (e.g., DVD) and the Internet. The potential impact that this increased access will have on how research and clinical practice is conducted in psychology and the issues involved with general use by the population at large will need to be anticipated and analyzed from an ethical perspective. This chapter aims to address these topics.

### **Virtual Reality and Neuropsychology**

Neuropsychology is a branch of the psychological sciences where VR stands to have significant impact. While many VR applications have emerged in the areas of entertainment, education, military training, physical rehabilitation, and medicine, only recently has the considerable potential of VR for the study, assessment and rehabilitation of human cognitive and functional processes been recognized (Rizzo, Buckwalter & van der Zaag, In Press), Rose, 1996; Pugnetti, Mendozzi, Motta, et.al., 1995a). Indeed, in a U.S. National Institute of Health report of the National Advisory Mental Health Council (1995), the impact of virtual reality environments on cognition was specifically cited with the recommendation that: “Research is needed to understand both the positive and negative effects of such participation on children’s and adults’ perceptual and cognitive skills...” (p.51). One area where the potential for both “positive and negative effects” exists, is in the application of VR for the neuropsychological assessment, rehabilitation and research. In this regard, VR could serve to advance the study of brain/behavior relationships as well as produce innovative evaluation and intervention options that are unavailable with traditional methods.

**I. Neuropsychological Assessment :** In the broadest sense, neuropsychology is an applied science that evaluates how specific activities in the brain are expressed in observable behaviors (Lezak, 1995). Effective neuropsychological assessment (NA) is a prerequisite for both the

scientific analysis and treatment of CNS-based cognitive/functional impairments as well as for research investigating normal functioning. The NA of persons with CNS disorders using psychometric evaluation tools serves a number of functions. These include the determination of a diagnosis, the provision of normative data on the status of impaired cognitive and functional abilities, the production of information for the design of rehabilitative strategies, and the measurement of treatment efficacy. NA also serves to create data for the scientific understanding of brain functioning through the examination of measurable sequelae that occur following brain damage or dysfunction. Our understanding of brain morphology and activity has undergone a revolution in the past three decades that is akin to the revolution seen in microtechnology. However, the increase in our knowledge of the genetics, chemistry, molecular biology, and the “physics” of the brain is mitigated by our understanding of the behavior that is related to specific brain activity. For example, post-mortem studies of Alzheimer’s Disease have identified the entorhinal cortex as the area where the pathological changes of AD are first noted (Braak, Braak, & Bohl, 1993). However, this is of little clinical value unless we can identify the cognitive and behavioral processes that are serviced by this region. Once such processes are identified, it becomes possible to diagnose more effectively and intervene at an earlier stage of this neurodegenerative process. VE technology offers the potential to develop human performance testing environments that could supplement standard NA procedures that traditionally rely mainly on pencil and paper tests, behavioral observation and history taking. The capacity of VR technology to create dynamic, multi-sensory, three-dimensional (3D) stimulus environments, within which all behavioral responding can be recorded, offers clinical assessment options that are not available using traditional neuropsychological methods. In this regard, a growing number of laboratories are developing research programs investigating the use of VEs for these purposes and a number of initial studies reporting encouraging results are now beginning to emerge (Rizzo et al., In Press). This work has the potential to advance the scientific study of normal cognitive and behavioral processes, and to improve our capacity to measure and understand the impairments typically found in clinical populations with CNS dysfunction. VE applications are now being developed and tested which focus on component cognitive processes including: attention, executive functions, memory, and spatial abilities. Functional VE assessment scenarios have also been designed to test instrumental activities of daily living such as street-crossing, automobile driving, meal preparation, supermarket shopping, use of public transportation, and wheelchair navigation. These ongoing efforts could conceivably produce new methodologies that support earlier diagnosis by improving on standards for psychometric reliability and validity and drive test development that could produce better detection, diagnosis, and mapping of the assets and limitations that occur with different forms of CNS dysfunction.

The potential for VR’s impact for neuropsychological assessment was indirectly suggested early on by VR pioneer Myron Krueger (1993) in a visionary article published in the MIT journal *Presence* (“The Experience Society”). In a prophetic statement, in the context of a discussion of VR’s overall societal impact, Krueger proclaimed that, “...Virtual Reality arrives at a moment when computer technology in general is moving from automating the paradigms of the past, to creating new ones for the future” (p. 163). In this comment Krueger encapsulated what had also been so limited in neuropsychology’s approach to using computer and information technology at that time and opened a conceptual door to VR’s potential to advance the research and practice across many areas in the psychological sciences. Indeed, neuropsychology’s use of technology up to that time could be characterized as mainly translating existing traditional paper and pencil tools directly into computer delivered formats. In its defense, neuropsychology has been

increasingly integrating advanced neural imaging technology tools (i.e., fMRI, SPECT, QUEEG, CT, etc.) in its quest for a better accounting of the structure and process underlying brain/behavior relationships. However, while these advances in *response* measurement have led to new findings and conceptualizations, the *stimulus* delivery end of the equation has been somewhat limited. Stimulus presentation in traditional neuropsychological applications can be characterized as mainly coming in two forms: 1. *Analog* tasks involving standardized delivery of sound, text, symbols and still/moving image stimuli, responses to which are readily quantifiable but limited in ecological validity, and 2. *Naturalistic* tasks in “real-world” scenarios (usually requiring behavioral rating judgments) that are difficult or impractical to administer while still maintaining a systematic level of experimental control. Again, VR stands poised to fundamentally advance this area with innovative applications that leverage the immersive, involving and interactive assets available in VEs to deliver quantifiable analog-like stimulus protocols within the context of functionally relevant (and controllable) environments. Until now, these features have not been pragmatically available with existing methods in neuropsychology and thus VR may have plenty to offer in this vital and challenging area of the psychological sciences.

As well, a challenge to the conceptual growth of the field of psychometric testing methods was leveled in a 1997 *American Psychologist* article by intelligence theorist, Robert Sternberg (1997) in which he compared currently used intelligence and ability tests to black and white TV, rotary-dial phones, and the UNIVAC computer. His argument started by observing that the first edition of the most widely used intelligence test, the Wechsler Adult Intelligence Scale appeared in 1939, well before the UNIVAC. However, while computer and other information technology and telecommunication tools (i.e., TV, telephones, and sound recording) had undergone a revolution since then--with the exception of essentially cosmetic changes--tests of cognitive ability have remained essentially unchanged. Sternberg posited that “dynamic” interactive testing would be needed to provide a new option that could supplement traditional “static” tests. The “dynamic” assessment approach requires the provision of guided performance feedback as a component in tests that measure learning. This method appears well suited to the assets available with VR technology. In fact, VEs might be the most efficient vehicle for conducting dynamic testing in an “ecologically valid” manner while still maintaining an acceptable level of experimental control. Indeed, across most NA strategies, VEs may be especially suited to improve *ecological* validity, or the degree of relevance or similarity that a test has relative to the “real” world. This asset would allow for human cognitive/functional performance to be tested in simulated “real-world” VE scenarios. In this way, the complexity of stimulus challenges found in naturalistic settings could be delivered while still maintaining the experimental control required for rigorous scientific analysis. Such results might have greater clinical relevance and could have direct implications for the development of more effective functional rehabilitation approaches. However, it is also important to recognize that in all cases it may not be desirable for VEs to fully “mimic” reality. Another strength of VEs for assessment purposes may include the capacity to present scenarios that include features not available in the “real-world”. This would be the case when “cueing” stimuli are presented to determine what level of “augmentive” information can be used by patients to provide insight for the development of compensatory strategies aimed at improving day-to-day functional behavior.

It is possible that the use of VE technology could revolutionize our approach to NA. However, the current status of VE technology applied to clinical populations, while provocative, is still limited by the small (but growing) number of controlled studies in this area. This is to be

expected, considering the technology's relatively recent development, its high initial development costs, and the lack of familiarity with VE technology by established researchers employing the traditional tools and tactics of their fields. In spite of this, a nascent body of work has emerged which can provide knowledge for guiding future research efforts. Finally, the possibility of linking VE assessment with advanced brain imaging and psychophysiological techniques (Pugnetti et al., 1996; Aguirre & D'Esposito, 1997) may allow neuropsychology to reach its stated purpose, that of determining unequivocal brain-behavior relationships. While pragmatic concerns need to be addressed in order for this technology to advance the science required to reach this lofty goal, the benefits that could be accrued appear to justify the effort.

