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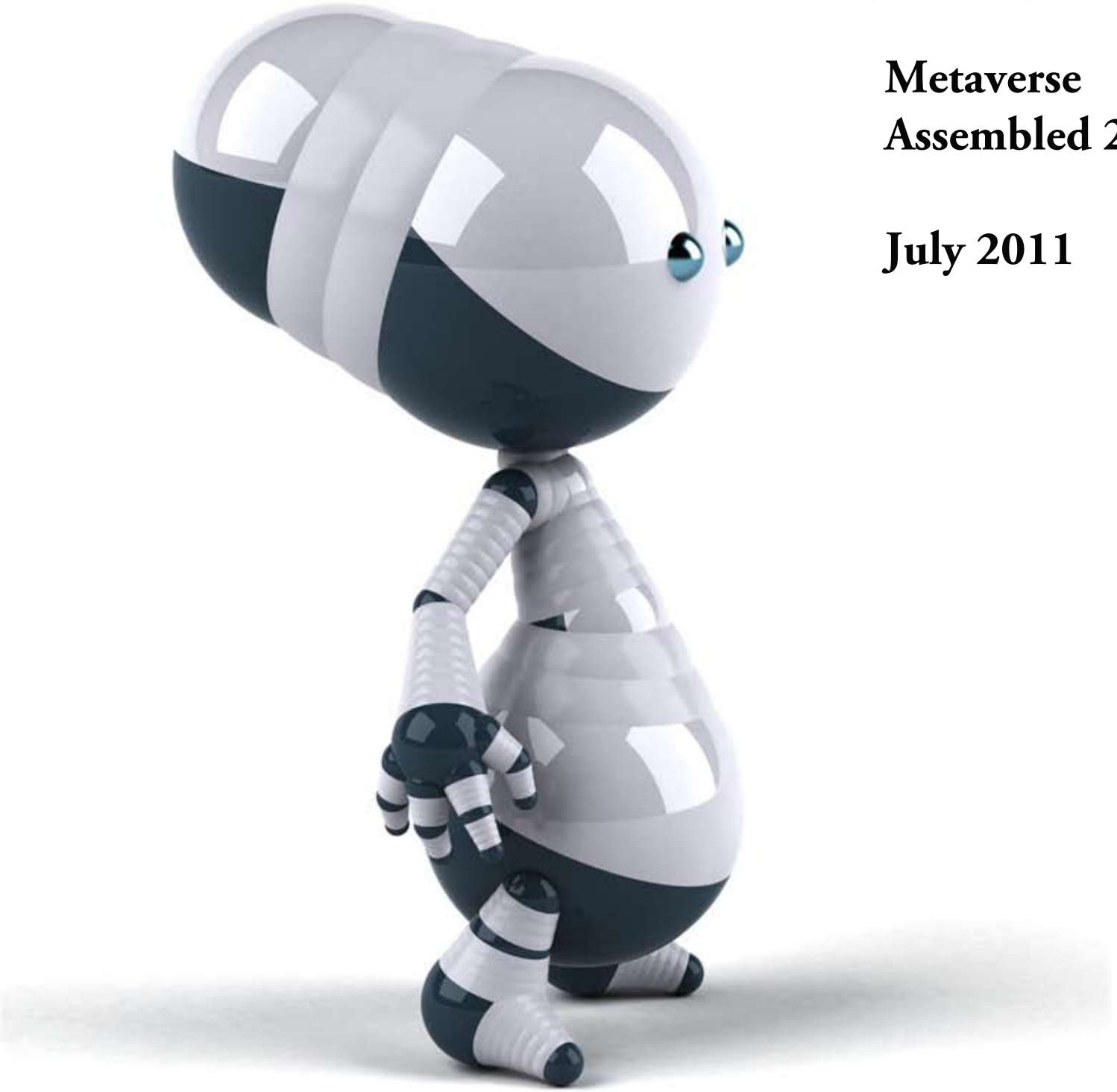

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Virtual Reality and the Criminal Justice System: New Possibilities for Research, Training, and Rehabilitation

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Abstract

Virtual reality systems are used to achieve a broad range of goals in a variety of fields of study. The criminal justice system can benefit from this rapidly expanding technology in three specific ways. First, the issues of experimental control and problematic research methodologies can be addressed. Second, both practitioners and offenders can benefit from training within virtual environments. Third, rehabilitation efforts can be improved by providing offenders a safe and controlled environment for treatment. With dwindling resources and increasing correctional populations, virtual reality offers cost-efficient and effective means of addressing the diverse needs of the criminal justice system.

Keywords: virtual reality; technology; experimental control, methodology; training; rehabilitation; treatment; CBT; special populations; exposure therapy; aversion therapy; PTSD; anxiety disorder; female offenders; sex offenders; veterans; substance abuse; ADHD

Virtual Reality and the Criminal Justice System: New Possibilities for Research, Training, and Rehabilitation

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With dwindling budgets and swelling jail and prison populations, the criminal justice system stands to benefit from using technology that has provided positive outcomes in many other fields. Virtual reality is currently being used to evaluate, train, and treat a multitude of diverse populations. By using virtual reality, researchers and practioners are able to create diverse environments that are safe, cost-efficient, and easy to control. The criminal justice system can incorporate this technology, along with conventional methods, in order to improve in the areas of research, training, and rehabilitation. This paper aims to offer an introduction of virtual reality and how it can be used in these areas; however, this foundational article is not exhaustive. We explore several topics here but, due to space limitations, we are unable to thoroughly explore any one particular area. Future publications will address these areas in more comprehensive detail. To explore how virtual reality can be of use in criminal justice, we begin with a brief introduction of the history and development of virtual reality technology.

Virtual Reality: A Brief Introduction

A virtual environment is a simulated, computer-generated world incorporating three-dimensional (3D) visualization that allows user interaction through transmission devices. The virtual environment can be viewed either directly or with the use of a head mounted display (HMD). Users can interact in the virtual world with standard input devices, such as a keyboard or a mouse, or through more advanced devices, such as wired gloves. User movements are tracked through these devices then digitally recomposed and displayed back to the individual. Through the eyes of an avatar, a computer generated image of the user, an individual can maneuver around the virtual world, manipulating virtual objects and interacting with other virtual beings.

Historical Perspective

Although advancements in the technology that supports virtual reality are a relatively recent development, the underlying concepts of virtual reality have existed for some time.

Throughout human development, inventors and artists have been in search of the *essential copy*--the image that gives an individual the sense of actually being present in a particular location (Biocca, Kim, & Levy, 1997). Early adaptations of the essential copy can be seen in various art forms. As technology has advanced, creators have been able to use increasingly sophisticated methods to generate more complex images. With each innovation, the realization of virtual reality has become more attainable. This section will provide a brief discussion of the progression in the technology that has led to the development of the advanced computer-generated worlds of today.

Some argue that the idea of a virtual world dates back as early as Plato's *Allegory of the Cave* (Boellstorff, 2008; Cruz-Neira, Sandin, & DeFanti, 1993; Zorn, 2010). In this famous piece, Plato described a group of prisoners who watched shadows on the wall of a cave. He then contemplated whether the prisoners would accept the shadows as real or as an imposter of reality. This remains a crucial question of the virtual experience in the modern world.

Fictional literature, through the creativity and ideas of an author, "transports" readers to another world where they can become engrossed in the lives of fictional characters. In fact, some argue the inception of virtual reality actually began with science fiction and fantasy writers (Biocca, et al., 1997; Boellstorff, 2008). Strange lands, magical creatures, and heroic battles allow readers to experience a world not attainable in real life. Virtual reality is now used in gaming to mimic this idea but with far more realism.

Panoramic paintings have also allowed viewers to be visually absorbed in another world. Churches and palaces have historically displayed these paintings to reflect idealistic worlds. More modernly, photographs and television have also allowed individuals to experience a real or fictional person or place. These key experiences have laid the foundation for virtual reality. As technology has developed, more advanced mediums, which incorporate multiple senses, have greatly impacted the intricate virtual systems of today.

