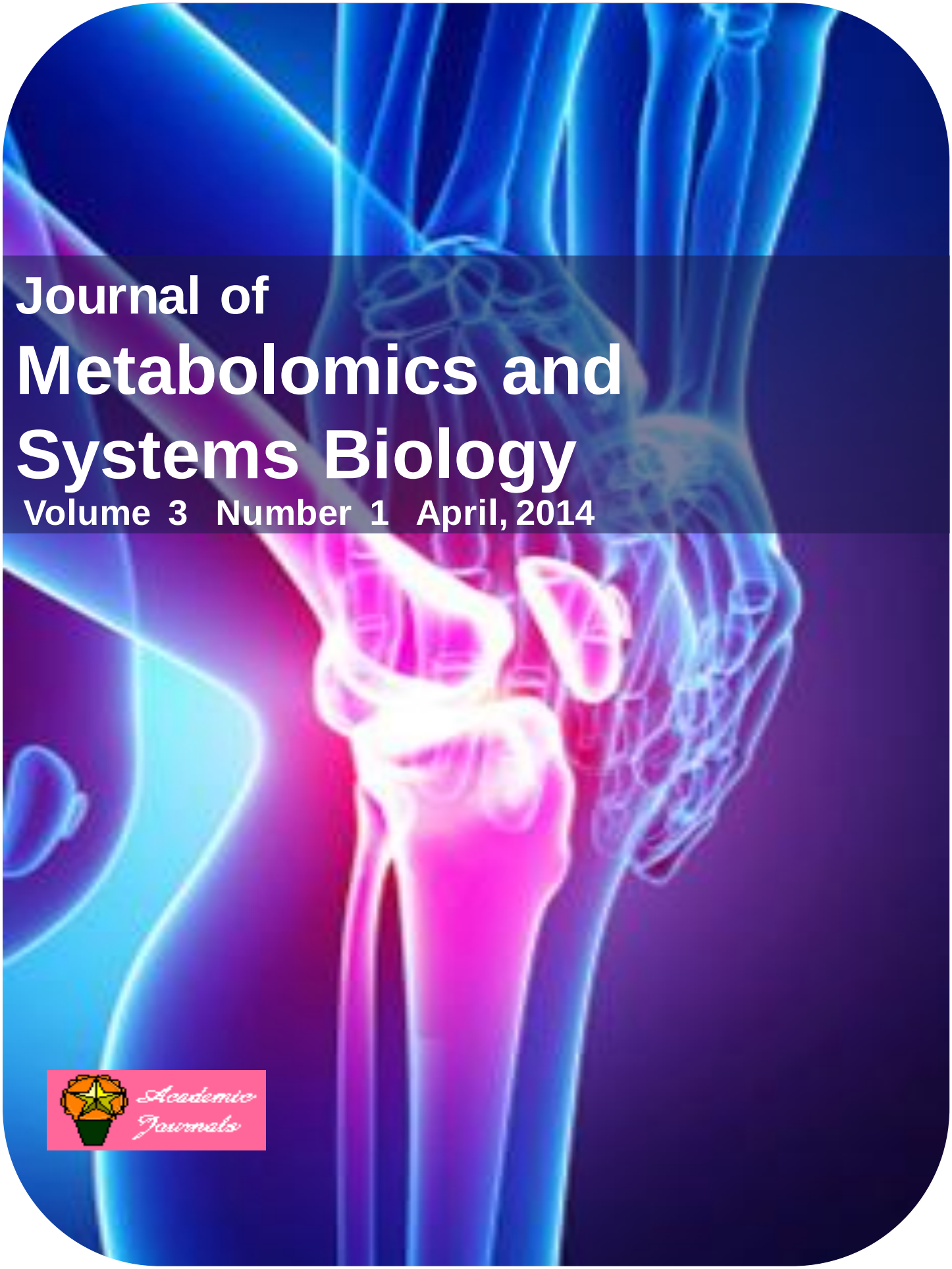

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Review

Virtual environments for mental health issues: A review

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Three-dimensional (3D) environments are increasingly being used to provide therapy to those suffering from mental health problems. Virtual environments can provide a safe and realistic simulation to expose patients to the cause of their problem. This paper presents a review of the use of 3D environments to assess and treat mental health problems. Within the review applications to treat mental health problems such as post-traumatic disorder, autism and phobias are described. The areas reviewed in this paper describe more recent works in the area of three-dimensional interfaces for the treatment of mental health problems.