**II. VR and Cognitive Rehabilitation:** Cognitive Rehabilitation (CR) can be defined as the applications of methods, following injury to the brain, which aim to restore cognitive processes or arrest the resulting decline (Parente & Herrmann, 1996). Sohlberg and Mateer (1989) suggest that cognitive rehabilitation is “. . . the therapeutic process of increasing or improving an individual's capacity to process and use incoming information so as to allow increased functioning in everyday life” (p.3). Thus, CR targets both specific component cognitive processes and fully integrated functional behaviors or Instrumental Activities of Daily Living (IADLs). Between the complexity of the subject matter and the challenges incumbent with conducting outcome research with such a heterogeneous population, considerable debate exists as to the relative effectiveness of various CR approaches (Wilson, 1997). Rather than debating the merits of any specific CR approach and for the purposes of describing the underlying rationale for VR in this chapter, we are assuming that CR subsumes strategies and processes that would be of relevance to a larger “holistic” conceptualization of neuropsychological rehabilitation that also includes focus on vocational, self-awareness and social interaction concerns (Prigatano, 1997).

CR approaches can differ based on a variety of conceptual criteria (Kirsch et al., 1992). For the purposes of describing the application of VE technology to CR, these conceptual dimensions can be “collapsed” into two general domains: *Restorative* approaches which focus on the systematic retraining of component cognitive processes (i.e., attention, memory, etc.) and *Functional* approaches which emphasize the stepwise training of observable behaviors, skills, and IADLs. In this regard, the restorative approach places as the primary objective, the attempt to retrain individuals on how to *think*, whereas the primary emphasis of the functional approach is to teach individuals how to *do*. Specific weaknesses have been identified in both of these approaches. One often cited criticism of restorative methods is the reliance on test materials or tasks that are essentially artificial and have little relevance to real-world functional cognitive challenges. This criticism holds that “memorizing” increasingly difficult lists of words or activities within a therapy or school environment does not support the *transfer* or *generalization* of memory ability to the person's real-world situation (Chase & Ericsson, 1981; O'Connor & Cermack, 1987). The fundamental criticism of functional methods is that the learning of standard stereotyped behaviors to accomplish IADLs assumes that the person lives in a static world where life demands do not change, and that the person's underlying cognitive processes are not specifically addressed. This is believed to limit the flexible and creative problem-solving required to adjust to and think through changing circumstances in the real world (Kirsch et al., 1992).

The application of VE technology for the rehabilitation of cognitive/functional deficits could serve to limit the major weaknesses of both the restorative and functional approaches, and actually produce a systematic treatment method that would integrate the best features from both methods. In essence, it may be possible for a VE application to provide systematic restorative training within the

context of functionally relevant, ecologically valid simulated environments that optimize the degree of transfer of training or generalization of learning to the person's real world environment. VEs could also serve to provide a more controlled and systematic means for *separately* administering restorative or functional techniques when this direction is deemed appropriate. An analysis of the suitability of VE technology in meeting the minimum criteria for both restorative and functional approaches can be found in a previous paper (Rizzo, 1994).

It should also be noted that underlying the goals of both of these conveniently termed treatment directions (thinking vs. doing) is the concept of *neural plasticity*. Neural plasticity refers to the capacity of the brain to reorganize or repair itself following injury, through various mechanisms (i.e., axonal sprouting, glial cell activation, denervation supersensitivity, and metabolic changes) in response to environmental stimulation. Recognition of neural plasticity in response to both environmental enrichment or impoverishment has its roots in the animal literature (Renner & Rosenzweig, 1987) and detailed reviews of this increasingly favored view of the brain can be found elsewhere (Rose & Johnson, 1992). Consequently, it can be appreciated that the stimulation or “enrichment” provided by both restorative and functional approaches may each have some effect on the physical brain structure, and hence, training with both methods would be assumed to affect brain plasticity. If this view is accepted, stimulating virtual training environments would seem well suited to support this process and new approaches to CR would be warranted.

Indeed, researchers and clinicians in neuropsychology appear to be “wanting” for these advances. For example, in a recent National Institutes of Health (NIH) Consensus paper entitled “Rehabilitation of Persons with Traumatic Brain Injury (TBI)” two recommendations were made which suggest research directions that VE technology appears well poised to address. The report recommended that “Innovative study methodologies that enhance the ability to assess the effectiveness of complex interventions for persons with TBI should be developed and evaluated.” and that “Innovative rehabilitation interventions for TBI should be developed and studied...” (National Institute of Health [NIH], 1998a). As well, direct interest in VR for general rehabilitation purposes has also been recognized by the National Institute on Disability and Rehabilitation Research (NIDRR) which recently highlighted in their Long Range Research Plan, “...The benefits of combining virtual reality with rehabilitation interventions are potentially extensive” and specifically called for research “...to determine the efficacy of virtual reality techniques in both rehabilitation medicine and in applications that directly affect the lives of persons with disabilities.” (<http://gcs.ed.gov/fedreg/announcement.html>). These observations suggest that the discipline of cognitive rehabilitation is fertile ground for developing the innovative applications that are possible with VE technology.

### **VR and Clinical Psychology**

In the area of general clinical psychology, VR applications were initially developed in the early-nineties for exposure therapy targeting anxiety disorders. Since that time, an evolved body of literature has emerged and has provided evidence for numerous benefits in clinical psychological applications. In general, the phenomenon that users of VR can become immersed in VE's provides a potentially powerful tool. For example, VR may be used to immerse individuals in a VE that activates relevant fears, which is useful in the treatment of anxiety disorders. Alternatively, VR may be used to immerse individuals in a VE that distracts them from the real world, which can be useful in treating individuals undergoing painful medical procedures. There is a growing body of literature suggesting that the use of virtual reality in exposure therapy for specific phobias is effective. Case studies have documented the successful

use of VR in the treatment of spider phobia (Carlin, Hoffman, & Weghorst, 1997), claustrophobia (Botella, Banos, Perpina, Villa, Alcaniz, & Rey, 1998), acrophobia (Rothbaum, Hodges, Kooper et al., 1995b), and the fear of flying (Rothbaum, Hodges, Watson, Kessler, & Opdyke, 1996; Smith, Rothbaum, & Hodges, 1999). VR has also been used successfully with Vietnam veterans with posttraumatic stress disorder (Rothbaum et al, 1999; Rothbaum et al., in press).

Emotional processing theory as applied to anxiety disorders purports that fear memories include information about stimuli, responses, and meaning (Foa & Kozak, 1986; Foa, Skeketee, & Rothbaum, 1989). Therapy is aimed at facilitating emotional processing and modifying the fear structure. Any method capable of activating the fear structure and modifying it would be predicted to improve symptoms of anxiety. Thus, VR is a potential tool for the treatment of anxiety disorders; if an individual becomes immersed in a feared virtual environment, activation and modification of the fear structure is possible.

In a controlled study, virtual reality exposure therapy (VRE) was used to treat the fear of heights, exposing patients to virtual footbridges, virtual balconies, and a virtual elevator (Rothbaum, Hodges, Kooper, et al., 1995). Patients were encouraged to spend as much time in each situation as needed for their anxiety to decrease and were allowed to progress at their own pace. The therapist saw on a computer monitor what the participant saw in the virtual environment and therefore was able to comment appropriately. Results showed that anxiety, avoidance, and distress decreased significantly from pre- to post-treatment for the VRE group but not for the wait list control group. Examination of attitude ratings on a semantic differential scale revealed positive attitudes toward heights for the VRE group and negative attitudes toward heights for the wait list group. The average anxiety ratings decreased steadily across sessions, indicating habituation for those participants in treatment. Furthermore, 7 of the 10 VRE treatment completers exposed themselves to height situations in real life during treatment although they were not specifically instructed to do. These exposures appeared to be meaningful, including riding 72 floors in a glass elevator and intentionally parking at the edge of the top floor of a parking deck.

