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EDITORIAL

Welcome to the second issue of the *Journal of CyberTherapy & Rehabilitation* (JCR). This peer-reviewed academic journal continues to explore the uses of advanced technologies for therapy, training, education, prevention, and rehabilitation. JCR is a quarterly published academic journal, which focuses on the rapidly expanding worldwide trend of moving toward technological applications in healthcare. Our main interests include, but are not limited to, psychiatry, psychology, physical medicine and rehabilitation, neurology, occupational therapy, physical therapy, cognitive rehabilitation, neurorehabilitation, oncology, obesity, eating disorders, and autism, among many others.

Advanced technologies such as virtual reality (VR), robotics, non-invasive physiological monitoring, E-health, and adaptive displays are being applied to several areas of healthcare. New areas of research regarding the use of advanced technologies in healthcare are transforming this ever-changing field revealing new discoveries, aiding patients with both mental and physical disorders.

Since the debut of our inaugural issue, JCR has received international attention from peers, international institutions, and international conferences. The JCR is the official journal of the International Association of CyberTherapy & Rehabilitation (IACR) and the official journal of the CyberTherapy Conference series, the fourteenth annual conference will be held in Verbania next June, which has gained interest from European high-level conferences on healthcare to Ministers of Health all over the European continent. The IACR has recently collaborated with Med-e-Tel 2009, an international annual telehealth conference that draws an enormous and diverse attendance, after Med-e-Tel's 2008 addition of telepsychiatry, to bring cybertherapy to another innovative field of healthcare. Both the Association and the Journal have been invited to European conferences on health and wellbeing, which has opened many doors for opportunities through our gained publicity. "Healthcare in Europe needs to change," remarked Zofija Mazej-Kukovic, Slovenian Minister of Health and currently holding the European Union Presidency, while interviewing for the JCR. "I look forward to working with as many possible partners and organizations in the future."

This issue of JCR features comprehensive articles by preeminent scholars in the field. This issue's reviews and studies include some of the most promising applications for technology in therapy and rehabilitation, surveying the concepts and studies that laid the groundwork for the field up to this point. In the previous issue, the focus of the articles were an introduction for those new to the field as well as an expansion of knowledge of those well-established in their careers with newer applications for technology in healthcare. This issue has many new and innovative expansions on cybertherapy and healthcare in more focused fields. It is exciting to see the JCR evolve into new aspects of the field, moving technology and scientific findings, as well as our journal, into the transforming field of cybertherapy.

In the first paper, Gamberini writes an article on the continual usage of computer games in healthcare. Gamberini et al. focuses their article on proposing a review of existing research on computer games, exploited for prevention, support, training, rehabilitation, and specifically reviewing the relationship between cognitive processes and gaming. The article shows the success and ability to foster motivation and to enhance cognitive processes.

The second article, by Mülberger et al. focuses virtual reality therapy on treatment for phobias, specifically on patients who suffer from spider phobia. "A Virtual Reality Behavior Avoidance Test (VR-BAT) for the Assessment of Spider Phobia" use virtual environments and spider scenarios for a behavior avoidance test, monitoring subjective anxiety, symptoms, heart rate, skin conductance, and approach behavior in 34 female patients. Their research found a very effective result for physiological assessment of fear.

The next article by Villani and Riva which is entitled, "The Role of Media in Supporting a Stress Management Protocol: An Experimental Study," focuses on stress management and the sense of presence carried out through virtual environments. This article suggests the importance of the sense of presence as a mediating variable between the experience and the efficacy of the relaxation process, creating new advances in therapeutic approaches.

After that, Alcaniz et al. authored "Low-cost Virtual Motor Rehabilitation for Neurophysical Disability Improvements in Impaired Patients," which attempts to find a new way of using technology to improve motor rehabilitation to customize exercises for patients. The end result brings promising outcomes, citing increased motivation for patients in the rehabilitation process.

Later is an article using technology and therapy to treat obese patients with emotional eating. "New Technologies and Relaxation: An Explorative Study on Obese Patients with Emotional Eating," written by Manzoni et al. analyze stress and negative emotions as critical factors in inducing overeating in obese patients using virtual reality. The authors present several examples of the effectiveness of relaxation training using VR for emotional eating.

Hoffman et al., wrote the sixth article, "Pain Control During Wound Care for Combat-Related Burn Injuries Using Custom Articulated Arm Mounted Virtual Reality Goggles," for the use of pain control for soldiers suffering from various combat-related wounds. The VR goggle system proved to distract and even entertain many patients during wound care, dropping pain from "severe" to "mild." This article focuses mainly on burn victims using VR as an effective adjunctive nonpharmacologic analgesic for reducing cognitive pain, emotion pain, and sensory components.

Finally, the article "Applying the Technology Acceptance Model to VR with People who are Favorable to its Use," by Bertrand and Bouchard tests the Technology Acceptance Model as applied to the use of virtual reality in clinical settings. The results reveal that Intention to Use VR is predicted only by Perceived Usefulness, which then indicates how to better document the dissemination of virtual reality among clinicians.

The third issue of JCR will continue to explore the ways in which technology influences and enhances the healthcare of citizens in Europe and throughout the world. We are interested in receiving original research and ideas for future theme issues from our readership. Current topics being considered include non-manual displays, neurophysiology, VR and e-health for special populations including the elderly, pediatrics, and those with disabilities, among others. Please contact us with your interesting manuscripts and ideas for additional topics for the Journal, and thank you for your support of this promising new publication.

Brenda K. Wiederhold, Ph.D., MBA, BCIA
Editor-in-Chief, *Journal of CyberTherapy & Rehabilitation*
Virtual Reality Medical Institute

A GAME A DAY KEEPS THE DOCTOR AWAY: A SHORT REVIEW OF COMPUTER GAMES IN MENTAL HEALTHCARE

Luciano Gamberini¹, Giacinto Barresi¹, Alice Majer¹, and Fabiola Scarpetta¹

Computer games are currently a focal topic in different research areas. One of the emerging contexts for their use is represented by healthcare. Thanks to their potentialities, they have been successfully exploited in this domain to foster motivation and to enhance cognitive processes. This paper proposes a review of existing research on computer games, exploited for prevention, support, training, rehabilitation, and particularly stressing the relationship between cognitive processes and gaming.