The term *virtual reality* (VR) is believed to have originated in 1938 with author Antonin Artaud, who referred to the theatre as "la realite virtuelle" (Davis, 1998; Zorn, 2010). Although used in this sense to describe more abstract concepts, visionaries were already beginning to create devices to mimic reality. In 1929, inventor Edward Link created the first flight simulator. This was of particular importance because it simulated a specific environment that offered users a safe but practical means for trial and error. More closely related, Morton Heilig designed the

Sensorama machine in 1956, which allowed one to four people to experience a prerecorded illusion of reality with the use of 3D pictures. The machine also used smell, sound, vibrations, and wind to make the illusion more realistic.

In 1968, American computer scientist Ivan Sutherland created the first HMD, which would become imperative to the development of fully immersive VR. In 1972, Atari released the first real-time, multi-person game with interactive graphics. The ability to interact in real-time is a key component of VR. By 1973, Sutherland and Evans delivered Novoview, the first computer image generation system for flight simulation. Later that decade, using a two-way video link to communicate, Myron Krueger established the first artificial reality laboratory. With the use of projectors and special hardware, *Videoplace* engaged users in a real-time interactive artificial reality.

In 1984, computer scientist Jaron Lanier founded the company VPL Research and popularized the phrase "virtual reality." VPL Research created virtual programming language and later, in 1987, introduced the first complete VR system. In 1992, the Electronic Visualization Lab at the University of Illinois at Chicago presented Cave Automatic Virtual Environment (CAVE), an immersive reality system that allowed multiple people to experience a virtual world without the use of a HMD. CAVE is a reference to the cave described in Plato's Republic, discussed previously. Henceforth, inventors and computer scientists have worked to increase the quality of VR systems and, most importantly, the realism for users. Two key concepts are theorized to have the greatest impact on users' VR experiences: *immersion* and *presence*.

Both immersion and presence are crucial to the virtual experience. A virtual environment that produces a greater sense of immersion usually produces a greater sense of presence. These concepts are commonly used to enhance the user's experience. As will be shown, these concepts are crucial to the success of implementation of virtual reality in the criminal justice system.

Immersion

The concept of immersion refers to the actual configuration of the VR interface while the user is connected. Users can experience varying levels of awareness of the real world. Depending on the goals of the simulation, various types of immersive techniques can be

employed. There are three main types of systems: fully immersive, semi-immersive, and non-immersive (Gutierrez, Vexo, & Thalman, 2008; Riva, 2009).

The most advanced are those systems that use full immersion. Fully immersive systems typically use a HMD. The goal of this type of system is to minimize the user's awareness of the real world. By isolating the user from the real world, researchers are able to increase the creditability and efficacy of the virtual experience.

Semi-immersive systems also seek to minimize the awareness of the real world but do so without the use of a HMD. Many of these systems use projectors, special cameras, and screens to display the virtual environment. One advantage of this type of system is that multiple users can experience the world at the same time. The CAVE system is an example of a semi-immersive system (Cruz-Neira et al., 1993).

Non-immersive systems are usually described as desktop-based VR systems. The most common types of non-immersive systems are video games (Gutierrez et al., 2008). These systems are economical, easy to install, and generally provide better usability than the larger, more costly, and complicated systems described previously.

All of these systems are designed with different goals in mind. For basic simulation and entertainment purposes, the inexpensive nature and wide availability of non-immersive systems make them sufficient. If the goal of the simulation requires that a group of users be immersed in a virtual environment together or if basic movements in the real world are required, such as walking or running, a semi-immersive system will suffice. Fully immersive systems are typically used when it is imperative for an individual user to believe that he or she is completely part of the virtual world. The most powerful VR system offers both a fully immersive component as well as the ability to view the scenario from the perspective of others (Suler, 1999).

All types of immersive reality depend on the psychological state of individual users, characterized by how users perceive themselves in the virtual environment (Witmer & Singer, 1998). This is commonly referred to as *presence*. Immersion and presence work simultaneously to enhance the virtual experience.

Presence

The concept of presence began with Marvin Minsky (1980), who defined *telepresence* as the ability of individuals to use various technologies, such as robotics, for the remote manipulation of physical objects. Sheriden (1992) expanded on this concept with the term *virtual presence* to describe telepresence in a virtual environment. Since then, a plethora of research has broadened our understanding of presence. This section will discuss the key elements of presence and explain how these components influence the user's VR experience.

Three types of presence are typically discussed: physical, social, and self (Biocca, 1997; Lee, 2004; Shen & Khalifa, 2007). Physical presence refers to the notion that a virtual world is a fully functional representation of the physical world. As such, users can actually experience an object that is created artificially. Social presence is when various forms of behavior give the user the impression that there are other beings present in the virtual world. Social presence represents the degree to which individuals will experience social interaction in the virtual environment. Self-presence is the psychological identity of the user within the virtual world. The greater the level of self-presence, the more likely it is that users will identify with their representation in the virtual environment. Essentially, the degree to which individuals are able to focus their attention within the virtual environment helps to determine level of involvement (Witmer & Singer, 1998). Each type of presence assists users in becoming more involved and thus heightens the virtual experience.

One problem noted with defining presence is that scholars from various fields of study use different terms to express the same or similar concepts (Lee, 2004). For the sake of clarity, we define presence as the psychological state in which a participant accepts, interacts, and is physically, socially, and emotionally engaged in the virtual environment. More simply, it is the acceptance of the virtual world as real. The extent of presence can vary based on multiple factors. The features of the virtual environment and the characteristics of the individual participant are the most important of these factors.

Specific features of the virtual environment affect the degree to which presence is achieved. The more the interface adapts to the individual, the more the individual will adapt to the virtual environment (Biocca, 1997). The user's field of view and the ability to move from one place to another should mimic a real world experience (Stanney, Mourant, & Kennedy, 1998; Steuer, 1992; Wiederhold & Wiederhold, 2004; Witmer & Singer, 1998). Color, contrast, and image size and quality impact the realism of the virtual world (Lombard & Ditton, 1997;

Wiederhold & Wiederhold, 2004). Additionally, the ability to feel textures, thermal variation, and kinesthetic force are vital (Blascovich & Bailenson, 2005; Stanney et al., 1998). Differences in presence can result from the features of the virtual environment, but the user's individual traits and abilities are equally as important (Fox, Arena, & Bailenson, 2009; Stanney et al.; Witmer & Singer, 1998).

An individual's age and technical experience can affect presence (Sherman & Craig, 2002; Stanney et al., 1998). Young children may have physical limitations that hamper their use of VR equipment. They may also inadvertently remove the input devices, thus terminating their virtual experience. Additionally, some participants may not be able to quickly adapt to the technical nature of the virtual world. These individuals may easily become confused or frustrated.

The goals of the virtual world should also be a consideration. Individuals will experience a higher level of presence in a virtual world and become more involved in scenarios that are relevant to their own goals (Riva, 2005). Together, immersion and presence determine how the user experiences the virtual world. This will be of utmost importance when incorporating virtual technology into the criminal justice system because we are proposing that VR be used to build skills, access psychological and physiological characteristics of the subject, and change cognitive functioning.

VR can be used to enhance criminal justice research, training, and treatment. Scientists can overcome the various obstacles of studying human populations by using VR in the research setting. Additionally, VR can be incorporated into training for law enforcement officers. Virtual environments are already being used for the treatment of a wide range of mental and behavioral disorders, many of which are correlated with criminal behavior. By tapping into the clinical benefits of VR, the criminal justice system can offer early intervention for deviant juveniles, rehabilitative treatment for adult criminals, and specialized treatment for specific subgroups of offenders. The remainder of this paper will broaden the discussion of how VR can be incorporated into research, training, and rehabilitation within the criminal justice system.