Key words: Mental health, virtual reality therapy, three-dimensional (3D) games.

INTRODUCTION

Mental health affects how we think, feel and behave (NHS Choices, 2007). In the United Kingdom, one in four people suffered from a mental health problem at some point in their lives. It can adversely affect people's lives and those around them and can lead to people committing suicide. Three-dimensional (3D) environments can help to assess and treat mental health problems by providing a sense of realism in a safe environment to expose the sufferer to the root of the problem. This level of presence that 3D environments can offer has led to the creation of a number of systems to treat specific problems. The review covers psychological problems such as post-traumatic stress disorder, phobias, attention deficit hyperactive disorder (ADHD) and autism. The review focuses on the hardware in order to provide an overview of the beneficial utility of 3D environments to assess and treat mental disorders. The intention of the review is to provide an overview for virtual reality (VR) researchers on the current use of VR to treat psychological problems. Post-traumatic stress disorder has received a great deal of attention as a psychological consequence of war. The review looks at the use of virtual environments and mental health from the 1980's to the present day. The main source of the review are jounal papers found on google scholar for the latest developments in the area and other interent websites such as academic sites.

POST-TRAUMATIC STRESS DISORDER (PTSD)

Post-traumatic stress disorder is a mental condition applications as opposed to the software development and

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that can affect people that have experienced enormous pressures through a traumatic event, such as military combat, sudden death of a loved one or a terrorist attack. The effects include flashbacks of the event, a loss of concentration, lack of sleep, a sense of detachment from society (NHS Choices, 2009a) and physical hyper-arousal (National Institute of Mental Health, 2008). Rizzo (2006) has suggested that initial evidence suggests that 1 in 6 Iraqi War veterans suffered from mental disorders such as anxiety, depression or PTSD. The traditional method of treating such a condition is cognitive behavioural therapy (CBT) where the patient works on the negative thoughts by exposure methods such as '*in vivo*' (experiencing the fear) or imaginal exposure (retelling trauma repeatedly to their therapist). The patient is exposed to the fear frequently, in order to des-sensitize them to the original fear.

Rizzo et al. (2009) have suggested that some patients have difficulty imagining the situation that has caused the trauma and that VR can aid in this area. A VR environment can also allow the clinician to systematically control the presentation of stimulus content such that the patient can be gradually exposed to trauma contexts that evoke the emotional memories to be processed. VR has been used in areas such as aircraft simulation and training (Boud, 1999) to provide a realistic environment to teach individuals in a safe manner. This safety factor has also been applied to the treatment of patients using VR. Rizzo et al. (2009) described the development of a VR system called 'Virtual Iraq'. Within the system, the patient is exposed to visual, auditory, olfactory and tactile stimuli corresponding to the event that originally triggered their symptoms. Twenty military personnel were used in a trial of the VR system, with positive results.

Gerardi et al. (2008) also reported a substantial improvement of a veteran with PTSD when using a VR system. The notion of tailoring the content of the VR system according to the patient's experiences has also been suggested by Van Der Mast et al. (2005), however, they suggest the system is also tailored to the specific therapist in order that they use techniques that they find beneficial. Considerations relating to the uptake of using this technology are also an issue. Hoge et al. (2004) has suggested that there is still a stigma associated with seeking help with the condition. Rizzo et al. (2009) in their trials noticed a high dropout rate in their trials. This is a problem they are trying to address. Work has also been carried out by the virtual reality medical center (VRMC) in regard to the prevention of PTSD by de-sensitizing the soldiers before they go into combat situations, this is termed stress inoculation training (SIT). The concept behind this is that they become accustomed to the traumatic aspects of combat before they physically experience it, thereby de-sensitizing them to the experiences that they may experience in such situations.

VR was used to treat PTSD effecting survivors of the September 11th World Trade Center terrorist attack (Coyle and Matthews, 2004). A financial worker who worked in close proximity to the World Trade Center experienced symptoms of PTSD such as a feeling of detachment and physical hyper-arousal. This impacted upon her family as well as her own mental wellbeing. She had tried conventional methods with little benefit. A VR system was used to gradually expose her to aspects of the trauma. There was a marked improvement of her symptoms as a result of this. A larger study of 10 PTSD sufferers after 9/11 found that there was a statistical and clinically meaningful improvement in 9 out of 10 of the patients' symptoms of PTSD (Difede and Hoffman, 2002). Overall, it appears that such incremental evidence from the literature supports the use of VR as a tool for delivering exposure therapy for the treatment of PTSD.