I. GAMES AND VIDEOGAMES

1.1 THE DOUBLE SOUL OF GAME

Playing is an activity that everyone has encountered more than once during his/her lifetime. Trying to provide a definition of games, Caillois (1957) identified some distinctive traits characterizing this activity. First of all, games are based on a free participation, and their development is circumscribed in time and place. Games are structured according to specific rules and the activity's outcome is unpredictable. Finally, players are well aware of the existence of this different reality, where norms and behaviors usually enacted in our daily life are temporarily suspended.

Developmental scientists have underlined that playing affects cognitive processes. Piaget (1945), for instance, observed that different stages in the psychological development of children correspond to different stages in play development. The perceptual play, based on perceptual and motor pleasure characterizing the first months of life, is substituted by the symbolic play, individual and subjective, focused on imagination and fantasy. Later, even the symbolic play will be gradually replaced by games with rules, involving a group of participants with different and specific roles imitating the real world. According to Piaget, the passage from symbolic to ruled games would also mark the appropriation of moral values (Piaget, 1932).

This Piagetian distinction between imagination and rules in play has been further developed by another important psychologist, Vygotskij (1967). He claimed that the effects of culture are visible even in the phase of symbolic play, as every imaginary situation includes social rules of behavior. For example, children will play Mom, reproducing the practices of what can be called a "maternal behavior".

If Piaget and Vygotskij depict children as sponges absorbing social and physical inputs from the environment, a constructivist approach to game interprets this activity as a process for the construction of meanings (Farné, 2005).

Corresponding Author:
Prof. Luciano Gamberini, PhD, Human Technology Lab, Department of General Psychology, University of Padova, via Venezia 8, 35121.
Padova, Italy, luciano.gamberini@unipd.it

¹Human Technology Lab, Department of General Psychology, University of Padova (Italy)

Manipulating objects, accomplishing tasks and activities the child is also actively shaping an idea; stimulated by his/her needs and the pleasure to explore, playing the child will learn to know his/her environment.

Cognitively, different games involve different kinds of skills. For instance, games based on a limited set of rules (e.g. board games or card games) and, consequently, a constrained number of possibilities in terms of played moves, engage perception, memory and thinking processes. Differently, the fact of having to rely on luck, as in lottery games, seems to involve mainly decision-making processes (Rogers, 1998).

Even though developmental advantages supported by games could not be good reasons to make children and adults play, entertainment and fun are. In fact, games have a double soul which emerges in their being entertaining but also educational (Myers, 1999). The entertainment dimension highlights the emotional experience, which increases the attractiveness of the game beyond its educational aim, and involves every age; for this reasons games can be considered powerful tools for training and clinical settings (Hartmann, 2002; Russ, 1995; Hopkins, and Wober, 1973; Morales-Sanchez, Arias-Merino, Diaz-Garcia, Cabrera-Pivaral, and Maynard-Gomez, 2007; Carter, Mackinnon, and Copolov, 1996).

This paper aims at providing an overview about studies investigating the relationship between game activity and cognition. In particular, a specific kind of game will be taken into consideration, namely “computer games”, and linked to its application in the healthcare domain. The paper is structured as follows. Next part will be devoted to the presentation of videogames and their peculiarities. Then, in part 1.3, the relationship between video games and cognition will be discussed. In section 2, studies on computer games in healthcare will be described in terms of their potentialities for prevention, support and rehabilitation. Finally, part 3 will be devoted to a proposal for usable, low budget, neurocognitive games.

1.2 COMPUTER GAMES

Games have changed in the last decades from “hide and seek” played in open-air with friends to “World of Warcraft” played in closed environments with people all over the world.

Esposito (2005a, pp. 2) proposes this definition of videogame: “A videogame is a *game* which we *play* thanks to an *audiovisual apparatus*, and which can be based on a *story*”. The gameplay is “the component of the computer games that is found in no other art form: interactivity. A game’s gameplay is the degree and nature of the interactivity that the game includes” (Rouse, 2004; in Esposito, 2005a, pp. 3). Historically, Esposito (2005b) marks the beginning of the “Computer Games Era” in 1971, with the release of the first commercial game “Computer Space”. From that date on, four periods have characterized the game development: 1971-1978, pioneers’ success (first years: milestones such as “Pong”); 1978-1983, genre development (also known as the golden age, for instance: “Adventure” for story and role playing, “Defender” for shoot’em up, “Qix” for abstract action, “Pole Position” for driving simulation); 1983-1994, strong ideas (less technological limits: powerful ideas in “Tetris”, cross-genres in “The Legend of Zelda”, complex simulations as in “Sim City”); 1994-today, recent games with advanced graphics, augmented interfaces and multiplayer games (“Quake III Arena”, “Super Mario Galaxy”, “World of Warcraft”).

To introduce the main differences between computer games and traditional games, a review of games taxonomies would be useful. According to the report “Guide to Computer Games in Education for NASA” by Laughlin and Marchuk (2005), games (term interchangeably used for computer games and video games in this document) can be categorized according to the technological platforms they exploit: personal computers, consoles, cell phones and handheld devices. Alternatively, they can be classified according to the communication modalities implemented. Text-based or graphic-based games are the main categories. Games can also differ in terms of the interaction modalities they support. In this case, games can be played in single-player modality, multiplayer modality (when the game is

performed in head-to-head situation, as is the case of some sport games), hot-seat modality (several players holding the control by turn-taking), network modality (several players sharing the same game environment by network), online modality (network games using the Internet as medium), massively multiplayer modality (permitting to a large range of players to share at once the same game, available online only, and constituting a persistent world).

Finally, games can vary according to the different activities the participant can carry on. Some examples can be:

- action adventure games: combining elements of problem solving and exploration;
- fighting games: two or more opponents fighting;
- management games: economic management, simulating environment;
- platform games: completing level moving and avoiding obstacles, jumping on platforms;
- racing games: riding a race vehicle like cars and motorbikes;
- real time strategy games: gathering resources and performing strategies on units;
- role-playing games: control of single or many characters, performing quests;
- simulation games: reconstructing and using an accurate historical or modern vehicle;
- world-building games: open-ended games with total control of characters and environment to manage.