Virtual Reality for Criminal Justice Research

VR offers social scientists the ability to overcome common obstacles of research such as environmental control, data collection, and measurement issues. By studying subjects in a

virtual environment, researchers have significantly greater control over the environment and can more easily replicate study conditions. Researchers can also create experimental situations in the virtual world that may be difficult or too costly to achieve in real life. Data collection can also become automated, thus reducing human error. Additionally, VR gives researchers the ability to create and evaluate objective measures. Methodological issues such as sample size, validity, and causal inference can also be addressed by using VR.

Environmental Control

While studying humans, researchers often lack environmental control. A major criticism of research in criminal justice is the inability of researchers to manipulate variables (Eck & Liu, 2008a). Using VR, researchers can create a multitude of situations in controlled environments, allowing them, with a few clicks of the mouse, to manipulate anything in the virtual world (Fox et al., 2009; Riva, 2005).

In addition to offering a great deal of experimental control, VR offers both researchers and subjects the benefits of conducting research in a safe and cost-effective environment. Subjects can be exposed to threats in the virtual world without facing the pitfalls of real world harm (Schultheis & Rizzo, 2001; Wiederhold & Wiederhold, 2004). Additionally, scenarios can be created through VR which cannot be realistically re-experienced or are too costly to reproduce (Fox et al., 2009; Gregg & Tarrier, 2007; Riva, 2009). Researchers also have the ability to incorporate vital virtual elements, such as high risk situations, that may otherwise be in violation of human subject guidelines or considered unethical in conventional research (Renaud et al., 2009; Thorton & Laws, 2009). In sum, virtual environments offer researchers tremendous control without sacrificing realism (Anton, Dobrean, & Rizzo, 2009; Blascovich & Bailenson, 2005).

By maintaining such a high level of control, replication of a particular environment or set of scenarios can be easily achieved using VR (Blascovich & Bailenson, 2005; Fox et al., 2009). Multiple subjects can be placed in the exact same virtual environment from one scenario to the next. This is difficult in conventional research where changes in the physical environment and unforeseen interruptions may impact the outcomes. VR ensures that all participants are receiving the same instruction, interaction, and treatment. By having exact replication, researchers can provide the same environment for each participant. Replication is a key factor in determining

causal inference and providing generalizable findings (Townsley & Johnson, 2007). The ability to control and replicate the environment offers researchers ease in data collection and an opportunity to evaluate various types of objective measures, some of which are not typically captured in current social science research.

Data Collection

Another issue with criminal justice research is that there are often missing and/or flawed data (Eck & Liu, 2008a). These issues can lead to erroneous or biased results. While in the virtual world, the user's inputs and actions are captured automatically and can be retrieved through the administrative interface. Tracking is an integral component of the virtual environment that permits researchers to capture where people are, who they are talking with, and any other events that take place in the virtual world (Jarrett, 2009). This automatic tracking is a means of ensuring that accurate data are being collected.

The hardware for the VR system can also be adjusted to collect various types of data. For example, HMD's have been configured to track eye movements which can be used as measures of gaze and dwell time (Renaud et al., 2009; Thorton & Laws, 2009; Yee, Bailenson, Urbanek, Chang, & Merget 2007). Additional devices can also be incorporated to measure various aspects of user interaction and reaction while in the virtual environment. Subjects immersed in VR demonstrate an increase in physiological arousal (Greenfield & Cocking, 1996). Multiple studies accessing VR have successfully used devices to measure heart rate, perspiration, muscular tension, and blood pressure (Chen, Jeng, Fung, Doong, & Chuang, 2009; Villani, Riva, & Riva, 2007; Calvert & Tan, 1996). Additionally, studies have incorporated the use of electroencephalography (EEG), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI) to measure various physiological responses, including brain activity, while in the virtual environment (Lee, Kwon, Choi, & Yang, 2007; Mraz et al., 2003). Researchers have also used penis plethsymotgraphy (PPG) readings in conjunction with VR to assess sex offenders (Renaud et al., 2009; Thorton & Laws 2009). Any device used to evaluate human physiological response has the potential to be used within the virtual world.

In sum, VR provides an accurate depiction of user interaction in the virtual world and offers the added benefit of tracking and recording physiological responses. Any verbal or physiological response that occurs during the simulation is automatically captured. As a result,

data collection becomes more reliable and exhaustive. Automation of data collection is already proving to be an invaluable tool in the crime prevention area of criminal justice (Eck & Liu, 2008b). Once captured, these data can be used to test specific theoretical constructs.

Objective Measures

Objective measures are often preferred so that unbiased conclusions can be derived. As previously discussed, VR allows researchers to study individuals in a safe, controlled environment. Due to environmental control and automatic data collection, objective measures can be created. This includes user responses and physiological readings taken during specific tasks. Researchers can also develop objective outcome measures based on user interactions during the virtual simulation (Schultheis & Rizzo, 2001). Within the virtual environment, objective measures can be created and monitored during any part of the participant's involvement with the system.

The use of VR also offers researchers the unique ability to capture objective measures that are typically beyond the scope of criminal justice research. During observational studies, these measures can include time spent on a particular task, the exact proximity between people or structures, changes in the voice, and physiological reactions, such as variation in body temperature. During interviews or survey designs, VR can allow researchers to capture information such as the time elapsed to answer particular questions and eye movements during response cycles. All of this information can be recorded and ultimately used to measure particular themes or theoretical constructs (Blascovich & Bailenson, 2005).

Other Uses in Research

Sample size is a concern in criminal justice research, especially in relation to special populations. With the use of VR, researchers are no longer restricted to a single group of people or just one location. While studying an online virtual world, researchers can have sample sizes far larger than those that might be obtained in a cost-effective and timely manner in the real world (Jarrett, 2009). With networked environments, researchers have the capability of reaching several different populations. This can address the issue of non-representative samples (Fox et al., 2009).

With increased environmental control, ease of data collection, the ability to capture objective measures, and possibilities for gaining large representative samples, a well-designed VR system can obtain greater predictive validity and increased external validity over conventional research methods (Anton et al., 2009; Thorton & Laws, 2009). Additionally, VR provides a medium to assess causal factors through the manipulation of variables and various other aspects of the virtual experience (Freeman, 2008). These benefits offer clear advantages for the use of VR in criminal justice research.

Virtual Reality as a Training Tool

Many actors within the criminal justice system require some form of training and/or on-going education. For instance, police officers require specific instruction on how to respond to various situations. Offenders can also benefit from education and training. A virtual training environment (VTE) offers trainees the ability to learn and practice a particular set of skills in an environment that mimics the real world. This can offer benefits for education and training in the criminal justice system. This section will evaluate the current uses of VR as a training tool and discuss how virtual environments can be incorporated into training law enforcement officers and offenders.

Current Uses of Virtual Training Environments

One benefit of using VR as a teaching and training tool is that the virtual simulation can be used to achieve real world goals (Fox et al., 2009; Riva, 2009; Schultheis & Rizzo, 2001). In the educational setting, universities across the world are currently using online virtual worlds to provide students real-time interaction with faculty and other students. Participating in a virtual class offers students the ability to overcome the physical restraints of the real world and gain access to scenarios that cannot be realistically reconstructed, are historically lost, or can be too costly to recreate (Jarrett, 2009; Warburton, 2009). Second Life is the most active virtual world in higher education with more than 100 universities renting or owning "virtual land" (Baker, Wentz, & Woods, 2009). They employ this space for an array of uses such as lecturing, meetings, music performances, gatherings, and art shows.

Various professions are also taking advantage of the real world experience in VTE's. VR is currently being used as a platform for teaching and training in a variety of vocations including

medicine and aeronautics (Gutierrez et al., 2008; Tichon, 2007; Sherman & Craig, 2002). Training using VR allows participants to interact in a safe and controlled environment while they practice and perfect particular skills. VTE's are of particular value in professions where mistakes can equate to loss of life. Trainees can respond to high risk or high stress situations while avoiding real world harm. In this sense, VTE's offer clear advantages for training law enforcement officers.

