3

# Applications of 3D Simulation in Mental Health: Utilities and New Developments

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## 1. Introduction

During the last two decades, there has been growing interest in psychology and psychiatry in the use and possible applications of Virtual Reality and, in general, procedures using 3D simulation environments as a tool applied to both evaluation and treatment of psychopathological disorders. It is well known that the enormous advances in recent years in development of 3D simulation environments have made them increasingly similar to real life, and the flexibility in creating new and ever more complex Virtual Reality programs has made it easier to apply this type of procedure as a supporting tool for intervention in the study, treatment and evaluation of a wide variety of mental disorders.

It should be mentioned that the use of this type of technology is not proposed as a replacement for traditional intervention procedures and evaluation methods, but as a tool to be used within the framework of treatment or evaluation used, whether cognitive-behavioral or other. Therefore, it should be emphasized that the use of 3D simulation environments in clinical practice be understood exclusively in the context of the psychotherapeutic orientation used, where this technique would make senses along with the rest of the practices included in each intervention framework. Its use is therefore not considered alone or as a replacement for other evaluation and treatment procedures used.

As many other researchers in the field of Virtual Reality have mentioned, the use of this type of technology has numerous advantages over traditional treatment and evaluation systems. Some of the main advantages of its use are (Scozzary & Gamberini, 2011; Adams et al., 2009; Botella et al., 2007; Perpiñá et al., 2003):

1. *Experiences similar to real life*. The main characteristic of this technology is that it allows a person to experience something similar to what he might in the real world if he were in that context. Thus VR can cause the same emotions, thoughts, and behavioral responses in general, as if the person were exposed to the real context that is being simulated by VR.
2. *Safety of the Virtual World.* VR environments are presented as a safe context where the person is not exposed to the risks that he would be in the real world. In this sense, the person immersed in the virtual world can experience emotions, thoughts and react knowing that nothing in the virtual environment that really frightens him in the real world can cause him any harm, which allows the context of therapy to be perceived by the person as a safe environment where he can behave freely and without any risk.

3. *Simulation of real world situations.* As we all know, the use of 3D simulation allows any situation in the real world to be realistically recreated. This characteristic is especially relevant in both evaluation and intervention, since it allows the person to be submerged in a virtual world with characteristics similar to those in the real world, where their responses in certain conflictive contexts can be studied, and which could, in turn, improve the ecological validity of measures using VR instruments over the usual procedures.
4. *Presentation of situations at any time*. Another important characteristic of VR is that it enables the desired scene to be simulated at any time, and it is unnecessary to wait until the situation occurs in the real world. This characteristic would allow the patient to be exposed to clinically significant contexts as often as necessary, overcoming the limitation of the usual interventions in which you must wait for a certain event to occur to expose the person to that context.
5. *Control of scenes presented.* The use of VR systems allows the therapist greater control over the stimuli in situations presented. Certain parameters in the scene can be manipulated, for example the intensity of the stimuli presented. In fact it makes evaluation and treatment more flexible and adaptable to each person, as well as the demands of the therapist or researcher.
6. *Confidentiality*. Indeed, the fact that it is unnecessary to expose the person to real contexts, as VR environments make it possible to carry out exposure sessions right in the therapist's office, total confidentiality of participant responses and his treatment are guaranteed, since the use of 3D simulation environments allows the person to be exposed to any context similar to those in real life.

The use of 3D Simulation or Virtual Reality definitely makes it possible to overcome some of the limitations of the usual procedures in both evaluation and treatment of disorders. That is why, as seen in the following section, a growing number of studies have been directed at the application and evaluation of the usefulness and effectiveness of this type of technology applied to clinical psychology.

## 2. Applications of 3D Simulation in the field of mental disorders

As mentioned above, many studies have concentrated on the application and study of the possible usefulness of the use of 3D simulation environments or virtual reality to psychopathological disorders, and at present there are a large number of studies on it. Thus, as suggested by Gutiérrez Maldonado (2002), the study done by Schneider in the eighties in the last century with acrophobic patients, in which he used lenses that could be manipulated to alter the sensation of depth perceived by acrophobic patients, could be considered a first pioneering procedure in the field of VR (Schneider, 1982). Although this type of strategy did not yet use computers, since then there has been growing interest by researchers around the world in possible applications of VR in clinical psychology and psychiatry.

As it is not within the scope of this chapter to describe the many studies that have used VR in a diversity of fields related to mental disorders, we go on below to point out some of the most characteristic, as a sample of some of the main VR applications developed to date for evaluation, treatment and study of psychological disorders.

### 2.1 Treatment of anxiety disorders

The field of anxiety disorders has received the most attention by researchers, who have developed VR scenarios for a diversity of specific phobias, such as fear of spiders, fear of

flying, agoraphobia, social phobia, claustrophobia, panic disorder with agoraphobia or for Post Traumatic Stress Disorder (PTSD), among other disorders (Scozzari & Gamberini, 2011).