VRE was compared to standard exposure (SE) therapy and to a wait list (WL) control in the treatment of the fear of flying (Rothbaum, Hodges, Smith, et.al., 2000). Treatment consisted of eight individual therapy sessions conducted over six weeks, with four sessions of anxiety management training followed either by exposure to a virtual airplane (VRE) or exposure to an actual airplane at the airport (SE). For participants in the VRE group, exposure in the virtual airplane included sitting in the virtual airplane, taxi, take off, landing, and flying in both calm and turbulent weather according to a treatment manual (Rothbaum, Hodges, & Smith, 1999). For SE sessions, in vivo exposure was conducted at the airport during Sessions 5 - 8. Immediately following the treatment or wait list period, all patients were asked to participate in a behavioral avoidance test consisting of a commercial round-trip flight. The results indicated that each active treatment was superior to WL and that there were no differences between VRE and SE. For WL participants, there were no differences between pre and post self-report measures of anxiety and avoidance, and only one of the 15 wait-list participants completed the graduation flight. In contrast, participants receiving VRE or SE showed substantial improvement, as measured by self-report questionnaires, willingness to participate in the graduation flight, self-report levels of anxiety on the flight, and self-ratings of improvement. There were no differences between the two treatments on any measures of improvement. During the flight, participants receiving either VRE or SE indicated low levels of anxiety, with no differences between treatment groups.

Comparison of post-treatment to the 6-month follow-up data for the primary outcome measures for the two treatment groups indicated no significant differences, indicating that treated participants maintained their treatment gains. By the 6-month follow-up, 93% of treated participants had flown since completing treatment.

Researchers in Italy, led by Giuseppe Riva, are conducting innovative work integrating VR with experientially based cognitive therapy for eating disorders (Riva, Bacchetta, Baruffi, et al., 1998). In a recent case study, virtual reality was used in the inpatient treatment of a 22-year old university student diagnosed with anorexia nervosa (Riva, Bacchetta, Baruffi, et al., 1999).

Whereas the use of virtual reality exposure therapy for anxiety disorders and eating disorders capitalizes on immersing patients in the virtual world, VR for pain management benefits patients by distracting them from the real world. A recent case study examined the use of VR for pain management for two adolescents receiving burn wound care (Hoffman, Doctor, Patterson, et al., 2000). Using a single-subject design, two patients received opioid analgesia in conjunction with distraction. Distraction included playing Nintendo or entering a virtual kitchen, in which the patients could pick up appliances with a cyberhand or touch the body of a spider. Both adolescents received both types of distraction using a single-subject design, with one patient playing the video game first and the other patient entering the virtual kitchen first. Both patients reported dramatic decreases in pain ratings, anxiety, and amount of time spent thinking about pain during burn care while in the virtual kitchen as compared to playing Nintendo. The patients also reported higher levels of immersion in VR as compared to video, and the level of immersion in VR increased across burn care sessions. These data are particularly important, as immersion is presumed to be a key feature of VR, though it has rarely been tested in a systematic manner. VR has also been used to distract pediatric cancer patients during painful procedures and has been shown to significantly lower these patients' heart rates as compared to having the procedures without the VR (Gershon et al., submitted; Rothbaum, Hodges, Zimand, Gershon, Pickering, & Lemos, unpublished data). These findings suggested that it is possible for individuals to become immersed in a virtual environment to the point that attitudes and behaviors in the real world may be changed as a result of experiences within a virtual world.

In summary, the use of VR for exposure therapy in the treatment of a variety of anxiety disorders, including specific phobia and PTSD, seems promising. In addition to efficacy, VR offers other advantages, including preserving confidentiality for the patient, increasing control of the exposure for the therapist, and increased convenience for both the therapist and the patient. Of course, there are disadvantages as well. Some patients may not be able to immerse themselves in VEs, and currently there is no data regarding who constitutes a good candidate for VR rather than in vivo exposure. Furthermore, as with any computer program, there are occasional programming glitches. Finally, the cost of VR has in the past been prohibitively expensive for the typical therapist in private practice. However, the price of using VR continues to drop and the ease of use of VR continues to improve with advancements in technology.

### **Ethical Issues for the Use of VR**

Thus far we have detailed some of the arguments and research findings in support of the use of VR in the psychological sciences. The feasibility of designing, developing and implementing these tools has radically advanced in the last five years and it is expected that this evolution will continue into the foreseeable future. Along the way, more sophisticated VEs that are as accessible as common word processing programs and computer/video games will appear on the clinical and societal landscape. As psychologists directly involved in the application of this

technology and as members of society at large with a professional and moral-ethical responsibility for the promotion and maintenance of mental health, we are accountable to consider and address incumbent ethical concerns that surround this emerging technology. As in any area of ethical debate, clear-cut answers that cover all dilemmas are rarely found. Therefore we will briefly address some of the looming ethical challenges concerning side effects, exclusionary criteria, professional practice issues and concerns regarding general societal impact for the use of this technology as it continues to evolve in the future.

### **1. What is the potential for VE-related side effects (Cybersickness/Aftereffects)?**

In order for VR to become a safe and useful tool for human applications, the potential for adverse side effects needs to be considered and addressed. This is a significant concern as the occurrence of side effects could limit the applicability of VEs for certain clinical populations. Two general categories of VE-related side effects have been reported: cybersickness and aftereffects.

*Cybersickness* is a form of motion sickness with symptoms reported to include nausea, vomiting, eyestrain, disorientation, ataxia, and vertigo (Kennedy, Berbaum, & Drexler, 1994). Cybersickness is believed to be related to sensory cue incongruity. This is thought to occur when there is a conflict between perceptions in different sense modalities (auditory, visual, vestibular, proprioceptive) or when sensory cue information in the VE environment is incongruent with what is felt by the body or with what is expected based on the user's history of "real world" sensorimotor experience (Reason, 1970). However, the simple explanation of "sensory cue incongruity" influencing cybersickness in VEs requires further study in view of the observation that highly "congruent" VEs sometimes produce these ill-effects, and conversely, incongruent scenarios may not produce them (Nat Durlach, personal communication, 1999).

*Aftereffects* may include such symptoms as disturbed locomotion, changes in postural control, perceptual-motor disturbances, past pointing, flashbacks, drowsiness, fatigue, and generally lowered arousal (Rolland et al., 1995; DiZio & Lackner, 1992; Kennedy & Stanney, 1996). The appearance of aftereffects may be due to the user adapting to the sensorimotor requirements of the VE, which in most cases is an imperfect replica of the non-VE world. Upon leaving the VE, there is a lag in the readaptation to the demands of the non-VE environment and the occurrence of aftereffects may reflect these shifts in sensorimotor response recalibration. The reported occurrence of side effects in virtual environments in unimpaired populations varies across studies, depending upon such factors as the type of VE program used, technical drivers (i.e., vection, response lag, field of view, etc.), the length of exposure time, the person's prior experience using VEs, active vs. passive movement, gender, and the method of measurement used to assess occurrence (Hettinger, 1992; Regan & Price, 1994; Kolasinski, 1995). It has been suggested that side effects can be reduced via gradual repeated exposures to VEs and by the provision of more optimal levels of user initiated control over movement in the virtual environment (Stanney & Kennedy, 1997). These issues should be investigated further in order to determine what effective methods exist to reduce side effects that could limit the feasibility of VEs for applications with clinical populations.

A recent review of this area (Stanney et al., 1998) targets four primary issues in the study of VE-related side effects which may be of particular value for guiding feasibility assessments with different clinical populations. These include: "(1) How can prolonged exposure to VE systems be obtained? (2) How can aftereffects be characterized? (3) How should they be measured and

managed? (4) What is their relationship to task performance?” (p.6). These questions are particularly relevant to developers of clinical VEs, as these systems are primarily designed to be used by persons with some sort of defined diagnosis or impairment. It is possible that these users may have increased vulnerability and a higher susceptibility to VE-related side effects, and ethical clinical vigilance to these issues is essential. Particular concern may be necessary for neurologically impaired populations, some of whom display residual equilibrium, balance, perceptual, and orientation difficulties. It has also been suggested that subjects with unstable binocular vision (which sometimes can occur following strokes, TBI, and other CNS conditions) may be more susceptible to post-exposure visual aftereffects (Wann et al., 1996). Unfortunately, statistics on the occurrence of side effects with clinical populations have been inconsistently reported in the published literature to date. This is an aspect of data reporting on VEs that should be changed. Some type of assessment and reporting of VE-related side effects, whether using “in-house” designed ratings scales or standardized subjective and objective measures (Kennedy et al., 1993), should be standard procedure for presenting results on systems in this area.