Training Law Enforcement

Police and corrections officers are often faced with difficult circumstances and must react quickly in order to control the situation. VTE's allow trainees to be exposed to scenarios that they are likely to experience while in the field. The goal of the VTE is to provide a simulation that will elicit specific responses to certain cues and allow for the transfer of these responses to real world situations (Tichon, 2007). Officers can use VR simulations to experience and react to stressful or dangerous situations without the risk of costly mistakes and loss of life. Currently, semi-immersive simulations are being successfully used for training law enforcement officers on weapons handling. The use of VTE's can be broadened so that officers can practice a variety of additional skills, such as sensitivity training and problem solving, in a controlled environment that allows for safe trial and error. For evaluation purposes, VTE's can also be used for the identification of deficiencies in all types of training (Tichon, 2007). In addition, VR can be used to enhance the skills required to manage offenders in a variety of situations.

Training Offenders

Criminal offenders can also derive benefits from using VR. VTE's can incorporate modeling, role playing, and instant feedback as a means of social retraining. This can help offenders by teaching them appropriate social norms and cues, as well as reducing the fear and anxiety that often coincide with reintegration into conventional social settings (Schultheis & Rizzo, 2001). VTE's also offer the benefit of hands-on vocational training to teach offenders valuable skills that might help them obtain gainful employment upon release. Additionally, VR includes an element of gaming that can be used as a motivational tool for many participants (Schultheis & Rizzo, 2001). This may be particularly helpful for segments of the criminal population who are unwilling or unmotivated to explore training or treatment that will help them

adapt to life outside of the criminal justice system. For these reasons, VR can serve as an integral part of offender reintegration programs.

The use of VR as a teaching and training tool requires careful consideration. Participants will need to spend time acclimating to the virtual environment. During this phase, users will create avatars and learn to navigate the virtual world. Lack of technical ability can pose some problems. There are also varying costs associated with using VR to train and teach individuals. Having participants use VR to learn and practice can be invaluable; however, matters of cost, efficiency, and practicality should be considered.

Virtual Reality for Rehabilitation

For a little over a decade, VR has been used in psychology as a treatment option for many anxiety and behavioral disorders. Current uses of virtual environment treatment (VET) that work in conjunction with psychotherapeutic approaches have been shown to be effective in treating disorders commonly associated with offenders. Additionally, offenders with special needs can benefit from assessment and treatment involving VR. This section addresses the various approaches to VET and discusses those offenders who can benefit most from it.

Treatment Mechanisms

A fundamental assumption of VET is that once immersion and presence have been achieved, people behave in virtual worlds as they would in real life. Recent studies have supported the notion that interactions in the virtual environment mimic patterns in the real world (Houriles et al., 2009; Jarrett, 2009; Yee et al., 2007). Additionally, VET requires the user to have sufficient presence so behaviors learned in the virtual environment can translate to real life. Treatment with VR has been shown to be effective with many mental and behavioral disorders including anxiety, anger management, conduct disorder (CD), oppositional defiant disorder (ODD), post traumatic stress disorder (PTSD), and substance abuse (Côté & Bouchard, 2009; Cukor, Spitalnick, Difede, Rizzo, & Rothbaum 2009; Fox et al., 2009; InWorld Solutions, 2010; Riva, 2009; Wiederhold, 2004; Wiederhold & Wiederhold, 2004).

One particular advantage of using VET lies in the ability to integrate various psychotherapeutic techniques within the virtual experience. Although conventional therapies are effective in many ways, they are dependent on the patient's ability to imagine himself/herself in

specific situations. Therefore, these therapies can be enhanced, and thus made more effective, with the use of VET. VET allows the user to be fully immersed in a scenario while single or multiple therapeutic techniques are employed (Riva, 2005). VET incorporates such techniques as classical conditioning, exposure therapy, and cognitive behavioral therapy. Each technique is used to treat specific types of disorders, some of which are highly correlated with criminal behaviors.

Classical Conditioning. Ivan Pavlov introduced the concept of classical conditioning in 1927. The main idea underlying classical conditioning is that particular stimuli elicit specific responses. When a neutral stimulus is repeatedly coupled with a stimulus that occurs naturally (an unconditioned stimulus), the two stimuli will eventually become associated and the subject will produce the same involuntary response to the neutral, or conditioned, stimulus. This is referred to as the conditioned response. In terms of treatment, practitioners typically use a particular type of classical conditioning called aversion therapy, in which the subject is exposed to a stimulus while simultaneously being exposed to some form of discomfort. The goal is to cause the subject to associate the stimulus with the disagreeable response in order to stop the behavior.

VR can enhance this form of therapy with the use of multiple sensory feedback. In the virtual environment, subjects receive multiple visual and physiological responses. This improves on conventional exposure therapy because the subject is in a controlled environment where the stimulus can be increased or decreased at any time. Multiple aversive stimuli can also be introduced, including those too expensive, unsafe, or ethically challenging to achieve in traditional therapy.

Exposure Therapy. Exposure therapy (ET) is used to help patients confront feared objects, situations, or memories. ET involves the exposure to a feared object or situation in an environment that is devoid of real danger. Cognitions, emotions, and patterns of physiological arousal of the feared stimuli are identified, then practitioners attempt to break these patterns through progressive exposure until habituation is achieved. Exposure is often delivered using imaginal techniques; however, some patients are either unable or unwilling to imagine the feared stimuli. VET offers a safe and controlled environment where patients tend to be more willing

and able to participate. ET via VR is an especially effective form of treatment for those suffering from anxiety disorders (Côté & Bouchard, 2009; Cukor et al., 2009; Fox et al., 2009; Riva, 2009; Wiederhold, 2004).

Cognitive Behavioral Therapy. Cognitive Behavioral Therapy (CBT) focuses on maladaptive patterns of thinking and the beliefs that underlie such thinking. Behaviors are prompted and supported by thoughts; therefore, both cognitions and behaviors must be addressed (Van Voorhis, Braswell, & Lester, 2007). CBT has been useful for treating a wide variety of problems, including mood disorders, anxiety disorders, personality disorders, eating disorders, substance abuse disorders, and psychotic disorders. CBT-based treatment programs use a range of techniques, including modeling, role-play, reinforcement, and cognitive exercises. Commonly, offenders engage in thinking errors that allow them to reinforce deviant behaviors (Van Voorhis et al., 2007). Conventional CBT has been successful in addressing these thinking errors. When compared to alternative approaches, programs using CBT have demonstrated greater success in treating, preventing, and correcting criminal and delinquent behavior (Akers and Sellers, 2004; Andrews & Bonta, 2010; Cullen et al., 2003). VR can improve on conventional CBT by offering a controlled environment for offenders to learn and practice skills and allow practioners the ability to provide instant feedback, virtual role playing, and scene manipulation during the sessions.

Treating the Typical Offender

One way to tap into individual-level predictors of criminal behavior is through correctional assessments. Offenders are evaluated with a variety of assessment tools, such as the LSI-R, which classifies offenders according to risk and identifies behaviors to target for change. Treatments that adhere to the principles of effective intervention are the most effective in reducing recidivism (Andrews, Bonta, & Hoge, 1990). Overall, these principles can be condensed into four main points. First, interventions should target known predictors of crime. Second, treatment interventions should be in the form of behavior-oriented programs. Programs should focus on a general personality and social psychology understanding of criminality while utilizing behavioral approaches to treatment. Third, treatment should be directed primarily at high risk offenders. Finally, treatment should entail a wide range of considerations that can have

an impact on treatment effects. This captures the ideas of program integrity, advocacy, and addressing issues of responsivity.

Cognitive-based programs address the underlying risks and needs of the typical offender by targeting antisocial attitudes and beliefs for change. Cognitive-based programs have been shown to be an effective form of treatment for offenders (Andrews & Bonta, 2010; Andrews et al., 1990; Hollin & McGuire, 2008; Lipsey, Chapman, & Landenberger, 2001; Van Voorhis, 2006). Additionally, CBT-based program effectiveness and integrity are directly correlated to lower recidivism rates and program success (Lowenkamp, Latessa, & Smith, 2006; Van Voorhis, et al., 2007). VR engages the unconscious mind and works to overcome cognitive barriers (Optale et al., 2004).