PHOBIAS

A Phobia is a reoccurring fear of an object or situation that is excessive and to the point that it is not regarded as normal behaviour. For example, a fear of flying, heights and spiders can all lead to irrational behavioural traits relating to the sufferer's behavioural traits. The effect of this phobic fear can influence bodily and mental functions, such as 'being glued to the spot', an increase in heart-rate and breaking out in panic-based sweating. It has been suggested that in the mid 1990's, 10 to 12 percent of the US population will be subject to some kind of phobia in their lives (American Psychiatric Assoc, 2002). VR has been used as a successful technique that exposes aspects of the phobia to the patient in a safe manner in order for them to habituate the trigger so that it no longer causes such an excessive anxious response. As Roy (2003) has pointed out, VR can allow a more controlled form of therapy than conventional approaches in a realistic but not harmful environment. Hodges et al. (2001) described the use of 'emotional processing theory' whereby the patient within the VR system is exposed to their fear and then provided with information to counteract the unreasonable anxiety. There are a number of phobias that have used three dimensional user interfaces to help patients overcome their fears such as social phobia, fear of flying and a fear of small insects.

Augmented reality superimposes virtual information onto the real world without the need for complete immersion (Haniff et al., 2000). Juan et al. (2006) described the development of an augmented reality system (AR) to treat people's phobias of small insects. The system uses a marker based AR system and a markerless AR system developed using the ARToolkit (HITlab) and virtual reality modeling language (VRML). The markerless system uses an infra-red camera to detect an invisible marker

that has been produced using special ink. The research examines whether the treatment of the phobias is effected by the presence of a marker or not. VR has also been used for such fears as arachnophobia (fear of spiders). Bouchard et al. (2006) conducted an experiment whereby they used a VR system to expose the patient to spiders. In their study, 11 participants made significant improvements in their reduction of fear towards spiders and they have suggested that VR is a more acceptable form of treatment than actual exposure to spiders. Another phobia which has received attention from the VR community is social phobia.

A social anxiety disorder is an excessive fear of social situations such as public speaking. Slater et al. (2004) in a study involving 16 people with a social phobia of public speaking found that in a VR environment, people respond the same way as they would in a real environment where they had to carry out public speaking. Herbelin et al. (2006) have noted that in the 1990's, it has been estimated that 19% of the population suffer from this phobia. As pointed out by Grillon et al. (2006), the most common form of social phobia is public speaking however, Klinger et al. (2006) have identified four situations which cause the most distress to sufferers of social phobia: performance, intimacy, scrutiny and assertiveness. The authors also state that the physical effects can be sweating, increased heart-rate, dryness of the mouth and twitches. The long-term effects are that it can lead to depression and alcohol addiction.

In the studies conducted by Klinger et al. (2006), the therapist is present in the virtual reality session and asks questions of the participant such as, 'what thoughts do you have?' (in order to ascertain cognitive processes) and 'what do you feel?' (in order to gauge emotional intensity). The VR scenarios included situations such as: establishing contacts talking to neighbours and friends and making small talk (fear of intimacy). The results of the VR studies suggested an improvement over cognitive behavioral therapy (CBT). Another form of social anxiety disorder is shyness of males toward attractive women (Pan and Slater, 2007). The authors are investigating whether virtual female characters elicit the same response to an attractive virtual female as a real female, by using biosensors to measure the male participants' physiological state. Their initial results suggest that males do respond to physically attractive virtual females in a similar manner to real females.

VR systems have also been developed for transport phobias such as flying and driving. Rothbaum et al. (2000) comment that 10 to 25% of the US population have a fear of flying and argue that those that need to fly take alcohol or sedatives to alleviate their fear while flying, which has social consequences. The researchers have described a study using 49 participants where a VR exposure system was compared to gradual real exposure and no exposure at all. The study found that the VR system performed as well as the gradual real exposure, and performed significantly better than no exposure at all. Rothbaum et al. (2002) and looed et al. (2002) also looked at the fear of flying in a long-term assessment of the technique of exposure therapy. Tomasevic et al. (2000) used a driving simulator to treat a patient who had a fear of driving on motorways due to serious accident that he was involved in. The patient was gradually exposed to 11 traffic scenarios which would induce increasing levels of anxiety. The VR system was successful and the participant was able to overtake and manoeuvre on the motorway.