Thus far, anecdotal reports of flatscreen scenarios used with clinical populations have not indicated problems with these less immersive systems. However, it doesn't appear that much systematic assessment has occurred, or in some cases the verbal report of the patients may have been compromised. Also, most clinical applications appear to use short periods of exposure (10-20 minutes) and this may have served to mitigate the occurrence of side effects based on the scant reporting in this literature. In one of the first studies to present systematic data for a HMD system used with populations having CNS dysfunction, 11 neurological patients were compared with 41 non-neurological subjects regarding self-reported occurrence of side effects (Pugnetti et al., 1995b). Subjects were tested in a VE specifically designed to target executive functioning with CNS populations. The results suggest a reduced occurrence of VE related side effects relative to other studies using the same assessment questionnaire, the Simulator Sickness Questionnaire (Kennedy et al., 1993), with an overall rate of 17% for the total sample. The authors concluded that the neurological subjects appeared to be at no greater risk for developing cybersickness than the non-neurological group. In a more recent study, Pugnetti et al. (1998b) reported side effect results comparing 36 patients having mixed neurological diagnoses, with 32 normal controls for a 30-minute VE exposure using the system described above. Using a variety of self-report questionnaires, assessments were conducted prior, during, and following VE usage and no differences were found between the groups on any of the side effect measures. It is important to note though, that the patient group was recruited from those with stable neurological conditions (good bilateral visual acuity, no epilepsy, preserved dominant handedness, and no psychiatric, vestibular, or severe cognitive disorders), and this screening procedure may have contributed to the low level of side effect occurrence. The screening of patient groups, as was prudently done by these authors, may be the safest course of action until more specific and “cautiously” acquired data becomes available from more impaired populations, particularly regarding the objective assessment of perceptual aftereffects.

While these initial findings are encouraging, further work is necessary to specifically assess how the occurrence of side effects is influenced by factors, such as the type and severity of neurological trauma, specific cognitive impairments, psychological/emotional factors, length of time within the VE, previous VE exposure and characteristics of the specific VE program. This is an essential step in determining the conditions where VEs would be of practical value with clinical groups. A useful tool for monitoring VE-related side effects is the Simulator Sickness Questionnaire (SSQ) (Kennedy et al., 1993). While more involved “objective” measures may

exist, particularly for the measurement of aftereffects, SSQ data is relatively simple to collect and may serve as a low-cost method to begin to specify and document the basic occurrence of VE side effects in clinical populations. Until we have better data on these issues, extra caution may be needed with some applications. For example, since we couldn't be confident regarding the absence of potential perceptual aftereffects occurring in a recent study with an elderly group (+65years old) testing visuospatial abilities, we had funding built into our grant to provide transportation to and from the test site, thereby minimizing any possible risk for altered driving behavior resulting from the VR exposure. Concerns, such as these, must be addressed in order to assure a positive course for developing VE applications for all persons and particularly with clinical groups.

## **2. What special considerations are needed for VR applications among individuals with altered awareness or reality-testing?**

The immersive and interactive features that add to the "realism" of VEs are two of the most appealing benefits of using this technology for clinical applications. However, it is the multidimensional and multisensory aspects of VR, that also hold the potential to be harmful for some clinical populations. In particular, specific considerations should be given when working with individuals who may have psychiatric conditions resulting in distorted reality testing or individuals with cognitive impairments who may have altered awareness. Specifically, such impairments, may result in increasing an individuals vulnerability for negative behavioral responses following exposure to VEs or the development of a propensity for escaping from reality through the use of VEs.

**Altered sense of reality:** One creative VR application, proposed by some, is its use to understand different mental states, such as hallucinations, delusions and altered states (Tart, 1990). While, it can be argued that individuals with intact mental functioning are able to distinguish between virtual and real environments and efficiently detect errors or distortions, individuals whose judgement is already impaired may be at a high risk for further distortion of their reality testing. For example, difficulties in detecting experiences between real and virtual environments could lead to misinterpretation of sequence of events, and/or the development of paranoid delusions. In addition, because VR protocols are more dynamic than traditional psychological or psychiatric approaches, the level of stress induced, as well as, the lure of an alternate environment would be hard to predict for individuals who are faced with the daily struggle of coping with visual or auditory hallucinations. As such, these individuals may be at higher risk for negative behavioral and psychophysiological responses. Finally, it should be considered that as this technology becomes more accessible, it is possible that individuals may seek to enter virtual environments in order to increase their own understanding of their psychological processes (Whalley, 1994). Such independent exploration, which lacks the therapeutic support and guidance, could prove to be detrimental to individuals with altered levels of reality-testing.

**Limited Self-Awareness:** Increasing awareness of deficits, is a common goal in the rehabilitation of cognitively impaired populations. Prior studies incorporating awareness building have demonstrated the benefits of increasing an individuals awareness of deficits for improving functional outcome. The added level of "realism" that can be delivered with VR may allow for a higher level of awareness training. Subsequently, ethical considerations for the overall consequences of increased awareness require attention.

For example, while traditional neuropsychological testing can elicit feelings of frustration, anxiety or concerns about performance, typically, this response is task-specific and often is not generalized to daily activities by the patient. Subsequently, patients rely on feedback from clinicians, to help them understand how their impairments will relate to their day-to-day functioning. The use of VEs offers a medium for patients to directly experience their impairments in "real world" situations. As a result, a new level of response to this awareness of deficit can be anticipated. For example, in assessment of driving capacity in cognitively compromised populations, traditional measures (e.g., paper and pencil tests, computer tests), often are not easily associated to actual driving behaviors by the patients. By contrast, with VR's realism, patients can more easily associate their poor performance on a VR driving simulator to "real world" driving. The impact of this awareness may be beneficial for some but potentially harmful for others. For example, poor performance may elicit increased anxiety and/or concerns regarding driving capacity, which may result in a choice to discontinue driving. Dependent on the circumstances, this could significantly alter an individual's lifestyle, such as altering vocational situations, relying on external support for transportation, added demands on family members, and possible negative emotional responses (i.e., depression, isolation) to the loss of independence. As such, the evaluation of these types of potential responses to VR should be conducted both before and after VR exposure, as part of standard protocol.

In addition to increased awareness, individuals with physical and/or cognitive disabilities may also be more vulnerable to "escapism" via exposure to VE's. For example, the application of VR for simulated walking by individuals with spinal cord injury has been proposed (Riva, 2000). While therapeutic benefits may be the fundamental intention, one can predict that the VE could be more enticing and positive than the real world. The question then arises, will the patient with time, choose to escape from the confines of a wheelchair and the reality of the real world, and choose to spend more and more time in the virtual world? As well, if it is argued that behavior is influenced by experience, it could be anticipated that individuals with such disabilities, may demonstrate changes in their behavior in response to the VR exposure. That is, continued exposure to life without disability in the VR, may result in individuals experiencing increased difficulties in accepting their disabilities in the "real world".

**Loss of Choice:** Finally, with both altered reality-testing and impaired awareness the question of choice must be addressed. This can be considered both from a clinical and legal point of view. First, from a clinical perspective, the choice of the virtual experience to be administered to patients is often dependent upon several factors: the computer, the skill of the designer, and preferences of the supervising clinician. Subsequently, for the patient, there is a restriction of choice that can unfortunately allow for opportunities of abuse. In addition, it should be considered that because VE's are limited to the designer's interpretation, the meaning of these experiences imposed by the patient may not agree with those imposed by the designer. The result may be negative experiences and subsequent maladaptive behaviors.

From a legal perspective, the fact that so many factors can limit, control and /or determine a VE experience, issues of accountability, responsibility and liability may require an additional level of consideration for these vulnerable populations.

