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MII-School: A 3d videogame for the early detection of abuse of substances, bullying, and mental disorders in adolescents

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The current research deals with the preparation and application of an assessment tool aimed at the early detection of drug use, bullying and mental disorders in Secondary Education students in school, family and spare time context. The assessment program we have designed uses 3D virtual environments to realistically recreate, in the style of current videogames, the contexts of drug abuse, bullying and family problems which usually occur during the teenage years. The Mii-School program consist of 17 stages of detailed three-dimensional simulation in which various avatars interact, causing problematic situations in which the participant must choose how he would behave, given the different response choices offered. The program then includes the different response styles of the participant in the situations presented. This would be very relevant from a preventive and therapeutic point of view, as it provides the possibility of knowing what persons would be in a risk situation and their responses in the above mentioned contexts.

Key words: Virtual reality, psychological assessment, drug abuse, bullying, mental disorders.

MII-SCHOOL: un videojego 3D para la detección temprana de abuso de sustancias, acoso escolar y trastornos mentales en adolescentes. La presente investigación trata sobre la preparación y aplicación de una herramienta de evaluación orientada a la detección precoz de conductas de consumo de drogas, acoso escolar y trastornos mentales en contextos escolares, familiares y de ocio, dirigido a estudiantes de Enseñanza Secundaria. El programa de evaluación diseñado utiliza entornos virtuales en 3D que recrean de manera realista, al estilo de los actuales videojuegos, los contextos de consumo de drogas, acoso escolar y dificultades en las relaciones familiares que usualmente ocurren durante la adolescencia. El programa Mii-School consta de 17 escenarios de simulación tridimensional en donde diversos personajes que interactúan entre sí provocan situaciones conflictivas ante las cuales el participante ha de elegir cómo debería comportarse, dadas las diferentes estilos de respuesta que se le ofrecen. Después, el programa incluye los diferentes estilos de respuestas del participante ante las situaciones planteadas. Desde un punto de vista preventivo y terapéutico creemos que es muy relevante por cuanto da información de qué personas se encuentran en situación de riesgo en función del que tipo de respuestas dan cuando se encuentran inmersos en dichos contextos.

Palabras Clave: Realidad Virtual, evaluación psicológica, abuso de drogas, bullying, trastornos mentales.

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Since the nineties, a gradual increase in virtual reality (VR) applications has been observed in the field of psychology, both in evaluation and as an aid to psychological treatment for diverse disorders, to the point where the term, *Virtual Reality Exposure Therapy* (VRET) has been coined for those treatments that use virtual environments as an intervention tool.

When virtual reality was first applied to the clinical setting, it was as a technique for intervention in various specific phobias, such as acrophobia or fear of heights, claustrophobia, phobia of insects, fear of flying, etc., and in general, for other anxiety disorders, such as social phobias, posttraumatic stress disorder and panic disorder with or without agoraphobia (Pull, 2005; Botella, García-Palacios, Baños & Quero, 2007; Anderson, Jacobs & Rothbaum, 2004). The use of virtual reality applied to these and other disorders was mainly used as part of the psychological exposure techniques to stimuli triggering fear behavior (essential for its treatment). That is, the use of VR would allow the patient to be gradually introduced in virtual computer-generated contexts in which those stimuli the person fears (insects, public places, heights, people, etc.) would appear.

VR has also been used in a similar manner for the treatment of addictions, by designing virtual scenarios where the patient is exposed to certain key contextual situations (certain drugs, casino slot machines, and places of leisure where substances are used, etc.) in order to cause craving response. Such intervention concentrates on diminishing craving through extinction processes, cognition change, and other psychological techniques (Saladin, Brady, Graap & Rothbaum 2006; Bordnick *et al.*, 2008; Barkley, Murphy, O'Connell, Anderson & Connor, 2006; Woodruff, Conway, Edwards, Elliot & Crittenden, 2007; Bordnick *et al.*, 2004).

From that time on, VR was also used in other disorders, such as autistic disorders (Mitchell, Parsons & Leonard, 2007; Parsons, Mitchell & Leonard, 2004; Parsons, Mitchell & Leonard, 2005; Herrera, Jordan & Vera, 2006) and the rehabilitation of skills deteriorated by brain damage, and in the study of neuropsychological processes (Schultheis, Himelstein & Rizzo, 2007; Plancher, Nicolas & Piolino, 2008). Other studies have also appeared showing their effectiveness for treatment of eating behavior disorders. In this respect, VR has been used for the treatment of changes in body image in the framework of current cognitive-behavioral intervention (Perpiñá, Botella & Baños, 2003), and for compulsive eating (binges). In these studies, different scenarios are represented in VR, where both the perceptions of the person's own body image and disadaptive behavior are evaluated so it can be changed, at the same time the person is exposed to certain things he fears, such as placing the patient in front of food and observing his reaction. VR treatments have thus been shown in several preliminary studies to be at least as effective as the reference treatments they are compared to, and the VR-treated groups even show a slight improvement over the standard treatment groups (Riva *et al.*, 2000; Botella *et al.*, 2007).