With the use of VR, practitioners are able to target specific cognitive systems for change (Riva, 2005). Participants can learn specific behaviors then model them in scenarios they might experience in the real world. In addition, the simulation can be started or stopped at any point to facilitate instant feedback and reinforcement of particular behaviors. The use of VR also offers consistent program delivery that can increase overall effectiveness and program integrity. Therefore, in accordance with the principles of effective intervention, CBT-based programs can be enhanced with the use of VET.

Treating Special Populations

In addition to the typical offender in the criminal justice system, there are many offenders with specific needs. VET can be used to target the needs of mentally ill offenders, female offenders, and sex offenders. These groups of offenders are increasing in presence in the correctional setting. VET offers specific advantages to treat these special populations of offenders.

Mentally Ill Offenders. Many offenders under the control of the criminal justice system suffer from some form of mental illness or cognitive impairment (Soderstrom, 2007). A large percentage of offenders are diagnosed with specific mental disorders (Adams & Ferrandino, 2008; Soderstrom, 2007), with 10-15% of offenders being diagnosed as severely mentally ill (Roskes, 1999; Lamb & Weinberger, 1998). This population can pose both administrative and therapeutic challenges (Lord, 2008). These offenders benefit from a variety of therapeutic

approaches. Incorporating VR into treatment provides criminal justice researchers and practitioners more options and the potential for greater success with specific groups of offenders.

Offenders with Anxiety Disorders. Anxiety disorder is the most common mental health disorder in America and the most common psychiatric diagnosis made by primary care physicians (Wiederhold, 2004). Anxiety disorder is a blanket term for a variety of anxiety related diagnoses. Specific anxiety disorders include acute stress disorder, agoraphobia, generalized anxiety disorder, obsessive compulsive disorder, panic disorder, phobias, and post-traumatic stress disorder Symptoms include heart palpitations, chest pain, dizziness, restlessness, derealization, and muscle tension. Anxiety becomes a disorder when the symptoms last for more than two days to four weeks, and the anxiety is interfering with everyday life. Anxiety disorders are most commonly treated with medications, cognitive therapy, and behavioral interventions (Wiederhold & Wiederhold, 2004). Not only are anxiety disorders extremely common in the general population, adult and juvenile offenders in jails and prisons are also diagnosed at high rates.

In a longitudinal study of U.S. jails and prisons, the National Commission on Correctional Health Care (2002) found that 14-20% of federal inmates and 22-30% of offenders in state prisons suffered from anxiety disorder. In a sample of offenders in long-term solitary or supermax confinement, 91% suffered from high anxiety (Haney, 2003). Studies of female prisoners indicate that 44-75% of inmates meet the criteria for anxiety disorder (Morgan, Fisher, Duan, Mandracchia, & Murray, 2010; Pimlott Kubiak, Beeble, & Bybee, 2009). Furthermore, studies based on detained juvenile offenders demonstrate that 31% of females and 20% of males suffer from some form of an anxiety disorder (Abram, 2003; Teplin, 2006). Snyder & Sickmund (2006) report that 61% of youths in residential treatment suffer from anxiety.

Reducing anxiety is the most common use for VR in the treatment setting (Riva, 2009; Wiederhold & Wiederhold, 2004). VR has been used in conjunction with exposure therapy to successfully treat a variety of anxiety disorders. Virtual reality exposure therapy (VRET) has been shown to be effective in reducing anxiety and phobias, outperforming both control conditions and in vivo treatments (Parsons & Rizzo, 2008; Powers & Emmelkamp, 2007; Wiederhold, 2004). By using VRET, therapists are able to provide stimuli exposure to patients who struggle with imagining real-life situations by offering a true-to-life experience that protects

patients from harm (Grillon, Riquier, Heberlin, & Thalmann., 2006). VRET is effective in treating anxiety disorders because its realism allows patients to become fully immersed in the virtual environment, leading them to accept the experience as real (Botella et al., 2007). This type of therapy is believed to be safer, less embarrassing, and less costly than traditional treatments (Riva, 2009; Wiederhold & Wiederhold, 2004). Having the level of control offered in VRET, therapists can avoid unpredictable events during therapy, thus making some patients more willing to participate (Botella et al., 2007).

Virtual reality cognitive behavioral treatment (VRCBT) is also used in the treatment of anxiety, primarily with those diagnosed with panic disorder. Panic disorder is characterized by unexpected and recurrent episodes of intense panic and fear accompanied by physical symptoms. Additionally, individuals with panic disorder have an overwhelming fear of another attack, worry about what the attacks signify, and significantly change their routines for fear of subsequent attacks. VRCBT allows therapists to provide stimuli that represent real life situations to change errors in thinking. Through modeling, role-playing, and reinforcement, therapists teach patients how to cope with a panic attack and calm fears about future attacks (Botella et al., 2007; Wiederhold, 2004).

Offenders who suffer from high anxiety have trouble adjusting to the prison environment, do not respond well to interventions that focus on cognitive skills, do not improve without treatment, are likely to escalate negative behaviors, and have the highest long term recidivism rates (Listwan Johnson, Gentry Sperber, Murphy Spruance, & Van Voorhis 2004). Both VRET and CBT enhanced with VR can be successful with this high-risk criminal population. Despite the need to treat offenders with anxiety, most programs for offenders do not offer any therapy for this disorder. Anxiety disorders may be acting as a responsivity factor that acts as a barrier to successful treatment (Listwan et al., 2004). Treatments enhanced with VR provide practitioners the ability to address this barrier and concentrate more fully on therapeutic efforts that target antisocial thoughts, attitudes, values and beliefs.

Post-Traumatic Stress Disorder. Post-traumatic stress disorder (PTSD) is a type of anxiety disorder that can develop after exposure to a traumatic event that involves serious threat of injury or death. Some examples of events that lead to PTSD include violent personal attacks, natural or human-caused disasters, and military combat. If symptoms of anxiety following a

traumatic event last for longer than four weeks, a person may be diagnosed with PTSD (Wiederhold, 2004). Individuals diagnosed with PTSD experience persistent thoughts and memories associated with the event. Additional symptoms of PTSD include withdrawal from family and friends, sleep problems, feelings of detachment, difficulty concentrating, and agitation.

According to Kessler et al. (2007), 6.8% of the U.S. population suffers from PTSD, with females affected at nearly three times the rate as males. Among correctional populations, female offenders also appear to be most affected. A study of female inmates in a Midwestern urban jail established that 53% met the criteria for PTSD (Pimlott Kubiak et al., 2009). Additionally, 33.5% females awaiting trial at Chicago's Cook County Department of Corrections between 1991 and 1993 met the diagnosis for lifetime PTSD (Teplin, 1996). Another study of Midwestern jails revealed that 23% of female inmates had a current diagnosis of PTSD (Farkas, 2007). A diagnosis of PTSD increases the complexity of treating offenders with conventional techniques.

Additionally, many of the reported cases of PTSD are military veterans. According to Choudhry, Park, Stapleton Kudela, and Helmick (2002), there were 25 million veterans living in the U.S. in the year 2000, which equates to 12.7% of the U.S. adult population having previously served in the U.S. armed forces (U.S. Census Bureau, 2001). An estimated 30.6% of male and 26.9% of female Vietnam theatre veterans meet the criteria for lifetime prevalence of PTSD (Kulka et al., 1990). More recently, 9% of veterans from four U.S. combat infantry units deployed in either Iraq or Afghanistan met the diagnosis for PTSD (Hoge, 2004).