The applications developed directed at treatment of anxiety disorders have focused on being able to submerge the person in a VR environment similar to real life where he is gradually exposed to those stimuli or situations which trigger phobic avoidance responses characteristic of persons who show some type of anxiety disorder. The purpose of this exposure is the elimination of the avoidance responses, as well as reduction of the associated emotional and physiological states by getting the person used to the threatening situations avoided until then. It is a way of getting the person used to phobic stimuli avoided to which, as we know, an intense initial response triggered by the situation feared would precede a gradual decrease in the intensity of these experiences, as well as associated avoidance responses. Intervention using a VR environment would therefore pose an alternative to the classic exposure *in vivo* used traditionally as the treatment of choice for phobias and other anxiety disorders at present, in which, as we will see, the use of VR has been shown to be at least equally effective as an exposure technique for treatment of such problems.

### 2.1.1 Fear of flying

The consequences of a phobic response related to fear of flying can become a significant problem causing important social problems and difficulties on the job for people who suffer from it. The huge expense and cost in human resources (buying a plane ticket, travel by therapist, time used outside of the office, etc.) that *in vivo* exposure can cause for the treatment of fear to flying have led researchers to be interested in VR applications to this disorder very early on.

Rothbaum, et al. (1996) evaluated the efficacy of virtual reality exposure therapy in a case study of a person suffering from fear and avoidance of flying diagnosed formally as a specific phobia. To do this, these authors developed a virtual environment that reproduced the interior of an airplane, where the person was seated, exposed to take off and landing as well as several different weather conditions during the flight (calm and storm). The patient, equipped with head-mounted display (HDM) and audio (which reproduced the typical sounds of a flight), was also able to hear the therapist's recommendations during each of the stages of exposure carried out. The results showed the effectiveness of virtual reality exposure therapy (VRET) in reducing fear of flying of the participant. Since then, other case studies have separately demonstrated the effectiveness of virtual reality exposure therapy, for example in a helicopter simulator (North et al., 1997). Furthermore, several controlled studies have demonstrated the effectiveness of this type of VR exposure compared to the usual treatment for this type of problems. Both VRET and *in vivo* exposure proved to be equally effective both in reducing the symptomology and in the number of participants that continued getting on a real plane after treatment. These results were maintained in a 12-month follow-up, and the majority of the participants said that if allowed to choose the type of treatment, they preferred virtual reality to real exposure (Rothbaum, et al., 2000; Rothbaum et al., 2002; Maltby et al., 2002; Mühlberger et al., 2003; Rothbaum et al, 2006; Botella et al., 2004).

### 2.1.2 Acrophobia and claustrophobia

In an attempt to expose people to contexts generated by anxiety, such as fear of closed spaces (claustrophobia) or heights (acrophobia), virtual simulation environments have also

been developed to solve some of the problems exposure usually has, such as going outside the therapist's office. In a controlled study by Rothbaum et al. (1995), the efficacy of virtual reality graded exposure treatment was compared to a group with no treatment. The virtual environments simulated included a bridge or walk over water, balconies and a glass elevator. The results showed significantly better improvement in persons subjected to the VR environments than the group with no treatment. However, in this study, no comparison was made with a group that had undergone the classic *in vivo* exposure. Emmelkamp et al. (2002) developed VR environments for this similar to those used in *in vivo* exposure in order to compare the two treatments. The simulation environments created included a four-story shopping center with stairs and railings, the fire escape ladder of a building and a roof garden on a university building from which the plaza below could be seen. The results showed that VR exposure was as effective as *in vivo* exposure. Something else observed in other studies regarding the effectiveness of this type of treatment in people with acrophobia, is that these results are maintained in follow-ups after several months (Krijn et al., 2004).
The group of Botella and collaborators did a first case study focusing on exposure to enclosed spaces (claustrophobia), in which the patient was exposed to a total of three scenarios with graduating difficulty, recreating a balcony or small garden, a small room with doors and large window and, finally, an even smaller room than the one before with no furniture or windows in it. This exposure with VR reduced all the avoidance and fear measurements, providing evidence on the effectiveness of VR exposure (Botella et al., 1998). These results were confirmed by another controlled study, and after three months, the follow-up showed that exposure with VR was an effective treatment for fear and avoidance behaviors in people with claustrophobia (Botella et al., 2000).