### 3. Using VR out of your area of expertise

Principle A of the *Ethical Principles Of Psychologists* (American Psychological Association, 1992) regards competence. It reads:

*“Psychologists strive to maintain high standards of competence in their work. They recognize the boundaries of their particular competencies and the limitations of their expertise. They provide only those services and use only those techniques for which they are qualified by education, training, or experience. Psychologists are cognizant of the fact that the competencies required in serving, teaching, and/or studying groups of people vary with the distinctive characteristics of those groups. In those areas in which recognized professional standards do not yet exist, psychologists exercise careful judgment and take appropriate precautions to protect the welfare of those with whom they work. They maintain knowledge of relevant scientific and professional information related to the services they render, and they recognize the need for ongoing education. Psychologists make appropriate use of scientific, professional, technical, and administrative resources.”*

In the *Ethical Standards* (section 1.04), it further expounds on the Boundaries of Competence:

*(a) Psychologists provide services, teach, and conduct research only within the boundaries of their competence, based on their education, training, supervised experience, or appropriate professional experience.*

*(b) Psychologists provide services, teach, or conduct research in new areas or involving new techniques only after first undertaking appropriate study, training, supervision, and/or consultation from persons who are competent in those areas or techniques.*

*(c) In those emerging areas in which generally recognized standards for preparatory training do not yet exist, psychologists nevertheless take reasonable steps to ensure the competence of their work and to protect patients, clients, students, research participants, and others from harm.*

It is clear from the spirit of these ethical principles and standards that a professional should practice only within the realm of his or her expertise. This has come up repeatedly in the area of virtual reality exposure therapy. In the first published manual for providing virtual reality exposure therapy for anxiety disorders, this caution was included:

*“The Virtually Better<sup>TM</sup> virtual reality exposure therapy system is intended to be used as a tool by experienced clinicians who are also experienced in delivering exposure therapy. This is intended as a component of a comprehensive treatment program. If you are unsure, please seek supervision from an experienced clinician. Virtually Better<sup>TM</sup> should be considered essentially equivalent to in vivo exposure. Although research has not addressed this equivalence, if you would not be qualified to take a patient out for in vivo exposure, you should not attempt Virtually Better<sup>TM</sup> exposure, either.” (Rothbaum, Smith, & Hodges, 1999)*

Virtual reality should be approached as a tool to be used by clinicians experienced with the types of patient problems and treatment they are treating. It is not meant to be a convenient way of attracting new patients or of administering a new type of therapy that they are not qualified to provide. As an example, as described above, there is mounting evidence of the efficacy of VR exposure therapy. As mentioned in the caveat quoted from the treatment manual above, therapists should only attempt to use VR for exposure therapy if they are qualified to provide exposure therapy. Likewise, clinicians should only use the VR applications for ADHD or neuropsychological testing if these are areas of expertise. As the use of therapeutic VR expands,

it will be incumbent upon clinical training programs to train future professionals in its competent and ethical use.

#### **4. Will Therapists use VR at the expense of the normal therapist/client relationship?**

Much has been written about the therapeutic relationship between a patient and therapist, and it is an important variable in treatment. A discussion of the intricacies of the therapeutic relationship is beyond the scope of this chapter, but the impact of introducing technology such as VR should be examined. As in any social interaction, nonverbal communication is of paramount importance in the therapist/patient dyad. Much of this nonverbal communication comes from facial expression, body posture, hand gestures, and intonations. If patients are wearing head mounted displays, they cannot see the therapist and therefore lose all of the nonverbal communication absorbed visually. If it is a loud virtual environment such as the Virtual Vietnam or even the virtual airplane, the therapist may be talking to the patient through a microphone connected to the earphones. Although they can still carry on a conversation, some of the natural inflections are stilted and the therapist is speaking over the background noise of the virtual environment. The use of such technology definitely impacts on the therapeutic relationship. It may allow avoidant patients to “hide” behind the technology. Very avoidant patients may focus on the details of the technology (e.g., “Is this stereoscopic?”; “What’s the field of view in this?”) to avoid processing the feared stimuli. The astute therapist should deal with this rather than engage in a technical discussion. The use of such technology may also allow therapists who might be less than comfortable with interpersonal issues to hide behind the technology or to become comfortable with a routine use of VR instead of assessing the needs of the patient on an ongoing basis.

This is not to say that the use of VR must by definition lead to the loss of the normal therapist patient relationship. Presumably, VR was not introduced immediately upon the first visit, so there were likely several sessions of standard information gathering and skills training before the patient was ready for VR exposure. Within one session, there is still conventional conversation at the beginning of the session and at the end of the session. In fact, VR could possibly add to the therapeutic relationship if the therapist is very skilled at the presentation of feared stimuli at precisely the right moment and right intensity for a therapeutic exposure and processes the session sensitively afterwards. Just as standard exposure therapy is different from “talk therapy” and often occurs outside of the office and therefore fosters slightly different dynamics, so does the introduction of VR. Therapists should be cautioned not to hide behind the technology or let the technology dominate the session. Again, VR should be approached as a tool to be used to enhance therapy rather than the therapy itself.

#### **5. Will Therapists rely on VR as a substitute for good clinical skills or to mask shoddy service?**

Related to this issue is section 1.05 in the *Ethical Standards on Maintaining Expertise*:

*“Psychologists who engage in assessment, therapy, teaching, research, organizational consulting, or other professional activities maintain a reasonable level of awareness of current*

*scientific and professional information in their fields of activity, and undertake ongoing efforts to maintain competence in the skills they use.”*

As well as section 1.14 on Avoiding Harm:

*“Psychologists take reasonable steps to avoid harming their patients or clients, research participants, students, and others with whom they work, and to minimize harm where is foreseeable and unavoidable”*

And section 2.02 regarding Competence and Appropriate Use of Assessments and Interventions:

*(a) Psychologists who develop, administer, score, interpret, or use psychological assessment techniques, interviews, tests, or instruments do so in a manner and for purposes that are appropriate in light of the research on or evidence of the usefulness and proper application of the techniques.*

*(b) Psychologists refrain from misuse of assessment techniques, interventions, results, and interpretations and take reasonable steps to prevent others from misusing the information these techniques provide. This includes refraining from releasing raw test results or raw data to persons, other than to patients or clients as appropriate, who are not qualified to use such information. (See also Standards 1.02, Relationship of Ethics and Law, and 1.04, Boundaries of Competence.)*

As discussed above and as is made clear in the *Ethical Principles*, therapists should use VR to enhance therapy rather than substitute for it. It would not be advised to obtain the VR hardware and software to rejuvenate a floundering practice if the problem is the competence level of the clinician. Therapists must be thoroughly trained in the assessment or therapy they are delivering and use VR for the advantages it affords such as control over stimuli for assessment or treatment, ease of exposure, or cost-effectiveness. It would not be ethical to obtain the VR technology and use it as a substitute for clinical competence. To misquote a colleague, bad therapy with VR is still just bad therapy with VR

## **6. Will advances in VR access lead to cases of faulty self-diagnosis and self-treatment?**

Although the current therapeutic uses of VR still require a clinician to be present, future uses will probably not have this requirement. Individuals will be able to download or purchase locally VR assessment and therapeutic tools. Will this contribute to faulty self-diagnosis and inadequate self-treatment? Probably to a small degree, but also likely not more than currently exists in the self-help arena. One cannot overemphasize the importance of self-help programs. The fact of the matter is that most people “cure” themselves of their problems without ever seeking professional assistance. Anything that aids in this process can only be seen as advantageous. It is true that many people who rely on self-help programs may not meet diagnostic criteria for their disorders, but significant distress and interference can result even from subclinical syndromes, and therefore, these individuals have much to gain from any intervention. A self-help intervention for the fear of public speaking, for example, will likely attract more people than would meet DSM criteria for social phobia, but that’s not to say these individuals wouldn’t profit from such a program. One of the most significant problems with self-help programs in general is compliance. In this way, the attraction of the VR graphics and technology may hold an advantage of keeping people engaged long enough to profit from the program.

## **7. What are the risks of overstated claims in the application of VR to medical research?**

The history of medicine serves to provide numerous examples of the over-exploitation of new technologies. As is commonly the case, the introduction of a new application is often met with an atmosphere of optimistic overexpectation and urgency for implementation. Given its considerable potential to increase our understanding of human function and serve as a powerful treatment tool, VR is a current technology that clinicians and researchers are implementing in medical studies. As such, consideration of the potential ethical dilemmas that could arise from this overexpectation and urgency is warranted.