An unconventional application of VR for phobias was the use of a VR system to treat an elderly lady of a storm phobia (Botella et al., 2006). As predicted, the VR system benefited the patient more than real safe exposure methods such as bursting balloons.

VR provides a method for exposing people that suffer from phobias in a safe environment. Garcia-Palacios et al. (2007) conducted a survey with 150 participants with phobias and asked them if they would prefer VR treatment or real controlled exposure to their fear, 76% chose VR over controlled real exposure. The authors argue that VR can provide a method for the treatment of phobias that is more acceptable to the population as opposed to confronting their fears in the flesh, in the real world. It has been pointed out that only 20% of people with a phobia actually seek treatment (NHS Choices, 2009b) due to a fear of causing themselves harm by doing it in real life; VR can potentially bridge this gap.

ADDICTION

An addiction is a compulsion to take or use something with no control excessively and which may cause the person harm, for example alcohol or drugs (Lee et al., 2003). VR as discussed earlier can be used to expose people to situations in order for them to become desensitized to the stimuli. This technique has also been applied to nicotine addiction (Bordnick et al., 2004). The authors suggest that cravings such as for cigarettes can be reduced by using VR to expose users to stimulus cues that they would likely encounter in everyday life that have conditioned associations for inducing urges to smoke. By exposure to these cues in a VR simulation where the user cannot smoke (that is, clinicians office), it is believed that the user will eventually habituate to those cues, and urges will subsequently be reduced when they are encountered in the real world. The VR world also provides a context for the user to practice cognitive behavioural coping strategies that they can hopefully transfer to the real world and reduce the potential for relapse.

A pilot study on nicotine craving was carried out by

Bordnick et al. (2004) on 13 nicotine dependent participants, and they found that the craving for nicotine rose to 118%. The authors developed a VR system that presented situations such as people smoking in a bar. The authors conducted a study where they compared the use of a VR system with a normal picture and concluded that the VR system led to more of the craving feeling than the paper picture approach. The National Institute of Drug Abuse is conducting a research into the use of VR to expose drug addicts to 'crack houses' in order to control the temptation to take drugs (Thacker et al., 2005).

AUTISM

Autism is a developmental problem whereby the individual has problems with communication (verbal and non-verbal), social interaction (relating to people), and social imagination (taking everything literally) (National Autistic Society, 2009). While they can be very knowledgeable in one area, in other areas they are less able. Autistic individuals can also exhibit repetitive behaviour such as repeating what someone else has said. Trepagnier and Rosen (2009) however suggest that the social communication aspect of autism is the most common problem.

Jung et al. (2006) argue that autistic children have problems integrating motor and sensory experience and use as the basis of their VR system, the sensory integration theory (SIT) (Ayres, 1972). SIT works on sensory processing (that is, perception) as the basis for improvement on the higher-cognitive processes such as learning. The VR systems looked at the aspects of sensory integration such as the visuomotor process for co-ordination and social skills. Children without autism and children with autism were compared in performance of the VR tasks, and the researchers suggest that the VR system was accurate in eliciting the difference between autistic children and non-autistic children. They also suggest that in the treatment of children with autism, frequent use of the systems is required and that autistic children may feel more comfortable using a VR system than being directly evaluated. McComas et al. (1998) also suggest that VR systems have the benefit of restricting the amount of stimuli to autistic people which may cause them confusion in the real world.

Parson et al. (2008) described a project that uses VR for the treatment of Asperger's syndrome which is a form of high-functioning autism, whereby they have an intelligience quotience (IQ) level comparable to people who have not got the condition but lack the social skills to interact with people. The effects of such a condition can lead to social exclusion and ability to make friends, and this can in turn lead to having short-term jobs. The researcher's aims are to actively involve the sufferers of the condition in the development of the VR systems.