### 2.1.3 Fear of spiders and fear of driving

Fears related to insects, and in particular, fear of spiders, have also received attention by researchers, who have developed Augmented Reality (AR) environments, which are a type of virtual simulation environment in which real-life images not computer-generated are combined with computer-generated images. It could be said that it is a combination of exposure *in vivo*, since the person is seeing the objects and real life events that surround him at all times, and VR images. For example, case studies have been performed in which the person is exposed to virtual spiders, with which the person is able to interact, for example, by picking them up or simply letting them pass over their hands. A first exposure in a case study proved to be successful in reducing fear of spiders, observing after treatment that the patient's dysfunctional behavior related to spiders was reduced considerably, as was, for example, the reduction observed in obsessive-compulsive rituals this person did before treatment (Carlin et al., 1997). García-Palacios et al. (2002) also did a controlled study in which VR treatment was compared to a group without treatment, observing here also the effectiveness of treatment with VR, in which 83% of the participants assigned to the VR group showed a clinically significant improvement compared to 0% observed in the group without treatment.
In a case study dealing with fear of driving, a virtual simulator consisting of six scenarios including different weather and driving conditions, such as snow, fog, rain, etc., was used. The 3D simulation equipment included a steering wheel, controls for accelerator and brake and virtual glasses. In general, persons subjected to these VR environments showed a decrease in their dysfunctional behavior in activities in daily life, showing reduced anxiety

and avoidance, not only after treatment, but also throughout the sessions, and these results were maintained in a follow-up after seven months (Wald & Talor, 2000). Similar results have been observed in other studies, showing that this type of exposure is promising for treatment of people with this type of phobia (Wald & Taylor, 2003).

### 2.1.4 Social phobia and panic disorder

Many studies have concentrated on the study of applications and possible benefits of using VR environments for exposure to social contexts in persons diagnosed with social phobia and specifically, fear of public speaking. The use of VR environments improved some of the problems or limitations presented by *in vivo* exposure as the treatment of choice for this type of problems, given the difficulty of controlling the variables when a person is exposed to this type of social context. Therefore, the use of VR environments provides better control of stimuli, persons and scenarios presented, improves the confidentiality of the participant when exposed to public situations, etc. For example, a study by Anderson et al. (2005) evaluated the usefulness of cognitive-behavioral treatment for anxiety of public speaking with VR in ten persons diagnosed with social phobia or panic disorder with agoraphobia, where the main symptom was fear of public speaking. A scenario with a virtual podium was simulated from which the participant had to talk to an audience which varied in number, and that audience could also be controlled by the therapist, for example, showing them to be interested, bored, etc. After treatment, the participants showed significant improvement in the self-report measures, expressed satisfaction with the treatment and maintained these improvements in a three-month follow-up. The study done by Wallach et al. (2009), in which he carried out a randomized controlled trial in persons diagnosed with phobia of public speaking should also be mentioned. Again, the results showed similar results both for traditional cognitive-behavioral treatment and VR treatment, both showing significantly higher results than those in the group without treatment on the waiting list.

Several controlled studies on panic disorder have been carried out with promising results (Vincelli et al., 2003). For example, the VR program developed by Botella et al. (2007) enabled the perceptions and bodily states associated with a panic attack to be simulated. It was able to simulate palpitations and difficulty breathing, with three intensity or severity levels, visual sensations such as clouded vision, double or tunnel vision. The program consisted of 6 scenarios, a training room, a house, subway, bus, shopping mall and a tunnel. One of the most outstanding characteristics of this VR exposure program was the possibility of controlling the "difficulty" of each of the scenarios available, since it was possible to control the number of people in the scene, the duration of each scene, adversities such as an elevator getting stuck between floors, etc. This VR exposure treatment was then compared to the classic *in vivo* exposure, and to a group on the waiting list (no treatment). Just as in other studies which have compared both types of treatments, the results showed that the improvement observed after the VR treatment was similar to what was observed using *in vivo* exposure, and in turn, both were significantly more effective than the waiting list.

### 2.1.5 Post Traumatic Stress Disorder (PTSD)

Several themes have been used as simulated scenarios by different programs recently developed for the treatment of post traumatic stress disorder (PTSD). There are VR simulators for veterans of the wars in Vietnam, Afghanistan and Iraq, for victims of the attack on the World Trade Center in New York and traffic accidents (Rothbaum et al., 2001;

Difede & Hoffman, 2002; Wiederhold & Wiederhold, 2010). This type of program usually recreates the usual real contexts in this type of situation, for example, a convoy of vehicles going down a road in the desert of Afghanistan, where the convoy is attacked by guerillas who block the road, or a helicopter flying over the jungle in the Vietnam War. One example of these scenarios which has shown good results insofar as the efficacy of this type of technology for the treatment of PTSD is the one developed by Rizzo et al. (2010), which simulates a Middle Eastern city where a market place, devastated streets, checkpoints, ramshackle buildings, warehouses, mosques, shops and dirt lots strewn with junk can be seen. The buildings can be entered. Furthermore, in an attempt to generate as much realism as possible in the scenes simulated, moving vehicles and people walking down the street can be seen outside. Case studies have demonstrated the effectiveness such VR exposure in improving symptoms associated with this disorder (Rothbaum et al., 1999), and controlled studies done to date have also shown the effectiveness of VR exposure in reducing the associated symptoms (Gamito, et al., 2010; MacLay et al., 2011).