Due to the symptoms of PTSD, veterans who suffer from the disorder are at increased risk of engaging in behaviors that are correlated with criminal offenses. Approximately 10% of the nation's state and federal prisoners served in the military at some time (Greenburg, 2008; Noonan & Mumola, 2007). In a sample of Vietnam veterans, 13.6% had been arrested or jailed at least once since reaching adulthood (Kulka et al., 1990). Male veterans with PTSD are more likely to report relationship problems, parenting problems, and poor family adjustment (Jordan et al., 1992). In addition, they commonly report expressions of hostility and acts of physical violence directed at their spouses or partners (Carroll, Rueger, Foy, & Donahoe, 1985; Jordan et al.). Veterans are also more likely to be diagnosed with a mental illness and abuse alcohol (King, 2000; Mumola, 2000). Children of veterans with PTSD are significantly more likely to

suffer from behavioral problems, as well as have diagnostic scores that fall within the clinical range (Jordan et al.).

A major obstacle to treating patients with PTSD is addressing the avoidance behaviors that are a common symptom of the disorder. These behaviors often render the patient unable to participate in imaginal exposure (Cukor et al., 2009). VRET addresses this issue, offering more realistic and controllable trauma-relevant stimuli. Individualized treatments can be devised to deal with particular trauma-related events. VRET requires the patient to revisit the story of the trauma again and again in a safe environment until habituation is achieved. VRET can be used to treat any individual diagnosed with PTSD but has been especially successful in treating military personnel.

Combat situations often expose soldiers to high levels of stress and life-threatening situations, which can increase the risk of developing PTSD. The first VR application for PTSD Virtual Vietnam was created in 1997 (Cukor et al., 2009). More recently, the Department of Defense has been testing Virtual Iraq. It is currently available to personnel in several locations, including Walter Reed Army Medical Center in Washington, D.C., and the Naval Medical Center in San Diego, California (Halpern, 2008). Preliminary results indicate that test subjects experience significant reductions in PTSD-related symptoms, with 80% no longer meeting the diagnosis of PTSD after completing treatment (Shiromani, Keane, & LeDoux, 2009).

Overall, PTSD increases the risk of involvement with the criminal justice system. The National Commission on Correctional Health Care's (2002) longitudinal study of U.S. jails and prisons demonstrated that 4-9% of inmates in federal prisons and 6-12% of inmates in state prisons suffer from PTSD. Individuals diagnosed with PTSD are at increased risk of alcohol and substance abuse. They also report increased aggression and violent acts, especially toward family members. The symptoms of PTSD can lead to behaviors such as drunk driving, possession of drugs, assault, child abuse, and domestic violence. With the success of VRET in treating PTSD, the criminal justice system can benefit from incorporating treatment programs directed toward this population. Once offenders are no longer diagnosed with PTSD, rehabilitative approaches can begin to address criminogenic characteristics. Not only will this type of treatment program have positive outcomes for offenders, but the families of this population will also benefit. Improving the well-being of offenders and their families can translate into a more successful reintegration process.

Attention Deficit/Hyperactivity Disorder. Attention deficit/hyperactivity disorder (ADHD) is one of the most commonly diagnosed childhood disorders, with symptoms often persisting into adolescence and adulthood (National Institute of Health, 2010). Symptoms of ADHD include difficulty staying focused, problems with controlling behavior, and hyperactivity. Adolescents with ADHD are more likely to become involved in risk-taking behaviors (Anton et al., 2009). According to the Kessler et al. (2007), 8.1% of the U.S. population has been diagnosed with ADHD, with 9.8% of males and 6.4% of females meeting the diagnosis. Estimates of ADHD in the adult criminal population vary from 14%-25% (Eme, 2009; Westmoreland, 2010). Other studies estimate ADHD for detained juveniles ranging from 16-48%. ADHD has been identified as a risk factor for both juvenile delinquency and adult criminal behavior (Pratt, Cullen, & Blevins, 2002). Adolescents who display symptoms of ADHD consistently engage in a variety of problem behaviors (Sullivan, Childs, & O'Connell, 2010). Studies have shown that ADHD can be used to predict antisocial behavior (Babinski, Hartsough, & Lambert, 1999; Reesman Owens & Bergman, 2009).

Other studies indicate that individuals with comorbid ADHD and another behavioral disorder are more likely to engage in crime (Einat & Einat, 2007; Eme, 2009; Loeber, Burke, Lahey, Winters, & Zerba 2000; Moffitt, 1990). There is evidence suggesting that ADHD causes deficits in executive functioning which leads to both oppositional defiant disorder (ODD) and conduct disorder (CD), which are both associated with adult criminality (Eme, 2009; Loeber et al., 2000). Youths with comorbid CD and ADHD are arrested more often than those with CD alone (Forehand, Wierson, Frame, Kempton, & Armistead, 1991). Comorbid ADHD and CD increase the risk of substance abuse disorder and job and academic failure (Eme, 2009). Early conduct problems and the hyperactivity component of ADHD have been shown to significantly predict future arrests and self reports of criminal activity (Babinski, et al., 1999).

VR can be used in the assessment and rehabilitation of individuals who have been diagnosed with ADHD and who show early signs of other behavioral problems (Schultheis & Rizzo, 2001). Traditional treatment for ADHD and conduct problems involves multimodal CBT, which focuses on the individual, family, and school (National Institute of Health, 2008). Individuals learn how to more effectively organize their lives by breaking large tasks into smaller steps. During treatment, practitioners use reinforcement techniques and cognitive restructuring

to eliminate maladaptive behaviors (Anton et al., 2009). In private psychiatric care, VRCBT is now being incorporated into traditional CBT to treat individuals with ADHD and conduct problems. Video games have historically been used to successfully treat adolescents in residential treatment programs, because they keep participants engaged in therapy (Ceranoglu, 2010). Along the same lines, VR simulations are used to enhance willingness and participation through active engagement. An important aspect of using a virtual environment is the capacity to deliver precise control. Patients can learn and practice in the virtual environment while obtaining instant feedback on behavior. Thus, VRCBT has been incorporated with traditional therapy to reduce symptoms and improve outcomes for those with ADHD.

Juvenile and adult offenders can also benefit from incorporating VRCBT into rehabilitation programs. With the high prevalence rates of offenders with ADHD, addressing this diagnosis can be imperative to treatment success. Studies suggest that 31% of offenders diagnosed with ADHD have also been diagnosed with childhood CD (Westmoreland, 2010). Those offenders who suffer from ADHD and CD are more likely to be involved in serious, violent offending (Wright, Tibbetts, & Daigle, 2008). Treating offenders with ADHD only and comorbid ADHD diagnoses addresses underlying cognitive issues and will likely result in larger reductions in recidivism.

Substance Abuse. Substance abuse is another issue for many offenders under the control of the criminal justice system. In the general population, 13.2% suffer from alcohol abuse and 8% suffer from drug abuse. Rates for substance abuse among offenders are far higher. In 1997, 56.4% of state prison inmates and 46.4% of federal prison inmates had a self-reported history of substance abuse treatment (Mumola, 1999). In a 2002 national study of inmates, 68% met the DSM-IV criteria for a diagnosis of substance abuse (Karberg & James, 2005). A study in Cook County Chicago revealed that 32.3% of female offenders met the diagnosis for lifetime alcohol abuse and 63.6% met the diagnosis for lifetime drug abuse (Teplin, 1996). The Northwestern Juvenile Project demonstrated that 50.7% of males and 46.8% of females suffered from substance abuse disorder. Substance abuse is a problem that permeates the criminal population, thwarting attempts to sustain long-term, substantive changes in offenders.

A specific form of CBT that relies on cue-based exposure therapy is typically used to treat the cognitive and behavioral problems associated with alcoholism and substance

abuse (Cho et al., 2008). One limitation of this type of treatment is that individuals have to imagine situations that may induce them to consume alcohol or use drugs. Practitioners are incorporating VR with cue exposure therapy (VR-CET) to treat individuals diagnosed with alcohol and/or drug dependence. Laboratory-based cue exposure can be improved upon by using VR technology to expose patients to relevant contextual environments (Bordnick et al., 2009).