ATTENTION DEFICIT HYPERACTIVE DISORDER (ADHD)

The Department of Health and Human Services (http://www.cdc.gov/ncbddd/adhd/what.htm) define ADHD as a 'chronic level of inattention, impulsive hyperactivity, or both, such that daily functioning is compromised'. This often occurs in children and is said to affect 3 to 7% of children in the US. This can have effect on their ability to achieve academically, as their attention is limited and form relationship due to the hyperactive nature of their condition. They may fidget in class and be can easily distracted rather than maintaining focus. Three-dimensional systems have been employed to assess attention problems in ADHD children (Orlandi and Geco, 2004) and to help treat it. Rizzo et al. (2006) examines ADHD in children within a virtual classroom looking at the attention factors governing their behaviour that is, the level of distraction and the nature of the distraction. Those suffering from ADHD were compared with those that did not. The researcher found that ADHD sufferers made more bodily movements than those without ADHD, suggesting that their attention during the lesson was less focused than the students not suffering from the condition. As discussed previously, VR simulations allow the observer to introduce and take away stimuli in a virtual setting in order to examine the effects on the user.

National Aeronautics and Space Administration (NASA) have developed a neuro-feedback system integrated into games to improve the attention levels of children with ADHD. The system was initially developed to improve the concentration of pilots while on long flights. Electroencephalogram (EEG) data gathered from the brain waves of the individual were used to give feedback on the performance in terms of level of concentration. The games are integrated into standard games for children, for example, the Gran Turismo computer game with the most brain waves generated, the faster the car goes. With training, it is intended that the child's level of concentration is improved, as the game provides added motivation for the child.

PAIN DISTRACTION

VR has also been used as a distraction technique to reduce the levels of pain experienced by patients. The level of presence within a VR system can distract an individual from the pain that they are experiencing, for example, during a medical procedure. Gold et al. (2006) conducted a study to evaluate the effectiveness of pain

distraction using VR to divert children's attention for intravenous (IV) placement. The study used twenty children requiring IV for undertaking magnetic resonance imaging/computed tomography (MRI/CT). The study consisted of two conditions, one condition with no distraction and one with the VR condition used as distraction (playing a game). The children reported a four-fold increase in the perception in pain without distraction than those using VR for pain distraction. The children reported that they were less anxious about the IV procedure than those that received no distraction. The children also did not experience any motion sickness.

Hoffman et al. (2007) also examined the analgesic effects (pain relief) in the use of VR with the introduction of thermal pain simulation on 9 subjects. VR and opiod (morphine like substance) were evaluated for pain relief, the pain was measured through a subjective rating and blood oxygen level-dependent assessments of brain activity in five specific, pain-related regions of interest (using magnetic resonance imaging). The results indicated that VR significantly provided pain relief for the participants in terms of a subjective rating and their brain activity. These authors have also reported the successful use of VR to distract burn patients from pain while receiving daily wound care and during physical therapy following skin grafts. Magora et al. (2006) produced a study to assess the use of VR to control ischemic pain (insufficient blood flow for the needs of the organ). The study consisted of twenty healthy participants who would experience pain through the use of a blood pressure cuff. The duration of their tolerance of the pain was a measured as well as a subjective questionnaire concerning their experience of the pain. The study's results indicated that there was a significant difference between those with VR exposure and those without.

PSYCHOLOGICAL ASSESSMENT AND REHABILITATION

VR can be used in the psychological assessment of mental problems such as schizophrenia or cognitive abilities as well as being used for the rehabilitation of cognitive abilities that may have been caused by brain injuries. Schizophrenia is a chronic mental illness where the sufferer can see and/hear things that do not exist (hallucinations) and can believe things that do not reflect reality (delusions) (NHS Choices, 2009c). There is a misconception that it leads to a split personality in the individuals, but does lead to dysfunction of the thought processes. The causes of the condition are unclear but it is believed that it is partly genetic and environmental. Sorkin et al. (2006) have used VR to diagnose schizophreni by setting a navigational task within a 3D environment and assessing participants' performance. The study used 39 schizophrenia patients and 21 healthy patients, the result of the study was that 85% of the schizophrenia patients were detected using the VR system.

Sorkin et al. (2006) argued that VR can be used as a method of diagnosing schizophrenia. However, the authors pointed out that the patients did not exhibit unusual repetition of response despite stopping the task (perseveration), which is often present in patients with schizophrenia. Hanlon et al. (2006) used another navigational task to assess deficiencies in the hippocampus in the brain exhibited by animals which can aid in the diagnosis of schizophrenia. The research hopes to bridge the gap between human and non-human experimentation through the use of a VR model that was used on non-humans, Morris water task (MTW). The test involves escaping water by various navigational techniques. The hippocampus is used for navigation purposes and short-term memory.