The dimensions used as criteria to classify games represent the main differences between traditional games and computer games. First of all, computer games' scalability leads to a quickly disappearance of physical constraints as they can be potentially played everywhere. Secondly, contrary to traditional games, computer games can involve a large number of participants playing together. Finally, imagination is replaced by graphically advanced scenarios, where actions can now be carried out that could not be performed in the real environment. To sum up, computer games have revolutionized the spatio-temporal dimensions characterizing traditional games as well as the range of actions that can be performed while playing.

In the next paragraph the complex relationship between cognition and computer gaming will be discussed, emphasizing which new possibilities computer games offer to the development of cognitive skills.

1.3 HUMAN-COMPUTER GAME INTERACTION

Playing and cognition are deeply interconnected and with the advent of computer games new scientific interests for their relation emerged.

Green and Bavelier (2006) highlighted a range of cognitive processes modifications occurring with the gaming practice. They observed the perceptual and cognitive effects of games on cognitive functions, such as general enhancement in reaction time, visuo-motor coordination, spatial skills and visual attention.

To better understand the connection between computer games and cognition, Lindley and Sennersten (2006) proposed a model based on the assumption that learning "how to play" a videogame implies different cognitive skills. First of all, players need to learn how to manage interaction mechanisms, such as using the mouse or the remote appropriately. Secondly, players need to get familiar with interaction semantics, which means associations between physical actions (such as pressing a key) and the corresponding movement in the in-game environment. Thirdly, they should acquire game expertise, which would allow them to perform the right action at the right moment. While the first two skills become unconscious and automatic in a very short period, game expertise evolves according to the new challenges proposed by the game played. Decision-making can be considered as one of the main cognitive process underlying this expertise, and it cannot be set apart from the attention paid to the context-related contingencies as well as from memory of previous experience. Scientific investigation in areas such as learning or training has also

considered another important variable playing a role in the relation between game and cognition, namely motivation. Playing can be a good “motivator” for the student who has to learn a lesson. Kellar, Watters, and Duffy (2005), investigating on motivation in computer games players, highlight the relevance of some factors as:

- Possibilities for Control, (supporting self-regulation, autonomy, initiative);
- Context Awareness, (including rationale, feedback, storyline);
- Competency, appropriate and performable tasks and challenges;
- Engagement, involving personalization, role-playing, rewards, communication, social interactions. The engagement dimension is also traditionally linked with the sense of *presence* (Lombard and Ditton, 2003) or, in other words, with the feeling of being present in the gaming environment. Consequently, Retaux (2003) underlines that also presence could be critical in enhancing motivation. According to this author, *presence* can be experienced in virtual environments and it can reshape the context of gaming radically, providing flow and immersive sensation. As observed by Bracken and Skalski (2006), *presence* in gaming can be connected with the match between difficulty level and the player's skills, or more in general, with the possibilities of action offered by the environment and exploited by the individuals (Spagnolli & Gamberini, 2005).

Rambusch (2006) linked the engagement in the game to the embodied and situated nature of computer game play, highlighting the role of the interaction between players and complex settings. In particular, she defines the gaming environment as a setting composed by a real world and a virtual world connected thanks to their affordances exploited by the player. Playing can not be situated into a “virtual cyber-vacuum”, but it must be interpreted as a socially embodied and situated activity, which is constantly shaped by the physical experience emerging from the interaction between player and the environment. Narrative have often the goal to drive this relation between players and socio-environmental affordances; Schneider, Lang, Shin and Bradley (2004) observing the effects of the narrative dimension on several aspects of the gaming experience found that story-based games enhanced presence and engagement as well as the psychological arousal at a unconscious level. Probably, the multiplayer possibilities offered by the Internet represent one of the most effective motivator in today's players: networked game environments offer ideal contexts to support communication among players and to develop relationships with emotional investment (Yee, 2006). Multiplayer games offer relational contexts to enact cooperative dynamics: the Computer-Supported Cooperative Play (CSCP) triggers several phenomena related to identity and sociability, as observed in the XBox Live system by Wadley, Gibbs, Hew and Graham (2003). In these environments cooperation and competition are primary factors that determinate motivation and engagement levels acting on several social extrinsic motivators related to the desire for/rejection of potential affiliations with other players (Bonk & Dennen, 2005).

2. E-MENTAL HEALTH: FROM VIRTUAL REALITY TO COMPUTER GAME

In order to be more effective, technologically-enhanced health solutions work side by side (as alternative or supportive methods) with traditional approaches (LoPresti, Mihailidis, & Kirsch, 2004). Virtual and Mixed Realities represent the possibility to create a new, immersive place functional to enhance motivation, where patients can be trained while playing. Clinically, Virtual Realities allow to implement interactive treatment and training in controlled three-dimensional (3D) environments, where movement devices can be set to record and monitor patients' physical responses (Glantz, Rizzo, & Graap, 2003; Wiederhold & Wiederhold, 2007).

The potentialities of this new approach caught the attention of the European Union which, in 2001, funded a research project for Telemedicine and Portable Virtual Environments for Clinical Psychology, called VEPSY-updated (<http://www.cybertherapy.info>). The aim of this project was to investigate the effects of Virtual Reality systems adopted in clinical settings.

In particular, the project aimed at facing several clinical disorders (Riva et al., 2003), such as:

- social phobia, panic disorder and agoraphobia, exploiting the combination of VR and exposure therapy;
- obesity, bulimia and binge-eating disorders, using the Experiential Cognitive Therapy (ECT) to modify body image perceptions;
- male impotence and premature ejaculation, taking advantage of the immersive virtual reality to improve the efficacy of a psychodynamic approach in treating male erectile disorders.

The project integrated the cognitive behavioral therapy (CBT) with a Virtual Reality (VR)-enhanced treatment named Experiential Cognitive Therapy (ECT), which joined VR and telemedicine to be used in eating disorders' assessment and treatment (Riva, Bacchetta, Cesa, Conti, & Molinari, 2004). This program worked on many fronts, for instance helping the patients in understanding the origins and reinforcement of negative attitudes toward their body image, redefining the concept of beauty, decreasing the restriction in activities and negative feelings, supporting motivation and self-efficacy, developing individualized treatment plans regarding eating behaviors and exercise. Results showed that ECT had a significant effect on the perception of the body image. This outcome was usually associated to a decrease in problematic eating and social behaviors.