The medical use of electricity, has served as an example of a commonly accepted procedure in the nineteenth century, during which time clinicians who had minimal to no experience in the physics of electricity applied this technique to patients (Whalley, 1995). Similarly, with today's growing interest in the use of VR for medical research and treatment, consideration of who and how these procedures are implemented must be addressed. The foundation of completed studies can serve to demonstrate that successful and safe use of VR environments for assessment or treatment of clinical populations will require an integrated foundation of knowledge. To date, most protocols have combined the expertise of clinicians, programmers and engineers. Given the encouraging findings from initial VR studies, it is necessary to consider that numerous underlying gains which may lead scientists to "rushing into" the application of this technology and potentially making premature and overstated claims about its benefit.

It can be argued that scientists often are at risk of being too enamoured or wedded to their ways of thinking. This is a problem that has been around prior to VR. However, the enthusiasm for the use of VR in research, does raise the question of how well researchers will know this technology, its capabilities and limitations, prior to its application. The potential dangers of such limited knowledge are twofold. First because control of both the stimulus (input) and the desired outcome variables are at the disposal of the researcher, limited knowledge regarding the impact of VR technology on human performance could lead to inaccurate interpretations and conclusions. In addition, the probability of exposing patients to unnecessary risks would be increased. The importance of understanding the underlying mechanisms of new technologies is not unique to VR, and has been underscored by others (Whitbeck & Brooks, 1982; Whitbeck, 1993). Second, it is important to recognize that the introduction of new technologies often highlights capabilities and not limitations. As such, the question of how this new capacity influences the focus of research should be considered, to ensure that the appropriateness of the application does not get overlooked. Such a skewed perspective could result in a failure to pay attention to the scientific and clinical needs. Given the rapidly advancing changes in VR, the importance of recognizing both strengths and limitations can help researchers to better match VR's capabilities to investigative and scientific needs.

In addition to potentially premature and ill-judged clinical applications, it is important to recognize the possible secondary gains for researchers using this new technology. In a field where competition between institutions is openly acknowledged, and where funding sources are often dependent upon public funds, there is considerable pressure for researchers to achieve the highest level of expertise and to conduct studies that are at the forefront of scientific research.

As such, the application of promising, innovative technologies such as VR could be considerably appealing to researchers. Claims of "expertise" or "specialization" could serve to further the careers of researchers and attract funding sources to institutions.

Concerns regarding medical paternalism and misuse of VR technology have been recognized by many researchers (Kallman, 1993; Whalley, 1995). Subsequently, it is timely to examine the ethical issues that may arise in the development and application of VR to clinical research and treatment. VR possess enormous potential to improve our current scientific protocols and enhance our understanding of various medical issues, subsequently, it would be a pity if such opportunity were delayed or lost, as a result of unresolved ethical issues.

### **8. Will certain individuals prefer to spend time in virtual environments and interact with Virtual Human Representations (Avatars) to the exclusion of interactions in the "real" world and relationships with "real" people?**

As the underlying enabling technologies evolve, ever more realistic and compelling VEs will be created and many of these scenarios will be inhabited with very convincing and believable virtual human representations or "Avatars". Already we have seen the initial use of avatars on the Internet for: news presentations (Ananova, 2001), representing participants in chatroom interaction (Damer, 1998) and for avatar-delivered email messaging that allows for the transmission of 3D photorealistic renditions of faces capable of delivering voice messages. The use of avatars has also emerged as a "hot topic" for enhancing interaction in virtual environments and to promote better forms of human-computer interaction (Rizzo, Neumann, Enciso, et. al., 2001b). In fact, some of the major information technology corporations are looking to create computer systems that integrate avatar "technology" as part of a long-term view toward modeling human-computer interaction after human-human interaction. This direction aims to maximize naturalistic "engagement" between humans and computational devices by leveraging human cognitive, perceptual and social attributes in a way that promotes interaction with technology in a social manner (Turk & Robertson, 2000). This effort to support more naturalistic engagement between these two complex "systems" is seen quite poignantly in a statement from the IBM Almaden website on the area of "emotional computing" in the following statement: "Just as a person normally expects a certain kind of engagement when interacting with another person, so should a person be able to expect similar engagement when interacting with a computational device. Such engagement requires the computer to carefully observe the user, anticipating user actions, needs, and desires. Such engagement enables users to begin to build personal relationships with computers." (IBM, 1999).

By integrating such emotional computing concepts with avatar delivery formats (e.g. users giving voice commands to a virtual avatar instead of using a keyboard or mouse), we will see much more opportunity for human interaction and "bonding" with avatars on the Internet and in VEs in the future. It will also be possible for users to "select" both appearance and "personality" features for these avatars to suit specific user-determined needs, tastes and preferences. Already, advanced research is demonstrating the feasibility of developing avatars that are "fueled" with Artificial Intelligence (AI), aimed at fostering more "authentic" real time interaction between "real" humans and virtual characters for training purposes. For example, Rickel and Johnson (1999) have reported success in the implementation of an AI avatar named "Steve" who serves the role as "instructor" for a virtual training environment targeting the operation and maintenance of equipment on a battleship. As well, similar avatar applications for

testing and training tactical decision-making tasks such as crisis response in US Army peacekeeping operations are under development (Swartout et al., in press). These applications could be said to emulate the type of interactions that occur with holographic characters that are often portrayed on the ‘holodeck’ in various versions of the science ‘fiction’ TV franchise/series ‘*Star Trek*’.

On the positive side, more believable virtual humans inhabiting VEs would open up possibilities for scenarios that allow for assessment and intervention strategies that involve social interaction, naturalistic communication and more ‘personal’ guidance/instruction. Populating VEs with avatars could also serve to enhance a sense of realism that may in turn promote the experience of presence in VR. For example, VEs designed to target certain anxiety disorders might directly benefit from the presentation of virtual humans that are capable of some form of interaction, speech, and have the ability to recognize and emit typical non-verbal social communication via facial expressions and hand/body gesture cues. Early research in this area is investigating the use of video and computer graphics methods to render virtual humans for treatment of public speaking and social phobias (Anderson, Rothbaum & Hodges, 2000; Pertaub & Slater, 2001; Wiederhold, Riva, Choi & Wiederhold, 2000), as well as for a variety of social psychology research applications (Blascovich, Loomis, Beall, et. al., 2001). The capacity to easily render avatars that are modeled after ‘real’ persons in the users’ everyday life might also create new possibilities for mental health applications that could utilize more realistic ‘role-playing’ strategies.

However, the ‘creation’ of avatars at this level could also be ‘challenging’ to humans’ general self-perceptions on a number of existential and ethical levels and a truly visionary and involved treatment of these issues can be found in Kurzweil (1999). One of the key concerns in the future may involve the clinical and social ramifications due to chronic use or ‘addiction’ to ‘fantasy’ VEs and the avatars that inhabit them, at the expense of involvement in the real world and relationships with real persons. While limitations in the state of current VR technology make it doubtful that these issues will be of immediate concern, as the technology evolves and VEs begin to rival (or exceed) the experiences that are available in a person’s real world, there will undoubtedly be individuals who will develop preferences for the sensory, intellectual and personal control options that will be afforded in a synthetic virtual world.

This issue has already received considerable popular media press (and some academic attention) as it pertains to the current topic of ‘Internet Addiction’(cf. Young, 1999). As new information technologies become integrated into the sociocultural landscape, questions are commonly posed as to whether people will become so involved in their activities in cyberspace, that they will in turn neglect their social and functional involvement in the ‘real-world’. Efforts to examine the relationship between internet use and measures of social interaction and participation in other activities have produced a few large scale studies with contradictory results (Miller & Dunn, 2000) and no shortage of heated debate. Similar concerns were raised with the previous introduction of popular media forms (TV, video games) and as well with the rapid adoption of everyday assistive technology devices (calculators, cell phones). Along the way, TV has produced its share of ‘couch potatoes’ and ‘CNN junkies’, while the use of personal calculators never actually produced a generation of children who were unable to do simple addition. The question as to whether a frequently engaged activity becomes a pastime, a passion or a personal addiction warranting a DSM-4 designation becomes a very contentious and thorny area that often times becomes rooted in relativist philosophy steeped in personal value judgments. However, these existing forms of entertainment and assistive devices are easily seen

to allow for interaction and shared experiences with other people and provide a modicum of convenience for modern living. In contrast, the concern about persons who might prefer to spend time in VE's and form relationships with the "artificially intelligent and personable" characters that may inhabit them, seems to strike a unique chord in everyday judgments about pathological interests. Out of this concern, it becomes possible to quickly view these activities as a threat to psychological well-being by way of providing an unhealthy substitute for physical proximity and interaction with "real" humans that could promote or exacerbate social withdrawal or other forms of psychological disturbance? Yet we can observe socially-evolved Internet communities based on shared interests, as well as highly structured distributed internet gaming societies that serve as meaningful personal and social outlets for many participants without ever requiring face-to-face interaction. These issues are particularly challenging to address due to the rapid onset of the information technology revolution. Essentially, the psychological sciences are still trying to make sense of how much of the knowledge acquired over a century of empirical study in the real world can be usefully applied to predict the impact of activities in cyberspace on psychological processes. Consequently, no fully satisfying or comprehensive answers currently exist for these questions, nor are they expected to appear in the near future.