VR can also be used for cognitive rehabilitation purposes. Rose et al. (2006) argue that brain related illnesses such as dementia are on the increase and described them as a 'silent epidemic'. The researchers argue that VR can aid in addressing this problem by providing a stimulating environment. The researchers pointed to studies with non-humans that 'environmental enrichment' (enforced physical interaction with the environment) can help to alleviate the problems associated with not interacting with the environment. Rose et al. (2005) reviewed the use of VR for a number of brain related problems such as 'executive dysfunction' (problems sequencing and organising behaviour), 'memory impairments', 'spatial abilities', 'attention deficits' and 'unilateral visual neglect' (after brain damage to one side of the cerebral hemisphere, they are not able to respond to stimuli in the opposite side of the damage). Marusan et al. (2006) described the development of VR system to aid individuals who suffer from traumatic brain injuries by providing mental rotation tasks within a VR environment. The authors argued that the use of mental imagery is fundamental to cognition and VR can be used for neuro-rehabilitation for those with serious brain damage. Castelnuovo (2006) presents a VR system to aid dysexecutive syndrome, typical of the patients with frontal lobe injuries and other neurological diseases where they have difficulties with executive function, for example planning and forming a strategy. The system called V-Store is a VR system that places the user in a grocery store with a conveyer belt of baskets with fruit on a shelf, and they are given rules as to which basket to place the item. Various conditions can be altered such as the lighting in the store or belt speed modification.

Wiederhold and Wiederhold (2006) have used a VR game to help rehabilitate war veterans with physical as well as mental disabilities. The hypothesis being that by

using VR, they will be more motivated during treatment as the VR game is interactive and encourages body movement. The study used 20 participants with various problems, such as amputees and shoulder injuries. Psychometric tests as well as tests for their physical abilities were to be used by the study. The initial findings when comparing the VR system to traditional methods of rehabilitation indicated that the heart-rate and perspiration were higher for the VR condition than the control of traditional methods and that their enjoyed the experience more with the use of music during the game. Learning disabilities can also be addressed using VR (Tam et al., 2005).

BODY AND MIND

The link between the body and mind in the treatment of physically related problems has also been subject to the use of virtual reality, for example, to treat obesity and sexual dysfunction. Obesity is a growing problem amongst children around the world and can lead to health problems later in life. Manzoni et al. (2008) have suggested that in some cases, overeating is commonly associated with stress, and relaxation methods using a virtual reality system could reduce this level of stress and as a consequence the overeating. The study consisted of 60 obese females. The VR system provided a relaxing environment with relaxing narrative, and this was compared with imagining relaxing images and those that did not have any relaxation methods. The study found that the VR system improved the obese participant's perceived self-efficacy (belief of their capabilities). VR has also been used in the non-typical application of treating sexual dysfunction in males. In a survey conducted in 1998 regarding the effects of sexual dysfunction (http://www.sda.uk.net/), 21% of sufferers said that it was the cause of their relationship to break up and 62% felt of loss of self-esteem. Optale et al. (2006) used a VR system to treat patients with premature ejaculation and impotence. The VR system took them into a forest and presented them with non-erotic video clips about male-identity, taking them to a time when they first discovered their sexuality. The VR system achieved 73% partial or complete success (that is, sex lasting more than 2 minutes). The authors suggest that the virtual reality treatment open new brain pathways or conso-lidated existing ones due to the longevity of the effect of the treatment. VR has also been used in the treatment of anorexia (Riva et al., 1999) as well as body image (Rivo, 1998).