### 2.2 Substance abuse and addictive behaviors

An already classic procedure in the study and evaluation of addictive behavior is related to exposure to stimuli and use contexts (cue reactivity) in the field of substance abuse. What is pursued in such procedures is to evaluate the craving response that is triggered by exposure to stimuli and situations related to substance use. Traditionally, this exposure has used videos, photos or imagination. However, the results have not been very promising, both because of the lack of standardization of traditional procedures and little generalization of behavior in therapy with regard to what these persons do when they find themselves in a real drug use context (Bordnick et al. 2004).

VR procedures have been created that consist of presenting the client with different objects and persons related to drug use, by showing him the substances evaluated themselves, objects or "paraphernalia" related to their use, leisure places associated with use, etc., to produce and evaluate the craving response that is triggered by such stimuli. Then this information is used for the treatment, trying to lower the craving response through extinction, change of cognitions and other techniques that have been shown effective for treating these problems.

In the area of addictions, one of the fields that have received the most attention has been treatment of craving behavior and smoking. Bordnick et al. (2004) did a controlled pilot trial in which they compared the intensity of the craving response in 13 participants who were addicted to tobacco when exposed to an immersive VR environment with neutral stimuli and stimuli related to smoking, including an unanimated room where there were objects such as packs of cigarettes, an ashtray, a lighted cigarette, an electric coffee pot, etc. At the same time, in another room, a party is simulated, where other people are smoking and drinking, and they offer the participant a cigarette. The results show a significant effect in the intensity of the craving responses for those situations related to smoking. Based on these results, the authors underline that, in view of the capacity of VR environments for elicitation of craving responses in users, this type of technology is presented as a valid standardized method for the study of addictive behavior. At the present time, these results have been corroborated again by several studies in adult populations (Carter et al., 2008), in young adults aged 19 to 24 (Traylor, et al., 2008), and in teenagers in a case study (Bordnick et al., 2005). VR environments have also been designed for group viewing on a desk top computer

monitor (Baumann & Sayette, 2006), as well as in an internet-based 3D simulation environment (Woodruff et al., 2007). In all the studies cited, results were similar with respect to the effectiveness of VR environments for eliciting craving responses in smokers.

VR environments have been used for alcoholics to diminish the craving response as part of cue-exposure therapy. A study by Lee et al. (2007) used different VR scenarios in which they recreated two types of bars (Western and Oriental), where different types of people (alone or accompanied) appear having a drink. Objects related to drinking, like bottles with alcoholic beverages (beer, whiskey), appetizers next to them, and a poster advertising liquor on the wall are also shown, along with the typical background noise of this kind of establishment. The results showed the effectiveness of the VR cue-exposure therapy in reducing craving. Other studies have concentrated on specifically evaluating whether, as occurs with other substances, exposure to stimuli related with alcoholic consumption trigger craving responses. To do this, Bordnick and his team developed a scene in a kitchen, a party and an office (during a conversation). Viewing these scenes was accompanied by smell and auditory stimuli, with significant results in eliciting craving (Bordnick, et al. 2008). This has been corroborated in other studies comparing the craving responses of drinkers and non-drinkers (Ryan et al., 2010).

Concerning the use of other substances, particularly stimulants, in a study in which a 3D simulation environment was developed for evaluation of craving responses in users of crack-cocaine, shows people using these substances. Again the results backed the effectiveness of this type of VR scenario in eliciting craving (Saladin et al., 2006). This was also found for use of methamphetamines on the Internet using the online platform Second Life (Culbertson, et al., 2010).

Finally, we just point out that these results have also been validated in VR situations for other types of substance, such as cannabis (Bordnick et al., 2009) or heroine (Kuntze et al., 2001). For example, the study on cannabis used two scenarios showing key objects associated with it use, in which one of them showed different objects or paraphernalia related to use of cannabis, while in the other situation, animated characters were observed consuming cannabis.

### 2.3 Food and body image disorders

Various groups of researchers have shown interest in studying the reactions of people with this type of disorder when immersed in VR contexts compared to other types of exposure, because of VR's possible therapeutic applications as a tool for evaluation and treatment of alterations in body image.