Another field of research born from the development of VR is the emotional determinants of presence. EMMA (Engaging Media for Mental Health Applications) was another European Union funded project, realized to develop a Virtual Environment able to generate and enhance presence and emotions. This tool was successfully designed not only for users suffering from psychological problems, but also for users with acute restricted mobility or the general population (Alcañiz, Baños, Botella, & Rey, 2003).

Virtual City (Costa, Carvalho, & Aragon, 2000) is an example of cognitive training for stimulating cerebral plasticity changes, empowering the classical rehabilitation procedures. Authors report preliminary studies on schizophrenic patients, immersed into complex environments where several tasks and games were proposed to enhance processes of alertness (turning off the radio in a virtual house), concentration (distinguishing between sequences of stimuli in a music room), attention (solving puzzles in book and game rooms), perception (recognizing people on the street) and memory (reaching a telephone-box or reacting to signals and requests in open-air environments).

Even though the aforementioned projects have proved the effectiveness of Virtual Environments in clinical settings, their efficacy depends on a delicate balance among their components. Attracted by this issue, Rizzo and Kim (2005) performed a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) of virtual reality systems in therapy and rehabilitation, finding that:

- Strengths can be the enhanced ecological validity (degree of relevance or similarity between virtual test/training and reality), stimulus control and consistency (to support the repetitive and hierarchical delivery of stimuli according to a scale of difficulty), real-time performance feedback, cuing stimuli to avoid error learning, self-guided exploration and autonomous practice, interface adaptation to specific impairments, complete naturalistic data collecting, safe setting, gaming factors (to enhance motivation), low-cost environments that can be duplicated and distributed.
- Weaknesses depend on degree of natural interaction, disturbs of hardware wiring and devices, immaturity of engineering process, platform compatibility, front-end flexibility (clinicians are not programmers), data visualization, side effects (like cybersickness).
- Opportunities can be recognized in emerging advances in interfaces and hardware, real time data analysis, game drivers, intuitive appeal for the users, academic and professional acceptance, closeness of research and clinical professionals, integration with neuroimaging systems, tele-rehabilitation.
- Threats could be low costs/benefits ratio, after-effects, ethical challenges, and the idea that technology could

eliminate the need of clinicians, limited awareness and unrealistic expectations.

If the degree of natural interaction is a critical issue in Virtual Realities, a solution is represented by Augmented and/or Mixed Reality. Recent advances in interface technologies create semi-immersive settings for users with artificial augmentation of their experience through innovative controls and feedback visualizations, supporting and increasing the spontaneous interaction of players with the environment. The introduction of virtual elements in the real world is exploited for therapeutic reasons, as in the treatment of cockroach phobia (Botella et al., 2005). In this study insects super-imposed to real worlds allowed an exposure therapy in safe situations.

Pervasive Games represent the bridge between Augmented and Mixed reality and computer games. Extending the effective power of games across different media platforms (Lindt et al., 2005) and everyday life contexts (Benford, Magerkurth, & Ljungstrand, 2005), we can obtain information spaces for augmented experience overlapped and intersected with real spaces and objects. This physical distribution of digital information can significantly support the work of healthcare systems with the development of pervasive and portable telemedicine equipment, as in ambient intelligence (Riva & Gramatica, 2003).

An aspect that needs to be considered when discussing Virtual Realities as an alternative setting to host training activities is the possibility to *physically interact* with such environments. The development of haptic interfaces has represented a first step towards this goal. Among their various applications, in clinical settings they have been used to enhance the level of affective experience. An example is TapTap, a wearable haptic interface using its garment to produce the affective stimulation (Bonanni, Vaucelle, Lieberman, & Zuckerman, 2006). Another support to interaction is offered by tabletop technologies. Digital tables with touch-screens create the context for collaborative tasks and physical interactions, enriching the chance to share the same experience with other players, whose activity (comprising complex gestures) can be monitored in real-time on the screen (Tse, Greenberg, Shen, & Forlines, 2007). An example is provided by the ElderGames project, which aims at developing a tabletop technology exploitable by elderly people to play with their peers; the typology of games implemented and the possibility to interact with others is expected to contribute to their health and wellness in a monitored environment (Gamberini et al. 2008). The Nintendo Wii is one of the most popular examples of ergonomic, low-budget implementation of physical interaction in Virtual or Mixed Reality; it's offering several game scenarios where inputs are provided by a system that tracks and translates position, orientation and acceleration of the players' on a remote virtual movements in the game environment (Mäyrä, 2007). The Playstation EyeToy, discussed by Kizony and Weiss (2004), eliminates the remote control by positioning the users' outline in the on-screen scenario, and allowing the player to manipulate virtual objects by mirroring gestures performed in the real environment.

The development of videogames played without remote controls has attracted the interest of research areas such as eye-tracking and Brain-Computer Interfaces. The advantages offered by eye-tracking in gaming are remarkable. Discussing the Tobii ET-17 technology, Jönsson (2005) underlined that tracking the user's gaze is highly non-invasive and fast, easy and intuitive for the user; this technique can reduce fatigue, reveal attention, be non-invasive, and connected to other input devices. Another actor operating in the field of playing and work applications of gaze-tracking technology is COGAIN, a network of excellence on Communication by Gaze Interaction, supported by the European Commission's IST 6th framework program. The project is hosting an annual conference (www.cogain.org) and is developing several solutions to support users with disabilities.

2.1 GAMES FOR PREVENTION

The social etiology of particular diseases or the social cause of the deterioration of already weakened or stressed conditions are emphasized by models that describe the interaction of biological, psychological, and social factors (for instance, Bruns & Disorbio, 2006). On these bases, it is games can be useful to prevent or deal with health-related

problems. "Serious Games" are more than edutainment (education through entertainment) because they extend the aims of this kind of media (usually thought for preschoolers and basic learners) to train and inform a larger target, including universities and companies, about social relevant issues (Micheal & Chen, 2005). By exploiting the power of persuasion, serious games could represent an ideal tool for attitude and behavioral changes (Bogost, 2007).