GAMES

Three-dimensional games can be used to teach skills in an entertaining way, providing added motivation to learn. Rizzo (2006) has suggested that VR games offer several attributes for therapy: exposure (modification of existing games to provide exposure therapy), distraction (for example, distraction from pain), motivation (provide motivation for repetitive tasks), measurement (for example, tracking body movements). As pointed out by Brezinka (2008), games have been presented in a negative light with issues such as promoting aggression, lack of exercise and influencing academic achievement. However, they can be beneficial in teaching children teamwork and spatial awareness as well as strategy. Brezinka (2008) has developed a game that has therapeutic content embedded within it to influence children's cognition in a positive way. One of the features of the game is to replace unwanted thoughts with wanted thoughts, and this has been achieved visually within the 'treasure hunt' game. The game had been positively received by both the therapist and child with the disorder. Coyle and Matthews (2006) and Coyle et al. (2005) (http://medialabeurope.org/mindgames/) have developed a game 'Personal Investigator' that uses brief solution focused therapy (BSFT) which is a goal oriented form of therapy. The game is set in a detective agency and allows the patient to set personal goals (concerning a problem that they have) and explores how they can achieve that goal through resources etc., and what it is like to be free of that problem. As they progress through the game and progress to solve their problem, they are rewarded. When they achieve the solution to the goal, they are then promoted to 'master detective'. The authors pointed out that games can often reach adolescents who they suggest can be a difficult group to be receptive to therapy. The authors also suggested that there is an element of game play (making it fun) versus therapeutic consideration. They have noted that the therapists would like more therapeutic dialogue than game play as they argue it may distract the adolescents from their goals. Kalapanidas et al. (2008) advocates a framework for serious gaming.

STRESS

Stress is the feeling we have when we are put under pressure (NHS Choices, 2009d). A certain amount of stress can be good, helping to motivate, however too much stress can cause mental and physical problems. As Villani and Riva (2008) have suggested, stress can lead to chronic health problems, it decreases productivity and leads to an increase in the cost of health care. The authors have developed a VR system to aid sufferers by providing a means of relaxation in combination with other stress management techniques. The VR system was used to exploit the presence capabilities of virtual

environments. The realism of the relaxing environment was used to relieve the participant of stress. The system presented a 3D immersive video with an audio narrative. The participants' heart-rate was monitored in addition to their respiration and their subjective opinion through questionnaires. From their measurements, they found that the VR and audio narrative did affect their emotions in a positive manner.

As previously mentioned, Gerardi et al. (2008) describe the use of a VR system to train soldiers to deal with the stress of war by providing a realistic environment to expose them to the stress levels before going out to Iraq. As Gerardi et al. (2008) have pointed out, the emotional state of the soldier can affect their decision making process under pressure which could have fatal consequences. The VR system would habituate them to the environment to minimize their stress levels.

SOCIAL ENVIRONMENTS

Virtual environments can also have a social aspect with interaction with other users, for example second life (http://secondlife.com/). Such environments consist of avatars that allow social communication with other people and interaction with objects that can provide useful information as well as entertainment. Gorini et al. (2008) have argued that social presence of such environments can aid therapists when treating patients. It can be accessed from anywhere in the world and therapeutic techniques can be simulated in the environment. The authors discussed various second life applications such as for the helping of people with autism by providing a support group where sufferers can help each other and provide advice. It also has the advantages of a simulated environment in that techniques can be practiced, for example socializing in the safety of a virtual environment. However, they also argue that this can also provide risk as vulnerable patients maybe targets for people who would abuse themselves because of their disorder. Nevertheless, security can be put in place to make the 'island' private. The authors also point out that care needs to be taken in the exposure of such environments to patients as they may become accustomed to interacting with avatars and not people in real life. Gorini et al. (2008) also developed a system for the treatment of addiction where they interact with other sufferers and are taught healthy behaviour (or finding alternatives to their addiction).

It has been suggested that virtual humans in a VR environment can produce the same social effects as when interacting with a human. Park and Catrambone (2007) conducted a study whereby they observed whether 'social facilitation' is present with a virtual human as well as a real human. Social facilitation is where generally individuals do an easy task when another person is nearby better than when they are on their own. Oppositely, when people do a hard task and another person is nearby, they generally do that task less well than when they are on their own. The authors found that when a virtual human is present, real humans also react in the same way as if the virtual human was real in terms of social facilitation.

LIMITATIONS OF THREE-DIMENSIONAL THERAPY

Within this review, it has been highlighted that there are many benefits in using 3D technologies in relation to mental health, such as its ability to provide a degree of exposure to the cause of an illness, however, there are some limitations in the applications produced. Cote and Bouchard (2008) have produced a critical review into the use of VR for specific phobias and have noted that the long-term effect of the treatment of the patients has not been examined. Furthermore, many of the studies that they have reviewed contained small sample sizes. In addition to this, they stated that another drawback is the amount of training needed by therapists in order to use the VR system, as well as the cost of the equipment and Cybersickness. Huang and Alessi (1998) have suggested that the complexity of building a VR environment is a disadvantage in its clinical use. In addition, the researchers also point out that the lack of standards in the design of these systems for mental health use also needs to be developed.