One of the groups that have shown the most interest in studying and in the possible applications of VR to this field has been Riva and collaborators. This group created a 3D simulation environment called Virtual Environment for Body Image Modification or VEBIM (Riva, 1999) which was directed at treating body image distortion and dissatisfaction with one's body which is usually associated with this type of disorder. This treatment, which has become known as Experiential Cognitive Therapy, combines traditional cognitive-behavioral intervention with the use of VR environments. Taking a look at the characteristics of 3D simulation environments designed, the first scene is used to weigh the person and find out his real weight. Then two scenes are shown, a kitchen and an office, which show different types of food and drink, where the participant can eat anything, and the program notes the calories in each one eaten. After that, a new scene is shown in which images of models (men and women) are posing like in advertisements for the purpose of

breaking with associated emotions and beliefs. In the following scene, the participant is shown a mirror where he can see her own real image. Again, this exposure is used to apply several different cognitive intervention methods. The last scene consists of a corridor which ends in four rooms of different sizes where the person can only go through the door that coincides with the width of his body. Case studies have shown the effectiveness of this type of treatment in improving awareness of own body image and significantly reducing dissatisfaction with it, and as the authors point out, the person showed strong motivation to change after intervention (Riva et al., 1999). At the same time, these results have been confirmed by other studies with (Riva, et al. 2000) and without controls (Riva et al., 2002, 2003).

Perpiñá et al. (1999, 2002) also developed six VR environments for treating body image, which are very similar to those developed by Riva et al. (1999), recreating scenes similar to those described above, simulating a kitchen where food can be eaten, where the person has to say what his weight is after eating, and his subjective and desired weight. After that, there is a scene with different body constitutions. The following scene simulates two mirrors, where a 3D image of a body in one of them can be varied until the participant thinks it represents his own body. The second-to-the-last scene shows a door where the participant has to calculate the space for his to be able to get through. And in a last scene, different body parts have to be varied and the person is asked to model his subjective and desired body, and the shape that, according to his, a significant other would have of his. These authors compared the effectiveness of the VR treatment described above with cognitive-behavioral treatment for this type of disorder in a controlled study. The results showed significant improvement with both treatments. However, those who were exposed to VR environments showed a significant improvement in general psychopathology measures, measures specific to anxiety disorders, and also more satisfaction with their body in social situations, less negative thinking and attitudes about their own body, less fear of gaining weight, and less fear of reaching their healthy weight (Perpiñá et al., 1999). These results were maintained and even improved one year later (Perpiñá et al., 2004). Another study by these authors should also be mentioned (Perpiñá et al. 2003), this time on binge eating disorder. They developed a virtual environment comprised of a kitchen where different kinds of food with high calory content (pizza, hamburgers, etc.) were shown, and another with low calories, considered safe (apples, salad, etc.). In this scene, the participant had to choose something to eat, and was then asked how anxious he was, urge to binge, guilt and sense of reality of the experience. It was observed that eating in this virtual world triggered responses of anxiety, urge to binge and moderate to high levels of guilt. Furthermore, the participants indicated that it felt very real. These results definitely show the ability of VR to provoke the characteristic responses present in people with binge eating disorders (Perpiñá et al., 2003).

In another study to evaluate the type of responses triggered by VR environments in this type of problem, Letosa-Porta et al. (2005) developed a tool for perfecting some of the technical limitations of previous studies called Body Image Assessment Software (BIAS). BIAS provided greater freedom in modeling body proportions of the virtual person (avatar) to make it as similar as possible to the participant's measurements, and at the same time it allowed modification of specific body parts while maintaining a holistic vision of the avatar. Furthermore, this application was designed to be applied in any desktop computer, which facilitates its use and makes it available to large populations. The authors first evaluated the capacity of this program to produce responses related to exposure to these contexts, such as

anxiety and depression, in people with eating disorders, with positive results (Gutiérrez-Maldonado et al., 2006, 2009). Furthermore, the psychometric characteristics of this VR program were evaluated, showing good reliability and validity (Ferrer-García & Gutiérrez-Maldonado, 2008).

### 2.4 Psychotic disorders

VR applications in the field of psychotic symptoms have focused mainly on the simulation and study of the experiences that these people have, that is, their psychotic symptoms, such as visual and auditory hallucinations, and also, for rehabilitation and evaluation of their cognitive and social skills.

Environments have been developed for evaluation of social skills of schizophrenic patients that are directed at specifically evaluating their social competence or behavior by simulating scenes in which the participant is involved in common conversations, such as being introduced to a stranger, making a date with a friend and talking about business with a person from work (Park et al., 2009). In this study, the usefulness of this virtual simulation program for differentiating significantly between persons with and without diagnosis of schizophrenia was observed in the measure of their functional skills. In another study, the usual treatment for training in social skills with role-playing was compared to VR role-playing. After this comparison, the VR group showed more interest in training in social skills and better generalization of the skills acquired, observing that the VR group acquired more conversational skills and assertiveness than the group with the usual treatment (Park et al., in press). At the same time, continuing with evaluation of activities in daily life, Josmann et al. (2009) used VR environments to simulate a supermarket. This program was designed for use in desktop computers. The main results showed the presence of statistically significantly differences in the action of schizophrenic subjects and those without any clinical diagnosis in this context. This again supports the use of VR systems in this type of population.