An early test case for these issues currently exists in Japan where there is considerable controversy raging over the existence of a condition among adolescents popularly termed "*hikikomori*", characterized by a lack of social communication skills and withdrawal. While no systematic research has examined this condition scientifically, social critics have linked its occurrence generally to the widespread use of digital media and communication devices that are currently quite popular with children in Japan. More specifically, this social commentary has increasingly focused on the popularity of "Love Simulation Games" (Kato, 1997). These interactive computer games, involve the creation of thematic gaming scenarios where the "player" meets and evolves relationships with avatar representations of members of the opposite sex, each having differentially programmed personalities. The player makes an initial judgment as to which one he or she would like to form a relationship with and various choice points occur in the "game" (i.e., giving presents, having "conversations", planning dates, doing favors, etc.) that determine various outcomes. The player interacts with the characters and the game is won or lost based on by whether the sought-after avatar selects the player to be their "steady" at the end of the game. The popular image of the ill effects of this sort of gaming is the perception that adolescents with fears of failing at social interactions will immerse themselves in the many "Love-simulation" games that are available, in the absence of taking the risks that are involved in pursuing and forming relationships with "real" peers.

It is clear that many alternative views of these "relational" activities are possible. However, the previous discussion suggests one possible way that, even at the currently limited and unnaturalistic level of the interaction that is available with 2D computer game avatars, an involvement with the virtual characters that "populate" these thematic gaming environments occurs which is being seriously questioned (whether correctly or incorrectly). While space limitations preclude an involved treatment of this area, it is not hard to imagine the possible socioethical issues that will emerge when exotic VEs become available (beyond what is available to the user in their real world) that allow for behavior with custom-tailored avatars which is devoid of immediate real-world consequences. As psychologists, it will become increasingly necessary to consider possibilities that are both positive (i.e., social skills training, entertainment in imaginative growth-fostering VEs, etc.) and negative (i.e., increases in social isolation,

playing out of “pathological” exploitive impulses) with an appreciation of both the personal choice and real world mental health issues in the balance.

**9. What are the potential human and societal consequences that could occur with the creation of VEs that involve violent or dehumanizing content and how is this to be anticipated and investigated?**

As with most tools that result from human scientific and technological achievement, the use of VR can be seen as a “double-edged sword”. Indeed, many of the attributes that make VR such a promising tool for targeting useful goals and purposes could also serve to produce scenarios with the potential for negative consequences. Similar to the topics presented in the last section, the question here concerns the possibility that VR use could have a negative impact on real world attitudes and behavior. One of VR’s assumed assets is its capacity to deliver high fidelity training or rehabilitation environments that are designed to promote transfer of VR-acquired learning or behavior to the real world. Ordinarily this asset is expected to support “positive” outcomes and to promote human welfare, but it is not hard to imagine the development of scenarios that could serve less “noble” purposes. One highly visible concern is in the creation of VEs that involve violent content or allow for engagement in other forms of “dehumanizing” behavior, as has already occurred with less immersive computer games (e.g. “first-person” shooting scenarios). In this regard, there exists a long history of research and contentious debate concerning the effects of *exposure* to violent content in other popular media forms (i.e., television, film, gaming, etc.), particularly with children. An extensive and diverse literature has evolved in this area over the last 40 years, initially gaining visibility with the early work of Bandura and colleagues on the effects of “modeling” on the expression of aggressive behavior (Bandura & Walters, 1959; Bandura, Ross & Ross, 1961). More recently, in the wake of a rash of school shootings in the US, this issue has been thrust into the glare of the popular media spotlight. This has reinvigorated the debate concerning what role exposure to media violence may play in the occurrence of such tragic incidents. However, an involved discussion of this topic is well beyond the scope of this chapter and a rich literature representing a wide spectrum of viewpoints can be found elsewhere (for review see Calvert, 2002).

The purpose of this section is not to weigh in on the issue of whether certain media content directly influences or causes violent, anti-social or otherwise unhealthy or “undesirable” behavior. Rather, we will briefly address the issues specific to VR use, particularly in view of its immersive and interactive features, that are relevant to envision a research agenda to rationally examine VRs potential impact on negative or socially undesirable behavior. These topics will increase in relevance (and visibility) as VR technology advances and becomes more accessible, especially with the arrival of next-generation gaming platforms that will soon be capable of delivering compelling VEs (Macedonia, 2000). As this gaming infrastructure becomes integrated into the “digital homestead”, it is naïve to believe that game developers will ignore the future commercial potential for creating VEs that immerse players in violent or antisocial digital content. Already computer gaming has approached the “Hollywood” film industry in total entertainment market share and much of this may be partly due to the seemingly universal popularity of games that present highly realistic depictions of graphic violence. If history is any predictor of future design, marketing and consumer trends in the computer gaming industry, VR gaming scenarios will likely “advance” along a path similar to that which produced the “Pong” to “Space Invaders” to “Duke Nukem” evolution. While emotion-driven and value-laden

viewpoints often serve to promote wide social awareness of the problems that could occur with the popular adoption of any emerging technology, reasonable answers to these questions will require rigorous scientific investigation. A thoughtful and rationally planned scientific agenda to guide research examining VR's potential negative impact is needed that will necessarily integrate perspectives from many areas of the psychological sciences (i.e., social psychology, neuropsychology, communications theory, forensics, etc.).

A reasonable starting point for this agenda may be found in the examination of VR's specific characteristics in comparison to already existing forms of popular media. Unlike television or cinema, which essentially involves passive exposure or consumption of content, VR allows for more naturalistic interaction *within* the content. The difference between the passive viewing experience that is afforded by TV or cinema and the immersive/interactive features of a VE can be intuitively grasped by considering the difference between observing activity in an aquarium through a window vs. actually swimming within it. Such a capacity for immersive interaction may foster a sense of presence within a simulated VE that promotes an active behavioral learning experience that is supported by potent *procedural* learning mechanisms. From a neuropsychological perspective, procedural or skill learning/memory (Cohen & Squire, 1980; Charness, Milberg, & Alexander, 1988) involves the capacity to learn rule-based or automatic procedures including motor skills, certain kinds of rule based puzzles, and sequences for running or operating things (Sohlberg & Mateer, 1989). This type of "hands-on" experiential learning is based in very old neural circuitry that is initially responsible for basic acquisition of skills that are necessary for survival in young organisms, yet its functional value continues throughout the lifespan. In fact, the survival relevance of procedural learning can be inferred when viewed in contrast to *declarative*, or fact-based memory, which is usually more impaired in persons with CNS dysfunction and less amenable to rehabilitative improvement (Sohlberg & Mateer, 1989). As well, procedural learning may occur without any recollection of the actual training. This is commonly referred to as *implicit* memory (Graf & Schacter, 1985) and its presence is indicative of a relatively "sturdy" ability to process and retain new material without the person's conscious awareness of when or where the learning occurred. These learning concepts are of particular relevance when considering the potential impact of immersive interactive VE scenarios that, for better or worse, may produce "reflexive" behavioral responding operating beneath a person's awareness level. As such, some important initial research questions for psychologists concerned with these issues would include:

- (1) Will procedural skill acquisition for violent or undesirable behaviors acquired in a VE produce a higher likelihood that these behaviors will be manifested in real world behavior?
- (2) Human judgment processes may function to generally inhibit impulsive aggressive behavior under normal conditions. However, in high arousal situations, would implicit encoding of violent behavior patterns that are well-practiced and overlearned in VEs serve to increase the likelihood of aggressive reaction/reflex responding by placing these behavioral propensities in a higher "position" in a person's response hierarchy? Would this learning promote a higher likelihood of aggression in certain stressful or highly charged emotional contexts (e.g., reflexively delivering a kung-fu kick to someone when in disagreement, instead of responding with a persuasive verbal argument)?
- (3) Are there populations where such "reflexive" responding (number 2 above) would be more likely to occur as with children or individuals having certain neuropsychological or psychiatric diagnoses (i.e., dysexecutive syndrome, antisocial personality disorder, etc.)?