2.1.1 GAMES FOR PREVENTION AND HARM REDUCTION

Prevention and harm reduction represent valuable strategies to reduce the social costs connected to addiction. Videogames can support this endeavor. Videodope (Gamberini, Breda, & Grassi, 2007) is a serious game designed to enhance players' awareness of the effects that the abuse of psychoactive substances has on the body. By selecting a specific drug and a certain organ, the game displays a 3D human avatar (Figure 1) that can be zoomed in or made transparent, showing the organ and describing with images and text the short-term, medium-term and long-term effects of the selected drug on the organ as well as on the cognitive skills, and sexual ability. The description is integrated with legal and social information. At the end of this phase, a quiz starts, which allows to attribute the player a score according to his/her answers. Thanks to the provision of feedback as well as to the display of the connection between behavior and its consequences, this game represents an appealing persuasive tool (Fogg et al., 2001; Fogg, 2003) to be used in settings such as schools, discos, pubs and the web.

Another game that exploits the representation of behavioral cause and effects is called Playsafety (Purgato & Gamberini, 2005), and addressed young people's unsafe behavior; defined according to preliminary investigation of the nighttimes scenarios where dangerous behaviors most frequently occur, and to a scenario-based design, several situations were created (disco, park and restroom for drug abuse, a motorbike ride for safety driving). Players, represented by avatars, were offered different reaction options, followed by scenes depicting the consequences of their choice (Kerr, Neale, & Cobb, 2002).

2.1.2 GAMES FOR TRAINING

Fery and Ponserre (2001) analyzed a golf game used to learn real launches. Like virtual reality tools in general, the golf game showed a positive transfer of skills from virtual to real settings. The authors reported that even the mere view of swinging movements could be enough to create a representation of force feedback in users, and let them acquire the necessary skills to improve their real performance. Players used two different learning strategies, one focused on the movements of virtual characters, another one focused on a gauge representing the force. Practice and the time spent watching and learning equal a motor control experience, useful to better orient real world actions.



FIGURE 1. Videodope screenshot

Virtual environments can be also exploited in safety training in emergency situations. Gamberini, Cottone, Spagnolli, Varotto, and Mantovani (2003) show that in these situations users can show a change in their behaviors, in the direction of increasing the speed of their escape at the detriment of the movements' precision. The observation of this change, in the direction in which one would have expected it in emergency situations, encourages to think that event simulated emergencies can be experienced as realistic and the that a training there would reproduce some of the aspects of a real emergency situation. Spagnolli et al. (2007), report of another system for safety training, developed

by Honda, which the authors tested to find the social setting that would maximize the learning experience. The safety trainer includes motorcycle controls and offers different hazard situations in traffic conditions, designed on the basis of real accidents data involving motorcycles.

Other typical training applications of videogames are those targeting specific professional skills in the military personnel, in particular aircraft pilots. Gopher, Weil, and Bareket (1994) observed that cadets trained with Space Fortress performed significantly better in flight sessions than those trained with traditional methods. As a consequence, the Israeli Air Force incorporated that video game into the regular training program of its pilots. In this case the enhancement in perceptual and cognitive processing could induce significant differences in job performance.

Another example of professional training through videogame has been reported by Rosser et al. (2004); Laparoscopy is a surgical intervention technique based on a camera and some operating instruments introduced in the body via small incisions. The surgical instruments are steered by the surgeon who views the images transmitted from the internal camera to the screen. This type of surgery requires high levels of visual attention, manual dexterity, and hand eye coordination. The authors emphasized how video games could be successfully used as training for laparoscopic surgeons.

2.1.3 GAMES FOR EXERCISE AND FITNESS

Bogost (2005) defined this category as “exergames”, namely games that promote and support the users’ fitness. The users’ rapid movements of the fingers activate legs or feet movements in the virtual character to simulate sprinting or running. An example of exergame is Yourself! Fitness, allowing to create a virtual personal trainer, called Maya, who proposes personalized 30-minutes daily programs. The training game is customizable according to height, weight, vital parameters (such as heart rate) and goals of the users. The interactions with Maya are frequent and she adopts a gym-professional attitude in order to improve players’ participation according to the feedback received.

Bogost coins the expression “rhetoric of impulsion” to refer to score-based encouragements to engage in physical activity implemented in entertaining tools with no explicit training aims. An example is Dance Dance Revolution, where on-screen arrows at correct beats of music correspond to steps on the pad: at any missed step, a global energy meter decreases, accompanied by messages evaluating the accuracy of the players’ movements (Perfect, Great, Good, Almost, or Miss).

2.1.4 SOCIAL DIALECTICS

There are several games helping users to deal with social issues. FearNot (Hall, Woods, & Dautenhahn, 2004) is a virtual learning environment offered to 8-11 years old children to learn dealing with bullying and mobbing in the school context. Age Invaders promotes relations (Khoo & Cheok, 2006) between elderly and young people, who are required to play all together in the same virtual environment. The game adapts itself according to the age of the player. According to Khoo and Cheok’s research, elderly people benefits not only from the cognitive stimulations provided by the game, but also from familiar and social inclusion, positively affecting mood, self-expression, physical and cognitive activity.

2.2 GAMES FOR HEALTH SUPPORT

2.2.1 GAMES FOR SPECIAL NEEDS

The problem of differential access to technology involves elderly people (as already discussed in the previous paragraph), and people with physical disabilities. Cognitive training tools have been successfully developed for elderly people. Gamberini et al. (2008) reviewed a series of studies showing the incidental positive effect of classic “first generation games” (reviewed by Whitcomb, 1990) and “innovative games” on cognitive functions and quality of life of

elder people, both of them able to slow down age-related cognitive senescence. Åstrand (2006) proposed a user-based design process with iterative cycles to create an online word game for older people, called ACTIONPET (based on the ACTION project for healthcare: Assisting Carers using Telematics Interventions to meet Older persons' Needs). Van Schaik, Blake, Pernet, Spears, and Fencott (2008) described the design, development and testing of a VAE, Virtual Augmented Exercise tool, based on puzzles and target-hitting games. This gaming tool for older adults has been preferred to traditional physical exercises with adherence rate of 100%. A video-captureVR system, TheraGames, is supposed to enhance interaction of elderly people with rehabilitative systems exploiting the highly motivating game setting (Kizony, Weiss, Shahar, & Rand, 2006).