The virtual environment allows for the creation of realistic, high-risk situations that typically induce alcohol or drug cravings. For example, virtual crack houses have been used to elicit cravings for crack addicts (Saladin Brady, Graap, & Olasov Rothbaum, 2006). Over the course of the treatment, participants engage in modeling, role-playing, and reinforcement strategies to reduce the likelihood of consuming alcohol or drugs. Researchers believe that if virtual environments can be used to induce cravings, they can also be used to extinguish cravings using CBT techniques (Bordnick et al., 2008; Kuntze et al., 2001). VR-CET has led to statistically significant decreases in alcohol consumption (Lee et al., 2007; Lee et al., 2009). Additional programs for methadone maintenance have also revealed significant improvement in treatment outcomes (InWorld Solutions, 2011). With high rates of offenders having some form of substance abuse disorder, treatment programs stand to benefit from a VR-CET component.

Female Offenders. The number of incarcerated women in the United States has continued to grow over the past decade. According to Cooper, Sabol, & West (2009), from 2000 to 2008 the growth in the proportion of incarcerated women was 8% higher than that of men (15% for men as opposed to 23% for women). Today, women compose approximately 8% of all prisoners in local, state, and federal jails and prisons (Cooper et al., 2009). Female offenders in the criminal justice system share many common characteristics. They tend to be in their early to mid thirties, are likely to have been convicted of a drug-related offense, have fragmented family histories, have families and friends who have also been involved with the criminal justice system, are likely to have suffered physical and/or sexual abuse as both a child and as a adult, are unmarried mothers, and have sporadic work histories (Bloom, Owen, & Covington, 2003). Female offenders are also more likely than male offenders to suffer from depression, low self-esteem, and self-injurious behavior (Bloom et al., 2003; Holtfreter & Morash, 2003; McClellan, Farabee, & Crouch, 1997).

Overall, the gender-responsive literature suggests that specific needs should be addressed when assessing and treating female offenders (Van Voorhis, Wright, Salisbury, & Bauman, 2010). Women have unique pathways into crime that differ from those of their male counterparts (Belknap, 2007; Bloom et al., 2003; Daly, 1992; Reisig, Holtfreter, & Morash 2006). Included in these pathways are mental health and substance abuse, as previously discussed; however, additional needs for female offenders include poverty and dysfunctional relationships.

Financial issues and poverty are common in female offenders (Belknap, 2007; Bloom et al., 2003; Daly, 1992). The root of these difficulties generally lies in deficiencies in education and training, low paying jobs, substance abuse issues, and a lack of child care for dependent children (Van Voorhis et al., 2010). Poverty has been shown to increase the odds of female offender recidivism and supervision violations (Holtfreter, Reisig, & Morash, 2004). As many incarcerated women are in the bottom income levels (Cooper et al., 2009), poverty may have an impact on why some women turn to crime.

Many female offenders report a wide variety of relationship problems. They tend to become romantically involved in abusive, dysfunctional relationships (Bloom et al., 2003). They also tend to have poor relationships with their children (Bloom et al.; Van Voorhis et al., 2010). They often lack the ability to adequately parent their children, leading to either abuse or neglect, which might ultimately influence their children's delinquency. Child abuse is considered a major risk factor in the development of delinquency for females (Chesney-Lind & Shelden, 2004). Physical and sexual abuse can influence the likelihood of criminal involvement into adulthood (McClellan et al., 1997; Salisbury & Van Voorhis, 2009).

VR can be used in the treatment of female offenders in a variety of ways. First, through training programs, VR allows women to learn specific skills that can help them obtain gainful employment. They may also participate in non-immersive virtual education forums that allow them to work toward obtaining a GED and subsequent college credit. VR can also teach female offenders about relationships skills. Through role modeling and role playing, female offenders can be placed into virtual situations to learn and practice effective conflict resolution and problem solving related to romantic and parenting relationships. Addressing both of these needs reduces the likelihood that women will return to prison (Van Voorhis et al., 2010).

Sex Offenders. Sex offenders account for 15% of the total correctional population, with 60% of convicted sex offenders are under correctional supervision in the community (Anonymous, 2008; Finkelhor & Ormrod, 2001). Within a three year follow-up period, 5.3% of sex offenders are rearrested for another sex crime, and 43% are arrested for various other offenses (Langan, Schmitt, & Durose, 2003.). It is also interesting to note that many sex offenders have a history of anxiety disorder, social phobia, and PTSD (Raymond, Coleman, Ohlerking, Christenson, & Miner, 1999). Assessing and treating sex offenders are of great concern to the public. There are two main methods used to obtain objective measures in the clinical assessment of sex offenders--penile plethsymography (PPG) and approaches based on viewing time (VT). VR offers the ability to enhance both the assessment and treatment of sex offenders.

Assessment. The effective assessment of sex offenders is crucial to treatment success. Assessment is typically made using PPG or VT readings. A PPG device measures changes in penile blood flow. This involves the measurement in circumference or volume of the penis while a subject is viewing various sexually and non-sexually related images. The amount of time spent viewing an image is also a popular assessment tool, whereby subjects are shown images of nude males and females while their viewing time is recorded. Both PPG and VT methods have been criticized for having weak test-retest reliability and inaccurate tests resulting from mental distraction and faking strategies (Renaud et al., 2009).

VR can be used to address the shortcomings of PPG and VT assessments. Semi or fully – immersive virtual environments allow for the creation of avatars that are developed and validated to ensure they are perceived to represent specific age, gender, and other sexual properties. The HMD can track eye movements, or gaze time, automatically. PPG readings are also recorded and compared to eye tracking measures. Studies using the combination of both methods within the virtual environment leads to effective objective measures to gauge sexual interest (Renaud et al., 2009; Thorton & Laws, 2009). Using physiological, objective measures in conjunction with sex offender assessment tools can provide a more accurate and detailed evaluation that can be used when selecting treatment approaches for various types of sex offenders.

Treatment. A variety of treatments are typically available to institutionalized sex offenders. Individual counseling, group counseling, CBT, and relapse prevention are offered in many prisons. Both prison and community-based sex offender treatment programs successfully use CBT methods to reduce recidivism (Hanson et al., 2002; Polizzi, Mackenzie, & Hickman, 1999). As with other types of disorders, VR can enhance the use and effectiveness of CBT-based treatments. Through VR-CBT, the maladaptive thoughts and behaviors of sex offenders can be addressed through a variety of techniques. Offenders can participate in modeling and role-playing to learn and practice expected social norms and appropriate sexual relationships. Simulations can be paused at any point, allowing practitioners the ability to give immediate feedback and reinforcement. Sex offenders can be placed in virtual, high-risk situations in which they can practice self-control. Additionally, aversive conditioning, whereby a repulsive stimulus is paired with inappropriate sexual reactions, has been successfully used for sex offender treatment (Maletzky, 1991) and can be incorporated into VR scenarios.

The control allotted in a virtual environment allows the sex offender to be placed in a variety of situations that may be experienced in real life. This enables the offender to learn and practice desired skills in a safe environment, without the potential for real harm to either himself/herself or a victim. As with other forms of VR-CBT, the goals are to extinguish maladaptive thoughts and behaviors and to generalize treatment effects to real world circumstances. With the current success of conventional CBT for the treatment of sex offenders, the addition of a virtual component offers the possibility of even stronger rehabilitative outcomes.

Implementing Virtual Reality

Depending on the needs of the organization, virtual reality can be easily achieved. A basic semi-immersive system can be implemented requiring the same cost and technical expertise needed to set up a new computer workstation. However, certain considerations should be made before using a virtual environment in conjunction with other programs. First, we discuss the actual cost required to set up a basic VR system. Second, we will cover potential issues with technical ability and additional training costs. Although these are minimal, it does require some attention. Third, we will address the potential negative side effects associated with using VR. Many people do not experience these side-effects but they are an important

consideration. Finally, we will discuss the lack of consensus on how to implement programs using virtual environments. We can focus on the successes and failures of other disciplines in order to address this problem.