Freeman and collaborators have performed several studies on psychotic symptoms in the general population, assessing paranoid ideation in particular. They evaluated the effectiveness of VR environments for producing persecutory thinking in a non-clinical university population (Freeman et al., 2003), in which they simulated a library with different neutral avatars. Although most of the participants attributed positive attitudes to the characters, a few had referenced ideas and attributed ideas of persecution to the different characters that appeared. Later, in another study, the effect of virtual exposure in a scene in a subway car was evaluated in a clinical and non-clinical population (Fornells-Ambrojo et al. 2008), and in a non-clinical group alone (Freeman et al. 2008). The promising results showed that both populations had a high proportion of persecutory thinking and ideas related to the situation and the characters included in the 3D simulation of the subway car.

The Virtual Reality Apartment Medication Management Assessment (VRAMMA) was created for evaluating medication management skills in schizophrenic subjects. This VR program simulates an apartment in which the person is evaluated for the type and time of use of psychiatric drugs to find out how well he follows medication treatments, shown by the people in the VR context, and to validate the instrument used for such purposes. Results were significant insofar as it differentiated correctly between the actions of schizophrenic subjects and those with no diagnosis, observing more errors in those with schizophrenia in both the number of pills taken and the right time to take them (Kurtz, et al.2007).

Finally, programs have also been developed to simulate the type of visual and auditory hallucinations that schizophrenic persons may have. For example, a living room where voices are heard and different visual hallucinations, such as a picture frame in which the persons face or expression changes, the television turns on or off by itself, etc. In this same project, in a second stage to increase the realism of the hallucinations used, a psychiatric ward was recreated where the type of auditory and visual hallucination of a particular patient could be simulated. In this new scenario, an image of the Virgin Mary appears and speaks to the participant, and other animations, such as the word "death" in the headlines of a newspaper, or random flashes of light, which were included in this study, according to the patients themselves, were closer to the type of hallucinatory experiences that these people usually have. Finally, it should be mentioned that these scenes were developed for use in personal computers, thereby guaranteeing wider diffusion of this program among students and mental-health-care center workers (Banks, et al., 2004). Another study, by Yellowlees & Cook (2006) recreated a psychiatric ward which included self-critical voices, a television on which someone is criticizing the patient, and a mirror in which the person reflected seems to be dying. Among the participants in this study who used the program, 76% said that the simulated scenes improved their knowledge of auditory hallucinations and 69% of visual hallucinations.

### 2.5 Other disorders

Having reviewed the main disorders VR has been applied to, some of the most relevant studies concentrating on the possible utility of VR for application in other disorders are described below.

In first place, one field that has received much attention because of the possible advantages to be derived from the use of VR has been the evaluation of Attention Deficit Hyperactivity Disorder (ADHD). The main application of VR to this type of disorder has been directed at persons by adapting more commonly used computerized evaluation tools, such as the Continuous Performance Task (CPT), to evaluation of this type of behavior. The possibility of the therapist experimentally controlling the distracting stimuli that are presented in the 3D simulator enables these attention evaluation tasks to be perfected, and therefore to improve the ecological validity of the measures used. For example, Rizzo et al. (2001) developed a virtual classroom for evaluation of attention and the deficits associated with hyperactivity, in which the usual elements that appear in this context, like a teacher, desks, a window with a view outside, etc. are simulated. In this context, the child had to respond to certain auditory and visual stimuli, similar to traditional sustained attention tests, and also provides the evaluator with the possibility of using sounds, simulated objects or a combination of both distractions for the task. Later, other authors have evaluated the effectiveness of this program for evaluating children with this type of problem. The Continuous Performance Task Virtual Classroom has been demonstrated to be sensitive for discriminating between students with ADHD and those without, and could also have advantages for other similar measures insofar as its validity given the similarity of VR simulated scenarios to real life (Adams, et al., 2009).

In the field of cognitive rehabilitation, one of the applications that is awakening the most interest in researchers is the use of VR for improving the skills of patients with some disorder in the autistic spectrum. Several tools have been developed in which virtual worlds are created that are being used for training certain deficient skills in people with this type of

diagnosis. The study by Strickland et al. (1996) marked the beginning of VR program development for evaluating functional skills in daily life, such as training how to cross a street with cars in it. In the last ten years, other more recent studies have pursued evaluating the potential usefulness of VR as a tool to develop social skills in children with autistic disorder. Several simulated scenarios have been developed for this, such as a bar where two people are sitting talking to see whether the participant avoids getting between them according to social conventions, or whether he steps on flowers and plants in a park, or in a typical social situation in a café. In general, good results have been found that show evidence of the usefulness of VR as a technique for study and improvement of social skills in persons with this type of disorder (Mitchell et al., 2007, Parsons et al., 2004, Parsons et al., 2005).