Ijsselstein, Nap, de Kort, and Poels (2007) proposed several suggestions for design of games for elderly people, according to the limitations and potential of the users and the opportunities offered by modern games. ElderGames (Gamberini et al., 2006) is oriented to develop games with advanced visualisation and interaction tabletop interfaces to enhance the cognitive, functional and social skills of elderly through health monitoring, mental exercise and engagement. It implements also a communication system for multiplayer entertainment from a distance. The experts involved in this project analyzed attentively the cognitive needs of the older users to design appropriate mind-engaging games to affect positively the main cognitive changes in senescence (perception, attention, executive functions, memory). The presence of cognitive decline in elderly can be identified by using as index of game performance (Jimison, Pavel, McKanna, & Pavel, 2004). Cognitive Cubes (Sharlin et al., 2002) is an augmented tactile tool for assessment of spatial constructional skills to discriminate differences in cognitive skills and tasks, and correlate the scores with standard paper-and pencil 3D spatial assessment. The authors are studying possible developments to explore this kind of augmented solutions for clinical assessment.

Another category with special needs is blind children; Lumbreras and Sanchez (2000) created a 3D audio Virtual Game named AudioDOOM for blind children. The user is required to handle a joystick to explore a maze following 3D audio cues (sound and noise of footsteps, doors, echoes), and finding enemies. After several sessions, participants showed to be able to reproduce a physical representation of the maze using Lego bricks. Therefore, acoustic interactions during the game seemed to be efficient in supporting spatial-cognitive maps. In 2003, TPB, the Swedish Library of Talking Books and Braille proposed a series of 13 computer games on their web site, specially designed for children with different visual impairments. The games were small Macromedia Flash™ applications, designed using graphics and sound in order to encourage children with partial sight to exercise visual objects recognition, and to create picture-based and sound-based games. The positive response of children to TPB games suggested that the visual design of these games is suitable for children with different visual impairments (Weiss, Rand, Katz, & Kizony, 2004).

2.2.2 GAMES FOR CLINICAL ADHERENCE AND MONITORING

According to Michael and Chen (2005), games can help patients in reshaping their lifestyle in adherence with the special needs caused by their conditions. Jack et al. (2001) used a virtual reality setting to increase motivation and engagement in adult patients practicing physical therapy after a stroke. An innovation, which could deeply affect the life of diabetics, has been developed by Nintendo GameBoy called Glucoboy. Glucoboy is a tool aimed at increasing awareness of young people with diabetes about their blood glucose levels, providing incentives to adopt the treatments. Similarly, Bronkie the Bronchiasaurus is designed to help children affected by asthma to acquire information about their problems and the ways to cope with them.

Watters et al. (2006) proposed digital games as a possible means for long-term treatments of children (also recognizing their power to engage adults). Their framework is based on three main goals: to offer high accessibility even on small devices, to adapt the tool to player's interests and clinical needs, to maintain games novel and interesting over time. An accessory advantage is constituted of the users' data collection and monitoring, particularly useful to health-care operators.

2.2.3. GAMES FOR PSYCHOLOGICAL THERAPY

Goh, Ang, and Tan (in press) discussed how mental health professionals can explore and take advantage of the diffusion of computer games to help the treatment of mental illness. The authors propose guidelines and strategies for psychotherapeutic games to be used with children and adolescents, highlighting for instance the need for considering the potential users' characteristics, such as gender, culture, socioeconomic status as well as needs and expectations. This remark is supported by studies such as Greenhill's (1998, in Goh, Ang, & Tan, in press), who observed that stimuli present in the environment, such as colors and sounds, captured the attention of players in different ways: children diagnosed with ADHD, for instance, focused their attention on the videogame only in the case of vibrant colors and loud sounds.

The literature reports numerous cases of video games used in psychological treatments thanks to their capability to provide alternative realities where patients could feel safe and step back from the real world. Accident phobia has been successfully treated using virtual reality driving games in exposure therapy, a traditional methodology of the cognitive-behavioral therapy approach (Walshe, Lewis, Kim, O'Sullivan, & Wiederhold, 2003). Dandeneau, Baldwin, Baccus, Sakellaropoulou, and Pruessner (2007) succeed in lowering players' cortisol levels using a videogame that decreased a perceived threat. Finally, Moore, Wiederhold, Wiederhold, and Riva (2002) proposed virtual gaming environments as settings for psychotherapy of phobia, paired with several physiological measurements derived by behavioral indexes. The combination of exposure therapy and Virtual Reality (VR exposure therapy [VRET]) has been used in several researches on specific phobias, such as acrophobia (Emmelkamp, Bruynzeel, Drost, & van der Mast 2001), claustrophobia (Botella, Banos, Villa, Perpina, & Garcia-Palacios, 2000), fear of flying (Wiederhold & Wiederhold, 2003), fear of driving (Walshe, Lewis, Kim, O'Sullivan & Wiederhold, 2003) and spider phobia (Hoffman, Garcia Palacios, Carlin, Furness, & Botella, 2003) as well as on anxiety disorders, such as social phobia, panic disorders with agoraphobia and post-traumatic stress disorder PTSD (Krijn, Emmelkamp, Olafsson, & Biedmond, 2004). Walshe, Lewis, Kim, O'Sullivan and Wiederhold (2003) investigated the effectiveness of exposure therapy for the treatment of driving phobia following a motor vehicle accident program. The program was characterised by the combination of driving games (Game Reality, GR) and Virtual Reality driving environments (VR). Participants were exposed to a Virtual Driving Environment (Hanyang University Driving Phobia Environment) and computer driving games (London Racer/ Midtown Madness/ Rally Championship). Results suggest that VR and GR have an effective role in the treatment of driving phobia.

Positive effects of Virtual Reality Exposure Therapy have also been documented for treatment of Post-traumatic stress disorders (Rothbaum & Schwartz; Wiederhold & Wiederhold, 2008). The success of virtual realities games on PTSD inspired Rizzo et al. (2006), who successfully used the Full Spectrum Warrior graphic assets as a Virtual Environment for the treatment of Iraq War military service personnel diagnosed with PTSD.

Wiederhold and Wiederhold (2007) discussed the power of virtual technology and videogames to distract patients from pain: high immersion virtual reality requires attention to be focused on virtuality, decreasing the available amount of cognitive resources devoted to other experiences. The use of immersive virtual realities has been illustrated by Hoffman, Patterson, and Carrougner (2000) to distract burn patients from pain during physical exercises. Patients reported to feel less painful when immersed in a virtual immersive reality than when they were not, highlighting the value of this non-pharmacological method for pain reduction. A further study (Sharar, 2006) exploited a virtual immersive game named SnowWorld for pain reduction during physical post-burn therapy in children. Results underlined an analgesic effect of the game also confirmed by fMRI neuroimaging.