Another promising line of research uses VR to improve comprehension and treatment of psychotic disorders. Virtual scenarios have been developed to evaluate the skills psychotic patients have for handling medication (Kurtz, Baker, Pearlson & Astur, 2007). Virtual worlds have also been used in teaching, what hallucinations are and what

they are like in persons with psychoses (Yellowlees & Cook 2006; Banks *et al.*, 2004). Nevertheless, the most outstanding research has used virtual scenarios (a library, a subway car, etc.) to study paranoid ideation in clinical and nonclinical (without psychiatric diagnosis) populations (Freeman 2008; Freeman *et al.*, 2003; Fornells-Ambrojo *et al.*, 2008; Freeman *et al.*, 2008).

In recent years, several studies have appeared that have directed the application and study of virtual technology to the field of education, (Freitas and Neumann 2009; Kim, Park & Baek, in press), related to the evaluation of attention deficit disorders and the treatment of school phobia and test anxiety (Gutiérrez-Maldonado, Alsina-Jurnet, Carvallo-Becíu, Letosa-Porta & Magallón-Neri, 2007), interpersonal or behavior problems that usually appear in these contexts, such as the case of bullying in schools. In this context, a software called "FearNot!", designed to fight bullying problems in primary education by staging situations in which the 3-dimensional characters are bullied in a virtual school setting, should be mentioned. This software was conceived as an intervention tool for use with students involved in this type of problem (Zoll, Enz, Schaub, Aylett & Paiva, 2006).

The use of VR has definitely concentrated on the study and treatment of various different mental disorders. However, up to now, VR has not been used as a tool to detect mental or other behavioral problems common in school contexts, as for example, drug abuse, or bullying.

Possibilities and limitations of VR as an evaluation and intervention tool

It is important to emphasize that the current psychological tests using pencil and paper show several limitations, such as faking answers, occasional difficulty in seeing the perspective, when asked how one would react in a hypothetical situation in which the participant has never been involved in real life, for example, or when there is "decontextualization" of the participant because the questions are phrased in an overly simplified manner, without a detailed description of the circumstances or the context in which the question is asked.

As several different authors have emphasized, the use of VR would have advantages over other traditional psychological evaluation and intervention techniques (Perpiñá *et al.*, 2003; Botella *et al.*, 2007). Some of these are:

1. In the first place, as observed by both patients and the researchers themselves, the use of VR allows the person to experience reactions (emotions, feelings, etc.) similar to those that he would experience in a like situation in the real world, so we could recreate, simply and comfortably, the real-life situation in which the patient reacts that way.
2. Related to the above, VR would enable the therapist to control and modify the stimuli depending on the patient's own need during treatment, that is, the therapist has control over the stimuli that appear in the virtual world. For example, gradually increasing the complexity of the scenarios or how threatening the stimuli are, etc., making VR a flexible treatment adaptable to each person.

3. We can therefore affirm that another of the advantages is that VR is conceived as a "safe world", in which nothing that the patient sees can cause him any real harm. This would be especially useful for those persons who are not willing to expose themselves to certain live situations, or else have difficulties in imagining them. To this would be added the fact that patients say they feel more comfortable faced with a computer simulation than in the real life situation.
4. At the present time, the use of virtual environments similar to those in commercial videogames, because they are so widespread and so immensely popular, that it appears a priori to be an attractive tool, which attracts and is accepted by most people today, especially the youngest (Kim *et al.*, in press).
5. Since it has been observed that the reactions to a virtual scenario are similar to those the person experiences in real life, VR has the advantage of being able to provide us in advance with information on how a person would behave or react in a certain situation before it arises in real life. This would allow us to know beforehand what type of behavior it would be necessary to intervene in.

So, keeping in mind the advantages that would be derived from using VR in its possible applications to studying, evaluating and treating psychological problems, we thought this technology would be ideal for the major problems that usually appear at an early age in school contexts. We therefore present below the characteristics and development of the program called "Mii-School".

VR Simulator description: Mii-School

Technical characteristics

The "*Mii-School"* simulator was developed with the Blender *open source* software (Hess, 2007), one of the programs most widely used in the world of 3D design and animation based on the Python programming language. *Mii-School* does not have any pre-rendered animations. It is an interactive program in which all of the animations are executed in real time like videogames.

Simulated scenes

During the execution of *Mii-School*, the student watches a total of 17 interwoven scenes studying different aspects of his behavior related to bullying, drug addiction, family life, capacity for attention in class and integration in social groups.