## 3. New developments in 3D simulation

After reviewing some studies that have used VR environments in their applications to different mental disorders, two new developments of this type of technology for addictions and other related mental problems are described below.

### 3.1 My-School: Detection of drug use and bullying in young people using 3D simulation environments

The group directed by Adolfo J. Cangas and collaborators from Spain has developed a three-dimensional simulation tool for evaluation called My-School (MS), which is specifically directed at detecting drug use and bullying in young people of school ages.

The MS program, which was designed to be used in personal computers (Windows), consists of 17 scenes through which participant reactions to conflictive situations are evaluated. MS recreates some of the most significant situations in which drug use and bullying problems usually appear to young people in educational, family and leisure contexts. The specific scenes recreated in MS take place in the school playground, in a classroom, in a park and at the participant's home. The participant finds himself immersed, in the style of contemporary video-games, in scenes where he is faced with different conflictive situations and has to say what he would do in each.

In general, scenes related to bullying show situations in which the participant is bullied by schoolmates, another in which he sees how another schoolmate is bullied and one in which it is the participant who is bullying another student. The substance use scenes evaluate use of alcohol, tobacco, cannabis, MDMA or "ecstasy" and cocaine. The My-School 3D program also evaluates family dynamics, and their relations with other students (Carmona et al., 2010a).

My-School has been shown to have good psychometric properties showing adequate reliability and construct validity, and above all, has shown its usefulness in early detection of substance use, particularly alcohol, tobacco and cannabis (Carmona et al., in press; Carmona et al., 2010), as well as for detection of cocaine and MDMA or "ecstasy" (Carmona, et al., 2010b). In conclusion, My-School is presented as a new 3D simulation application that has shown its usefulness for the detection of risk behaviors in young students. At present, this same group is improving the graphic engine of the original program to increase the realism of the scenes, the characters and interactions included in the first version in addition to developing new scenes related to behaviors associated with eating disorders. On the other hand, it is being adapted for direct application online over the Internet. In this sense,

the MS program only needs an ordinary PC for its use, which would allow it to be applied to large populations, thus facilitating its diffusion and application.

### 3.2 The Playmancer Project: A video game for the treatment of addictive behaviors in adults

The main purpose of the European Playmancer Project is the creation, development and validation of a video game (serious game) directed at treatment of mental disorders and rehabilitation of people with chronic pain.

This research group has developed a video game for treatment of mental disorders specifically directed at persons with eating disorders and pathological gambling. The game scenario is an adventure game called Islands where the patient is confronted with various challenging situations, in which the affective state of the patient has a strong influence on the game. The aim is to change underlying attitudinal, cognitive-behavioral and emotional processes of patients in order to teach the patient to control his emotions, plan and learn to relax when he finds himself immersed in conflictive situations. These same scenes are used for rehabilitation of chronic pain, by attempting to improve physical functions, including inadaptive cognitions and emotions related to pain, for example, fear of moving (Moussa & Magnenant, 2009).

Although at present the Islands video game is still under evaluation and validation of its clinical efficacy, preliminary results with this 3D simulation tool have already shown that there is a relationship between playing the video game and the appearance of emotional and physiological reactions associated with its use (Jiménez-Murcia et al., 2009). It is therefore being shown to be a promising tool in the area of use of new technologies and, specifically in video games (serious games) for mental illnesses, given its capacity to provoke specific cognitive and emotional reactions.

## 4. Conclusion

This chapter has reviewed some of the main studies that concentrate on possible applications of virtual reality (VR) to the field of study, evaluation and treatment of mental disorders.

The main clinical studies that have used VR environments in their application to different mental disorders have focused on evaluating the usefulness of these scenarios for generating the behavioral, cognitive and emotional reactions in the person immersed in the virtual world that these same contexts would produce in real life, something which has been widely proven in the many applications studied (e.g., Bordnick et al., 2008; Ferrer-García et al., 2009; Culbertson et al., 2010). Moreover, a large number of studies have concentrated on comparing the effectiveness of this new type of treatment with VR with the usual interventions used, and to date, many case studies, non-systematic studies and controlled studies have shown the effectiveness of VR treatments in a wide range of disorders, such as anxiety, eating disorders, or in addictions, among other alterations (Gutiérrez-Maldonado, 2002). Specifically, in the studies reviewed in this chapter, Virtual Reality Exposure Therapy (VRET) has been shown to be at least equally effective as *in vivo* exposure in the framework of traditional cognitive-behavioral treatments for this type of disorder, and significantly more effective than absence of treatment (Riva, 2005; Scozzari & Gamberini, 2011). The use of VR environments has also been shown by several authors to have certain advantages over classic *in vivo* exposure, for example not having to wait until a certain event occurs in real

life, greater control by the therapist of the stimuli and situations presented to the participant or the safety of this kind of environments, as nothing the person is afraid of really happens in the virtual world (Perpiñá et al, 2003).