A third use of video games in psychological treatment rests on the neuropsychological functions stimulated by gaming. Under this approach stands the treatment of schizophrenia. Han, Sim, Kim, Arenella, and Lyoo (in press) suggested that limited internet video game could be used as an adjunctive tool in the treatment and rehabilitation of

schizophrenic patients. Indeed, the increased activity of the prefrontal cortex or the lead of dopamine release observed during video game playing could lead to a successful treatment of this disorder (Matsuda & Hiraki, 2006; Koepp et al., 1998).

A specific computer-based program developed for the training of cognitive skills in medicated patients with schizophrenia has been tested by Bender, Thienel, Dittmann-Balçar, Tackenberg, and Gastpar (2003). The tasks of the program were focused on specific cognitive functions, such as attention, memory, executive function, visuo-motor function and calculation. The program resulted to have significant effects both on cognitive functions and self-esteem.

2.2.4 GAMES FOR MOTOR AND COGNITIVE TRAINING

Videogames, involving the sensory-motor system and problem solving skills are more than serious candidates for neuro-rehabilitation and motor or cognitive training (Morganti, Gaggioli, Castelnovo, Bulla, Vettorello, & Riva, 2003; Gourlay, Lun, & Liya, 2000; Cameirao, Bermúdez, Badia, Duarte Oller, Zimmerli, & Verschure, 2007). Green & Bavelier (2006) identified several improvements in gaming activity, from reaction times to spatial skills, and highlighted the chances to use this kind of media to improve cognitive functions in individuals with particular needs (as reviewed for surgeons and soldiers) or for training and retraining of individuals with special health-related problems (such as young disabled or elder people) involving the nervous system. Koepp et al. (1998) reported that the level of dopamine, a neurotransmitter involved in reinforcement and learning, seems to increase during videogame activity.

Virtual Reality technology is widely used in post-stroke rehabilitation. (Broeren, Georgsson, Rydmark, and Stibrant Sunnerhagen, 2002; Wiederhold and Wiederhold, 2006), for instance, investigated the influence of a training with 3D-computer game (3D-Bricks), combined with the PHANTOM haptic device (SensAble Technologies Inc., Woburn, MA, US) on motor relearning in a patient suffering from a left arm paresis after stroke. The authors observed an improvement in grip strength, manual dexterity and kinematic patterns (like the trajectory and the motion direction). A similar project is currently in progress at the Rutgers University, aimed at combining an Xbox-based physical rehabilitation system with the assistance of a P5 glove (made by Essential Reality) connected to the console (Morrow, Docan, Burdea, & Merians, 2006). Video games have also been involved in physical therapy for balance. Betker, Szturm, Moussavi, and Nett, (2006) used a coupling foot center of pressure (COP) which controlled a video game on dynamic balance control. The authors observed that the COP-controlled video game-based exercise caused a significant improvement in dynamic balance control. Moreover, the training program, increasing the level of motivation, had a positive affect on subjects' desire to exercise and complete the rehabilitation program. Motivation has also proved to be enhanced by the use of EyeToy (a game disc and a USB camera plugged into a Sony PlayStation) in the training of the upper limb in children with cerebral palsy (CP) (Jannink et al., 2008).

Spatial cognition has also been investigated with the use of video games. Green and Bavelier (2003) investigated the effect of video games on visual selective attention. Results showed that playing action-video-games alters visual skills. They observed the difference in performances of players and non-players after action game practice: non-players showed marked improvement considering their pre-training abilities. Furthermore, Lager and Bremberg (2005) showed a cognitive enhancement regarding spatial skills and reaction times, and Green and Bavelier (2007), observed an improvement in the spatial resolution of attention in videogame players.

Another category of special players are young people affected by *Attentional Deficit Hyperactive Disorder*, syndrome of disattention and hyperactivity. McGraw, Burdette, and Chadwick (2005) investigated the effects of Dance Dance Revolution game on reading disorders of children affected by ADHD to verify that matching visual and rhythmic auditory cues could strengthen performance on particular aspects assessed by Receptive Coding and Finger Sense Recognition subtests.

Another example is Play Attention®, (<http://www.playattention.com>) which is a feedback-based training program

designed to train attention. In particular, it seems to increase concentration, task completion, visual tracking, short-term memory, and the ability to ignore distractions: these results are due to the increasing strength of high-frequency beta waves and decreasing low-frequency theta waves. Feedback-based technology has already been used by NASA to increase astronauts' and pilots' attention in training with flight simulators. Play Attention is an adaptation of this NASA technology for educational needs. The user can make videogame respond to his or her own brainwaves in order to control the game action.

Even though computer games have been successfully involved in rehabilitation, several problems concerning their use in this specific area have been discussed by Green and Bavelier (2006). First of all, game difficulty varies with the specific game and the individual characteristics of the participant (education, computer skills, age, health). Secondly, arousal (increased by the gaming) can be a critical factor for the analysis of the performance as it can by itself induce the desired neuropsychological changes. Finally, the discomfort of using certain tools such as virtual environments should be considered (Stanney, Hale, Nahmens, & Kennedy, 2003). This is especially true for games that are not designed for mental enhancement, but that are anyway able to improve cognitive skills incidentally (as reported in the studies by Whitcomb, 1990).

3. PROPOSALS FOR AUGMENTED NEUROTRAINING GAMES

Engagement has been widely considered as one of the main factors inducing motivation. Berthouze, Kim, and Darshak (2007) observed that, after the efforts made by game designers in enhancing players' engagement by improving characters' credibility and environmental appearance, the attention of professionals is now focusing on input devices and controllers. In one of their first studies they considered "Guitar Hero" for Sony Playstation, and compared players using the gamepad with players using the guitar-like control that allows gestures mirroring the guitar-playing acts. Outcomes led them to suppose that an increasing corporeal involvement should affect the feeling of presence even in absence of total immersion in the virtual environment. In particular, they concluded that a full-body experience contributes to facilitate the emergence of a presence feeling in the virtual environment. Lindley, Le Couteur, and Berthouze (2008) arrived to a similar conclusion by testing the effects of movements on bongos controls (enabled by body movements), in the Donkey Konga Game, compared to standard controls. Results showed that the first condition increased not only involvement in the virtual environment, but also social behaviors in the real environment.