There are a total of 5 scenes that study bullying. In some of them, the student is bullied by his schoolmates and in others he himself becomes the bully. This way bullying can be studied from several perspectives. More concrete cases are also studied, for example, the reaction of the student to the explicit violence of physical aggression in the schoolyard to see if he is a mediator or, to the contrary, violent. For each bullying scene, the student may select from a series of choices that almost always follow a general, well-defined pattern: feeling indifferent to the bullies, protesting, responding ironically, running away in fear, facing up to them or feeling ashamed.

During the 6 drug use scenes, the drug offered becomes gradually more dangerous. In the first scene, the student is tempted by his schoolmates to smoke in the school playground during recreation. In the second scene, he is invited to drink liquor while having a pizza at a friend's house. Afterwards, he is offered a joint of marihuana in a park. In the last two scenes, the risk is upped further when his friends offer him much more dangerous drugs, such as cocaine or ecstasy. The choices the student can make in the drug addiction scenes also usually follow a general scheme: usually use, refuse to try the drug, advise friends to stop taking it, use occasionally or leave because he feels uncomfortable (Figure 1).

Figure 1. Drug addiction detection scene

The student's relationship with his parents is also studied in three scenes: one scene checks the father's behavior, another, the mother's attitude and a third both. In the first two scenes, the student gets home much later than the hour agreed upon and checks whether the father or the mother scold him, threaten him or, on the contrary, are indifferent to his undisciplined behavior. In the third scene, the student gets home after school and feels anxious because he has problems with his studies and it checks whether his parents become involved in his problems or are indifferent to them. There are other scenes where personality-related problems and the student's mood, attention in class, beliefs and integration in social groups are checked.

Development methodology

The Mii-School program was technically developed entirely with the Blender tool. The development process was done in different stages.

Design

During this first stage, the 3D wireframe mode meshes were created for the virtual scenarios and characters that appear in the scenes (Roosendaal & Selleri, 2005). The Mii-School simulation takes place in four different scenarios: the school playground, the classroom, the main character's home and a park. Nevertheless, each scenario is made up in turn of several zones (for example, the home has several rooms,

the playground has an area with benches, another for sports, etc.) so that a different zone is used for each of the scenes so the user does not get the impression that the scenarios are being repeated and gives more of a feeling of variety. A total of 30 persons were created: several male and female students of different races and social conditions, the teacher who is teaching in the classroom, the student's parents, etc. All of the Mii-School 3D models were created using basic and advanced design techniques included in Blender: and finally, smoothing filters were applied for smoother surfaces without overly increasing the number of polygons.

Animation.

When the models had been designed, we proceeded to the animation stage by first creating skeletons associated with the characters' 3D wireforms, and then capturing movement using a series of intermediate poses with the aid of a technique called "inverse kinematics (Hess, 2008).

Animation of the characters was divided into two large groups: body and facial. Body animation affects the character's whole body. We implemented several types of body animation in which the characters perform some kind of action: walking, sitting, hitting, threatening, lying down, fighting, smoking, drinking, etc.

Face animations were developed focusing on the character's face in more detail to increase expression and realism of the body animations. So if one character is threatening another in a given scene, his face expresses aggressiveness, or if on the contrary, a character feels threatened, his face shows fear. To accomplish this level of expression in the characters' faces, the number of polygons and level of detail increases noticeably in eyes and lips, the zones most affected (Figure 2).

Figure 2. Scene for detecting use of alcohol

Final Program

The simulation of all the Mii-School scenes lasts approximately 40 minutes. The student can choose his sex at the beginning of the game to personalize the

animations to his own gender. Background music has been entered in the scenes and audio in the conversations to achieve more realism.

RESULTS

Preliminary results

Described below are the first results of a pilot study carried with a first application of the Mii-School (MS) program. Specifically, it was intended to evaluate the validity of the MS questionnaire in detecting behavior showing risk of substance use and bullying by comparing the answers given by the participants in the various scenes simulated in MS with two pencil and paper questionnaires directed at detecting substance use and bullying.

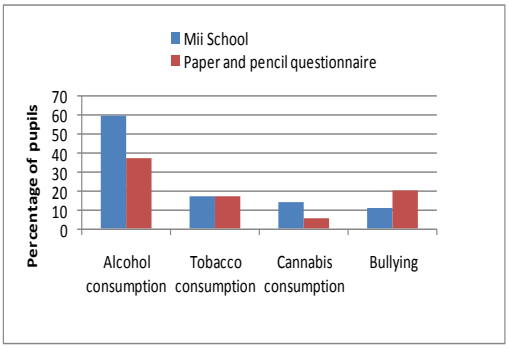
35 students (16 boys and 19 girls) of 1st, 2nd, 3rd and 4th year Secondary Education (*Educación Secundaria Obligatoria*) from a publicly subsidized private school in the province of Almería (Spain) took part in this study. Their ages ranged from 14 to 17 with a mean age of 15.29 (SD=0.95).