WHY IS THREE-DIMENSIONAL THERAPY SO EFFECTIVE?

As pointed out within this review, 3D environment can provide a means of presence with their realism that can be of benefit to those suffering from mental health problems within a safe environment. Morie et al. (2006) suggested that the main advantage of such treatment is that they provide a realistic model of an environment that can be reproduced and the patient can be monitored within that environment. Cote and Bouchard (2008) although critical of some of its features have pointed out that the therapist is able to remove and add stimuli as required to the environment. The authors have also stated that as a form of therapy for phobias, it is less intimidating than being gradually exposed to the real thing, and therefore patient may be more willing to go for treatment. Furthermore, treatment that involves imagining the trauma is subject to the patient's cognitive ability to picture the scenario in their minds, in addition to the therapist being able to control the stimuli.

VR can provide added motivation in the treatment of

mental disorders, for example, as noted earlier, adolescents use three-dimensional games in their daily lives as they are a fun past-time (Thacker, 2003). Using technology to provide therapy can make the process enjoyable as well as beneficial. With the increased use of multiplayer environments, they can also provide a social network that can support them while undergoing treatment which is a common factor in the treatment of problems such as alcohol addiction.

Rizzo and Kim (2005) stated that VR therapy treatment can 'assess and rehabilitate human functional performance under a range of stimulus conditions that are not easily deliverable and controllable in the real world'. In a strengths weaknesses opportunities and threats (SWOT) analysis of VR for therapy, the authors also pointed out that experimental rigour and replication can be maintained within a simulated environment, where variables can be controlled in the experimental set up and repeated. In addition, the authors suggested that VR can offer real-time performance feedback that may not be possible in some real environments.

CONCLUSIONS AND RECOMMENDATIONS

The review has looked at 3D environments for the assessment and treatment of several mental health issues, for example, post-traumatic stress disorder, phobias and ADHD. These illnesses can be debilitating for the sufferer and for those around them. As suggested by much of the research, 3D environments provide a sense of realism and presence that can aid the sufferer by exposing them to the situation they fear in a safe environment. The research suggests that this realism has beneficial effects and that people respond to 3D environment and virtual people emotionally in a similar manner to real environments and real people. The level of emotion in comparison to the real thing needs to be further understood and implies that although 3D environments are not completely realistic, they can prove beneficial in regard to the changing of cognitive behaviour. The potential of this technology to treat mental health issues underlies the level of work undertaken in this area.

As illustrated within this review, there is a huge potential and work being carried out in the use of 3D environments for the treatment of mental health issues. There has been work on addictions, however, more studies are required with bigger sample sizes, potentially, addictions such as gambling can be addressed by providing 'temptation' to the user. There is also an issue of the effectiveness of certain stimuli or approaches to treatment, for example, the content and the method used to address the problem. Exposure therapy might be used in one instance but at what level of narrative is needed to help them overcome their fear, none at all, or some intervention from a therapist, and in what form should that intervention take? These issues need to be addressed in order to provide effective VR systems. Guidelines therefore need to be produced that have been based on empirically sound data.

There is also little work on the use of augmented reality for therapy. The mixture of real and virtual objects may provide opportunities for more realistic scenarios, and there is an issue of whether this mixture is more effective than VR? The potential use of 3D information delivered on mobile phones can also be used to provide information in a graphical format wherever the patient is. This has the advantage of administrating therapy whenever the patient needs it, in almost any situation.

There are also other psychological disorders that may benefit from 3D therapy such as psychosis, paranoia, depression, self-harm, suicidal thoughts and obsessive compulsive disorders (OCD). As well, cognitive and motor impairments due to disease processes (that is, cerebral palsy) and brain/spinal cord injury have also been usefully addressed with VR rehabilitation approaches. By using VR as a complimentary treatment, many of these disorders may be treatable. However, this needs further clarification through additional studies. In addition, due to the vulnerability of some users, care needs to be taken in the design of these systems with extensive input from clinicians as well as the sufferers themselves. Through this careful examination of these disorders, insights into their cause may be gained, and this in turn could lead to their prevention. Furthermore, the long-term effect of these 3D treatments also needs to be examined and fully quantified.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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