Cost

Creating a virtual environment from scratch requires access to significant funds for hardware and software development. Developing an original VR system offers optimal flexibility but also requires a great deal of effort. A fully immersive system can cost more than $200,000 (Riva, 2009). Converting an existing VR application into one suitable for program needs is perhaps the easiest and least expensive option (Sherman & Craig, 2002). On a positive note, the financial cost of VR is beginning to decline, because some developers are sharing software free of charge (Gregg & Tarrier, 2007). Researchers and academics are also deploying point-and-click VR systems that are becoming widely available.

Cyberpsychology pioneer Guiseppe Riva heads the NeuroVR Initiative, which offers practitioners and researchers a low cost alternative to employing programmers and developers to create or modify existing VR systems. NeuroVR is a VR platform based on open-source software that gives professionals a cost-free virtual environment editor. This allows non-expert users to easily modify a virtual world and individualize the clinical setting. Using the NeuroVR Editor, practitioners choose the appropriate psychological stimuli/stressors from a database of objects and videos and place them into the virtual environment. NeuroVR can be used as a fully-immersive or non-immersive tool. The NeuroVR platform runs on standard personal computers with Microsoft Windows and an upgraded graphics card. A HMD is also required for the fully immersive simulations. Overall, setting up a full functional virtual environment costs about as much as a fully loaded workstation or laptop. This alternative makes the cost of delivering a virtual experience quite feasible.

Obtaining additional hardware is not realistic in some situations. InWorld Solutions, Inc. offers another solution that requires little modification to an existing computer. They demonstrated their internet-based virtual environment designed specifically for behavioral health care in August 2010 at the American Psychological Association's annual meeting in San Diego. The InWorld virtual environment platform incorporates various avatars, content, and features specifically developed for cognitive therapy, counseling, training, education, and supervision.

InWorld runs on the Windows operating system and requires broadband Internet access. The ability of participants to log onto the InWorld environment from any location provides flexibility for training and treatment programs. The InWorld virtual environment is customizable and attractively priced. Access can be granted based on yearly subscriptions or at a cost of mere dollars per session.

Both NeuroVR and InWorld Solutions provide a cost-effective way to deliver VR treatment and training. Both options allow practitioners and researchers the ability to customize and individualize the virtual environment. As this technology continues to be incorporated into the behavioral sciences, there is little doubt this emerging industry will develop lower cost and higher quality solutions for the use of virtual environments. The use of standard computer equipment along with some fairly inexpensive hardware allows for VR to be incorporated into programs easily and cost-effectively.

Technical Ability

One hurdle to VR implementation is the technical ability of both the researcher/practitioner and the participant. Time must be spent upfront in the creation of avatars and in learning to navigate the virtual world (Baker et al., 2009). In addition, there is the necessity and additional cost to train researchers and practitioners on how to set up and customize each virtual simulation.

Most VR systems provide a user-friendly administrative environment. Simulation administrators need only basic computer skills (use of a mouse, keyboard, and Microsoft Windows familiarity) in order to set up, customize, and run the simulations. Participants interact with the environment through the use of the HMD, verbal communication, and sometimes mouse or keyboard commands. The level of participation required to interact with the virtual environment can be adjusted for each participant's skill set. Some difficulty may be introduced when incorporating more complex devices, such as heart rate monitors or PPG instruments. Simulation administrators will need to know how to attach and operate these devices in conjunction with the VR interface.

As with any new program tool, researchers, practitioners, and subjects must be trained on usage. Programs such as NeuroVR and InWorld provide a user-friendly interface and on-going technical support. Participants engage in simple interaction in the simulation. Participant use

requires only basic computer skills to achieve navigation and communication in the virtual environment. The increase in the use of computers in nearly every facet of contemporary life will necessarily facilitate the skills needed to set up, customize, and implement virtual simulations, thereby reducing concerns regarding technical inability.

Side Effects

There are some potential physiological side effects for users of virtual environments. Some common problems include nausea and mild pain from the HMD (Greg & Tarrier, 2007). Due to the realism of a virtual environment, some participants experience physiological responses similar to those associated with motion sickness. Sickness developed within the virtual environment is referred to as *cybersickness*. Symptoms of cybersickness include eye strain, headache, paleness, sweating, dryness of the mouth, disorientation, and vertigo.

Whether cybersickness is experienced is dependent on the individual differences in participants; however, age, gender, and prior illness seem to play a role in who experiences cybersickness (LaViola, 2000). Children from the age of 2-12 years old appear to be most at risk. Females tend to have more instances of cybersickness than males. It is important to screen patients for migraines, history of seizure, and vestibular abnormalities, as these individuals have an increased risk of cybersickness (Wiederhold & Wiederhold, 2004). Most individuals do not experience problems during a virtual simulation; however, as with any treatment, researchers and practitioners should be aware and prepared to address issues associated with negative side effects.

Standardizations

Using VR in training and treatment is a relatively new phenomenon. Additionally, incorporating virtual simulations into research, training, and treatment within the criminal justice system has not yet been considered. If the criminal justice system embraces the use of VR technology, there will be a clear need for standardization. For a little over a decade, practitioners in communication, education, neuroscience, and psychology have used VR to enhance conventional methods. Although VR is in its infancy, these disciplines are beginning to develop standard protocols for its use. In the interest of space, we will not discuss these emerging standardizations here, but criminal justice researchers and practitioners should be aware that they

can benefit from interdisciplinary successes, failures, and lessons learned. Working with professionals in other disciplines not only allows for knowledge transfer, but also facilitates the ongoing collaboration necessary to evaluate and fine-tune VR systems.

Conclusion

Computer simulations are currently being used in the criminal justice system to further understand crime patterns and inform crime prevention strategies (Eck & Liu, 2008b). The expanded use of immersive virtual environments offers unique possibilities within the criminal justice system. Through enhanced experimental control, researchers can address issues such as replication, sample size, and data collection. Additionally, criminal justice researchers can develop objective measures that have often proven elusive. Addressing these types of limitations within social science research will enhance both validity and reliability.

Virtual training environments can also be used with both law enforcement officers and offenders. Virtual simulations produce environments that stimulate multiple senses, making the experience feel real (Wiederhold & Wiederhold, 2004). Virtual training sessions enable trainees to practice and perfect skills in a safe environment. Additionally, VR provides a rich environment that allows participants to learn actively (Stanney et al., 1998). Law enforcement officers can benefit from virtual training by reducing costly mistakes and the potential for loss of life. Offenders can learn a variety of vocational and social skills using virtual simulations.

Therapeutic techniques, such as aversion, exposure, and CBT, can be improved with the use of VR. Specific disorders such as anxiety, PTSD, and substance abuse, have been successfully treated with therapies that use VR. VR enables practitioners to target the specific needs of individuals and provides an environment where participants can express themselves more openly (Riva, 2005). Both the assessment and treatment of special populations in the criminal justice system can be enhanced with the use of VR.

VR is already being used in a variety of ways. In addition to the topics discussed here, virtual simulations have been used to alleviate stress (Chen et al., 2009; Villani et al., 2007), reduce risky sexual behaviors (Read et al., 2006), and treat erectile dysfunction (Optale et al., 2004). Although this paper has outlined three specific uses that seem to fit well with current criminal justice policies and practices, there are many other potential uses for the technology. For instance, VR might be used to identify suspects in police lineups or employed to strengthen

eyewitness accounts (Blascovich & Bailenson, 2005). Furthermore, VR might be used to recreate crime scenes for forensic investigations.

The uses of VR seem endless. We have argued that VR can be easily integrated into various programs within the criminal justice system. With the grim realities of overcrowded prisons, ineffective treatments, and dwindling state and federal budgets, now is the time for the criminal justice researchers and practitioners to think outside the box and embrace emerging this technology.

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