Along with the MS questionnaire, the United Nations Office for Drug Control and Crime Prevention's *Questionnaire on Drug Use* (DU) (2003) and Perceived Bullying (*Acoso Escolar Percibido*) (PB) by Manga, Abella, Barrio & Álvarez (2007) were used to collect the information.

As may be observed in Graph 1, in substance use, a larger percentage of participants said they had used alcoholic beverages and cannabis on the MS questionnaire than on the pencil and paper questionnaire. Looking at cigarette smoking, the percentage of student users was the same on the MS as on the paper and pencil questionnaire.

With regard to evaluation of bullying, a lower percentage of students said they were being bullied on the MS, and the percentage bullied was higher according to the answers given on the pencil and paper questionnaire.

Graph 1. Comparison between Mii-School and paper and pencil questionnaires



On the other hand, as the MS questionnaire was not only developed to detect substance use and bullying, but also to evaluate the type of answers the participants give when they find themselves immersed in conflictive bullying and substance use situations, allowed us to find out the specific risk response styles associated with these conflictive situations. In this sense, on the MS it was observed that consumers of alcoholic beverages, cigarettes and cannabis answered *trying* or *habitually using* substances when they are offered by friends. Non-users answered *rejecting* the offer, *warning* that using the substances is dangerous or even *leaving*. With respect to bullying, bullied students answered *ashamed* and simulated *not listening to* insults, as well as being *nervous, keeping to themselves* and *avoiding* others. Those who were not bullied answered insults from others *sarcastically, insulting them back*, and even with *violent threats.* During recess they usually *joined their friends* and *had a good time*.

DISCUSSION

In recent years, Virtual Reality applied to different areas of psychology has proliferated widely, especially in the treatment of a diversity of mental disorders, and has been shown to be a promising technique as a tool for their research, evaluation and treatment. The evaluation tool called Mii-School, developed by the authors of this article, has been presented. It is directed at the detection of drug abuse, and bullying in students of Secondary Education. This tool uses 3-dimensional virtual scenarios to recreate conflictive situations (drug abuse, bullying, family problems, etc.) in which such behavior usually appears.

Although there are some precedents based on the use of VR applied to these problems, Mii-School is innovative because it approaches them together, through different virtual scenarios created for the purpose, since it is considered important for an analysis to include several different types of behavior at the same time, as problematic behaviors are usually related to each other in real life (Mass, Bardong, Kindl & Dahme 2001; Dumas *et al.*, 2002; Kaltiala-Heino, Rimpelä, Rantanen & Rimpelä, 2000; Adalbjarnardottir & Rafnsson 2002; Gutiérrez-Rojas, De Irala & Martínez-González, 2006; González, García-Señorán & González, 1996).

The above results from the first pilot study with Mii-School show that it is sensitive to both detection of drug consumption and bullying and records the risk response styles related to these conflictive situations. Specifically, Mii-School found a larger percentage of drug users among the participants than the pencil and paper questionnaire because participants could respond more sincerely to the electronic format than to the usual one, and as shown by various studies, there is evidence that the type of drug use evaluation employed, whether electronic, paper and pencil or direct interview, etc., can cause the answers to change (McCabe, Boyd, Young, Crawford & Pope, 2005)

when what is being evaluated is illegal conduct, behavior causing social rejection or that is looked down upon by the community (Sudman, 2001). The lower percentage of students that show bullying in Mii-School than in the paper and pencil questionnaire may be because the bullying scenes simulated in Mii-School do not include all of the situations representative of bullying that appear in school contexts and there may be other situations not simulated in Mii-School. This in turn could have combined with the fact that the bullying scenes simulated in Mii-School may represent situations that do not coincide exactly in intensity or severity with those that usually occur in real life.

Due to the serious repercussions that certain problematic behaviors such as those referred to here can have on students, the use of tools like Mii-School that are capable of their early detection take on special relevance. In this sense, we believe that the Mii-School program, thanks to the use of VR, could help us to improve the detection of those students that are at risk, as it allows us to introduce the person in virtual scenarios similar to those in real life, with the possibility of acquiring information on how the person reacts or would react in such conflictive situations and also know which students would be at risk, with a view to later treatment, once we know what behavior it is necessary to intervene in. The Mii-School program, more than finding out whether or not certain behavior exists, concentrates precisely on finding and recording the behavioral styles the student would have in these situations.

Mii-School would definitely bring together the set of techniques based on VR applied to the area of psychological disorders. In this sense we believe that it may be a promising tool in the field of VR applications for problems of coexistence and behavior disorders that appear in school contexts.

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