- (4) Would highly proceduralized interactive “exposure” to graphically rich violence or other dehumanizing activities serve to diminish or habituate a person’s sensitivity to horrific events in the real world or would this activity serve to support an empathy-building function by way of exposing the user to a less “sanitized” depiction and *experience* of consequences than is typically seen with the passive observation of TV or cinema.
- (5) Would a “super-cathartic” effect occur due to proceduralized simulated engagement in such violent activities that would serve to “run-off” aggressive or maladaptive impulses and lead to an actual decrease in subsequent negative real world behavioral manifestations?

Clearly, it will be incumbent on the psychological sciences to begin to address these questions as advances in VR technology allow for more realistic and compelling scenarios to become widely accessible to the general public. The development of a research agenda to address these ethical concerns at the societal level as well as for individual human use falls squarely on the scientific and professional skills of psychologists. These issues are complex and diverse, and require a perspective that integrates the diverse specialized knowledge found across the many areas of psychology. While many benefits may be derived from the thoughtful use of VR, we cannot expect these to come without certain risks. It is to be expected that *unintended* risks will always exist in the mainstream distribution of products derived from any noteworthy human achievement. However, it is the *unanticipated* risks that reveal a lack of ethical responsibility and have the most potential to do harm. In this regard it has been the purpose of this section to reduce this potential by anticipating these risks and focusing awareness on the other edge of the VR “sword”.

#### **10. Will “Universal Access” prevail or will a “Digital Divide” emerge regarding the availability of these forms of VR assessment and treatment?**

As is apparent from the previous discussion, we are experiencing the emergence of an information society, increasingly based on the production and exchange of information. As this vision unfolds, those who are able to thoughtfully design, develop and apply information technology and telecommunications (IT&T), will be in a position to drive fundamental advances for promoting human welfare. However, in order to maximize the potential benefits of this paradigm shift for those with special needs, it is necessary to focus efforts on the development and application of more usable and accessible IT&T. This direction fits well with the “Information Society for All” concepts that have recently been addressed in the human-computer interaction literature (HCI) (Stephanidis, Salvendi, Akoumianakis, et al., 1998). Efforts in this area support the development of IT&T that accommodates the broadest range of human abilities, skills, requirements and preferences. The potential results of such efforts could substantially redefine the assessment and rehabilitative strategies that are used in the area of disabilities, particularly with clinical populations having (CNS) dysfunction. However, in all areas where humans have access to resources, there are the “haves” and the “have-nots”. Information technology resources are no different and the potential for inequity in this area has been recognized as a challenge to be considered (U.S. Dept. of Commerce, 2000a). This issue is clearly addressed in a series of U.S. government and international reports and is nicely summed up in the following:

*“In just about every country, a certain percentage of people has the best information technology that society has to offer. These people have the most*

*powerful computers, the best telephone service and fastest Internet service, as well as a wealth of content and training relevant to their lives. There is another group of people. They are the people who for one reason or another don't have access to the newest or best computers, the most reliable telephone service or the fastest or most convenient Internet services. The difference between these two groups of people is what we call the Digital Divide.”* (U.S. Dept. of Commerce, 2000b).

Up to now, discussion of the Digital Divide has mainly centered on the Internet and computer system access. However, it is not difficult to imagine how this issue will take on added relevancy if VR tools are proven to be more effective than traditional approaches, yet are only selectively available to certain socioeconomic classes. The potential exists for the public to perceive VR as a more technically complex and “sexy” approach and this perception could serve to push its application into the realm of a more costly alternative to standard assessment and treatment approaches. In essence, will a digital divide occur in the access to sophisticated VR scenarios for assessment/diagnosis, education, therapy and personal growth promoting applications? Will we see access to these forms of technology-supported services limited to delivery by private practitioners as a more exclusive and costly “specialty” approach? Will community-based mental health clinics or educational institutions serving lower socioeconomic communities (that often are lucky to have any access to computers for even administrative needs) fall into the future as VR “have-nots”? Although some may support the notion that market forces will drive availability to all in need as the demand becomes more substantial, this has not been the case in the managed care era of medical treatment. While the purpose of this chapter is not to promote a political agenda, it is our view that ethical concerns regarding fair access to services will need to be addressed, particularly if VR applications are found to be more efficacious than less expensive standard methods. Perhaps with continuing reductions in computing costs, this point will become moot as the technology “trickles-down” to all sectors of society. However, advance consideration and monitoring of digital divide indicators by psychologists (as well as other health care and educational professionals) is recommended. This could serve to promote the ethical ideals embodied in Universal Access principles to enhance availability of clinical and educational services by supporting access to emerging information technologies.

## CONCLUSION

VR appears to hold considerable promise for practitioners and researchers in neuropsychology and throughout the psychological sciences. With careful consideration of the ethical issues discussed in this chapter, the potential for improved understanding and treatment of our patients appears great.

### **Appendix -- Institutional Review Boards and Virtual Reality: Helpful tips.**

In general, the primary responsibilities of Institutional Review Boards (IRB) include overseeing the protection of the rights and welfare of human subjects involved in research studies and upholding federal regulations set forth by the Department of Health and Human Services and the Food and Drug Administration. To this end, specific risks, benefits and appropriate safeguards require careful consideration, when new procedures or protocols are

employed. Given the increasing number of VR applications within clinical research and treatment, we offer the following "IRB Tips" for the preparation of VR protocols:

- **Conduct ethical analysis.** As with any research consideration, determining ethicality, should begin with a clear description of the protocol under consideration and the list of potential affected parties and stakeholders. Thorough evaluation of each step of the process, identifying both the risks and the benefits for all parties involved, can then help to generate a rational foundation for choices at each level of the procedure.
- **Consideration of the unique risks of VR exposure.** As discussed earlier in this chapter, VR exposure has been associated with some side effects (i.e., simulator sickness, escapism) that may not be an issue in more traditional protocols.
- **Plan for the unexpected.** Because VR is continuing to evolve, not all of the questions regarding the consequences of VR exposure have been answered. As such, a thorough evaluation of all possible negative reactions should be conducted prior to initiation of protocol
- **Integrate safeguards into your protocol.** Although much remains to be learned about VR exposure, some side effects have been consistently noted, and subsequent procedures for minimizing risk to these side effects have been developed. Inclusion of the most recent screening procedures (i.e. Simulator Sickness Questionnaire) should be standard in all VR protocols.
- **Identify your most vulnerable groups.** As discussed earlier, some clinical populations (e.g. impaired awareness, psychiatric) may be at a higher risk for negative experiences when exposed to VR. As such, researchers should consider the need for inclusion of such populations, and when necessary identify the additional steps taken to minimize risks among these individuals.
- **Clearly define the need for VR.** As VR continues to evolve, new environments and applications will continue to be developed. Consideration and justification for the appropriateness of the addition of VR to protocols should be addressed in all newly proposed applications. Unnecessary exposure to risk is a justifiable limitation to any research protocol
- **Explaining your protocol.** Although improving, VR and the hardware required for delivering VR environments (i.e., HMD's) still remain in the "futuristic technology" domain for many clinical disciplines and laymen. As such, description of the VR component of research protocols, should be clear and concise with minimal jargon. In many cases, the use of diagrams for explaining hardware is often useful.
- **Defining your data.** Because VR affords an environment where all behavioral responses can be recorded throughout the virtual experience, variables to be measured in the VE should be clearly identified. These variables should be hypothesis driven and based on prior research or knowledge. The unique feature of recording all and any possible responses, sets up an opportunity for "fishing expeditions" which could subsequently lead to unnecessary exposure and abuse of this technology.
- **Identify responsibility, liability and accountability.** Given the fact that much remains to be learned regarding medical applications of VR, identification of procedures to address any significant complications should be clearly identified in the early stages of the protocol development.

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