It might be mentioned that to date, studies concentrating specifically on comparison of treatment by traditional exposure with exposure to 3D simulations have not been many compared the much more numerous studies evaluating the usefulness of 3D environments for triggering certain responses in persons exposed to these contexts. So focusing on the comparison of the two types of treatment, several questions could be pointed out.

In first place, several of the abovementioned studies have demonstrated that, in general, the effectiveness of the two types of treatment in their application to people with different types of mental disorders is very similar. Specifically, as discussed above, both procedures are equally effective in the various clinical applications studied (Scozzary & Gamberini, 2011). However, the choice of one or the other treatment (virtual reality exposure versus *in vivo* exposure) could be influenced by some of the characteristics that are derived from the use of 3D simulation environments instead of the classic exposure usually used. For example, the preference of some people with fear of spiders for one treatment or the other was evaluated, and significantly more motivation was found for participating in the VR exposure treatment than the traditional one, which could lead to more people unwilling to go through *in vivo* treatment accepting this type of treatment because of the greater acceptance and motivation generated by 3D simulation environments (García-Palacios et al., 2001). Furthermore, it has been observed that people who are subjected to this kind of 3D simulation environment prefer this type of procedures with VR to the classic *in vivo* exposure in the real world (Rothbaum et al., 2000, 2006). On the contrary, there is also evidence concerning possible advantages in using *in vivo* exposure instead of VR exposure, as shown by Wolitzky-Taylor et al. (2008), who found after a meta-analysis study in which the effectiveness of this treatment was compared to VR exposure for various specific phobias, that *in vivo* treatment is more effective than other types of interventions right after the application of the treatment, including VR exposure among these other interventions. Nevertheless, in the follow-up, that is, in the long-term, these differences were not maintained, and both VR and *in vivo* exposure treatments were equally effective. As similar results back both the usefulness and effectiveness of treatment with VR and traditional treatment usually used, the selection of one or the other would therefore be a matter of psychotherapist choice, depending on other variables, such as the inclination or preference of the patient for one or the other type of treatment, the time or cost of the treatment chosen, or the personal preference of the therapist, keeping in mind the empirical evidence backing the choice of one or the other.

In view of the results found in the various studies reviewed here, the use of 3D simulation environments is shown to be a promising tool in the area of evaluation, treatment and study of mental disorders, having demonstrated its usefulness and effectiveness in a wide variety of studies made to date.

Finally, it should be mentioned that future VR environment developments should make acquisition and use of 3D simulation systems in clinical practice less expensive. In this sense, several studies have shown that it is unnecessary to use costly 3D simulation systems (Krijn et al., 2004; Letosa-Porta et al., 2005; Carmona et al., in press). One of the great challenges for the future of VR environment development is therefore creation of effective 3D simulation programs which were more economical and easy to use, and thus more affordable to more

therapists interested in the advantages of this type of technology for use in clinical practice and research.

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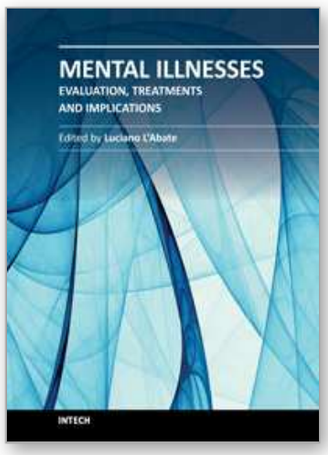


**Mental Illnesses - Evaluation, Treatments and Implications**
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In the book "Mental Illnesses - Evaluation, Treatments and Implications" attention is focused on background factors underlying mental illness. It is crucial that mental illness be evaluated thoroughly if we want to understand its nature, predict its long-term outcome, and treat it with specific rather than generic treatment, such as pharmacotherapy for instance. Additionally, community-wide and cognitive-behavioral approaches need to be combined to decrease the severity of symptoms of mental illness. Unfortunately, those who should profit the most by combination of treatments, often times refuse treatment or show poor adherence to treatment maintenance. Most importantly, what are the implications of the above for the mental health community? Mental illness cannot be treated with one single form of treatment. Combined individual, community, and socially-oriented treatments, including recent distance-writing technologies will hopefully allow a more integrated approach to decrease mental illness world-wide.

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