Physical interactions cannot only enhance the sense of presence, but has also several cognitive benefits, as observed by Colcombe and Kramer (2003) in the elderly. Fabre, Chamari, Mucci, Masse-Biron, and Prefaut (2002) observed that combination of fitness training and cognitive training is able to enhance memory performance more than individual training. Physical interaction in the improvement of cognitive processes has been recently addressed by Eng et al. (2007), who realized a visuo-motor rehabilitation virtual system for stroke patients with upper arms impairment. In this case patients were required to physically interact with items in a virtual environment. The theoretical framework of the authors refer to the evidences of "mirror neurons" for imitation in motor control imagery, with the hypothesis of facilitation in cortical plasticity and functional recovery through processes of motor observation, planning and execution.

In fact, commercial gaming technology is now focusing on physical interactivity, as in the control system of Nintendo DS®, and Nintendo Wii®, which involves the whole body in the game activity (<http://www.touchgenerations.com>). Both systems allow the manipulation of virtual objects on the screen, through the performance of intuitive gestures handling real tools (the pen on the touch screen for DS, the Wiimote for Wii). These potentialities of the Nintendo Wii body-based game system have inspired some interesting projects. Pearson and Bailey (2007), for instance, proposed to analyse the effects of this console system in supporting learning processes in cognitively and physically disabled people. The physical nature of interaction can be particularly appealing for these individuals, facilitating their

acceptance of computer-mediated learning programs. The Wiimote offers a force-feedback system with a rumble effect that is triggered by a collision of the cursor or the avatar against a virtual object. Force-feedback has been used in rehabilitation procedures (Popescu, Burdea, Bouzit, & Hentz, 2000), and it is also able to support presence in collaborative gaming environments (Salläs, Rasmus-Gröhn, & Sjöström, 2000). Feedback technologies have been useful in past to increase dexterity (Prisco et al., 1998), as well as problems of motor coordination or representation (like apraxia).

The authors are working on Wii-based technology to implement tasks involving and training specific cognitive processes. The advantage of using Nintendo Wii for treatment depends not only on its specific game potential, but also on the cheap price of the tool, which allows home training, and the involvement of the family in the patient's rehabilitation (as observed by Burdea, Popescu, Hentz, & Colbert, 2000). Furthermore, Nintendo Wii is a handy device that could also be used in settings such as clinics or retirement houses.

4. CONCLUSIONS

The present paper has reported a review of studies about computer games exploited in the healthcare domain. Besides their proved relations between playing games and training cognitive abilities, video games' added value with respect to other solutions resides on two aspects. First they are entertaining. In contexts where health rehabilitation or health support processes can be painful or boring, computer games act as motivators. Secondly, computer games provide alternative worlds, which can be shaped on the target's needs, facilitating the development of adequate behaviors transferable into the real world.

Probably, most possibilities have not yet been explored. For instance, as emerges from the majority of the studies reported, results on the improvement of cognitive functions due to the use of computer games have been mostly accidental. In other words, if the effects of computer games on cognitive processes have been widely confirmed, the possibility to develop specific tasks targeting specific cognitive processes has received relative little attention. Likewise, interfaces reacting to the users' physical movements are emerging now, as evidenced by the increasing interest for haptic devices. In addition to training certain motor skills, physical interaction can further enhance the sense of presence, engaging even more deeply the player with the game and, consequently, further fostering motivation.



FIGURE 2. Nintendo Wii setting

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A VIRTUAL REALITY BEHAVIOR AVOIDANCE TEST (VR-BAT) FOR THE ASSESSMENT OF SPIDER PHOBIA

Andreas Mühlberger¹, Miriam Sperber¹, Mattias J. Wieser¹, and Paul Pauli¹

Lang and colleagues postulated that fear responses must be described on three levels: subjective-cognitive, physiological, and behavioral. However, in-vivo assessments of fear in phobic situations are complex, difficult to control, and frequently associated with methodological problems. The present studies used a virtual reality spider scenario for a behavior avoidance test (VR-BAT). Subjective anxiety, symptoms, heart rate (HR), skin conductance (SCL), and approach behavior were measured in 34 female spider-phobic participants during two VR-BATs and during eight exposure trials in-between. The distance and fear ratings decreased from the first to the second VR-BAT and during the exposure trials. Interestingly, HR and SCL increased during the exposure trials and HR even between the first to the second VR-BAT. Physiological measures, fear ratings and approach were only partially associated, but approach and fear measures correlated with psychometric measures of spider phobia. The virtual reality scenario seems feasible for the behavioral and physiological assessment of fear.

INTRODUCTION

According to widely accepted criteria (e.g., Diagnostic and Statistical Manual, Version IV [DSM IV], American Psychiatric Association, 1994) the diagnosis of a specific phobia is based on reports of fear, on physiological arousal, and/or on behavioral avoidance triggered by phobic stimuli or situations. Similarly, Lang and colleagues postulated that fear must be described on three fairly independent response levels: subjective-cognitive, physiological, and behavioral. The simultaneous assessment of these three levels is necessary because fear reactions differ between levels as reflected in only low to moderate correlations (about $r = .30$, see Lang, 1978; Lang, 1994).

The discrepancy between the theoretical claim that a multi-level assessment of phobic responses is useful and necessary and the rare practical implementation may have two reasons: firstly, in-vivo assessments of fear in phobic situations are complex, difficult to realize and to control, and are frequently associated with methodological problems. Real-life situations cannot be presented in an experimentally controlled way. Furthermore, while in-vivo approaches might have a high potential to discriminate phobic from control participants, elaborate analyses to reduce measurement artifacts are necessary (Wilhelm & Roth, 1998). Secondly, standardized laboratory experimental set-ups hardly elicit clinically relevant emotions (Loomis, Blascovich, & Beall, 1999) and their ecological validity remains questionable (e.g., Cohen, 1977).

High-fidelity Virtual Reality (VR) is a technical development that may allow a reliable and valid assessment of both clinically relevant verbal and physiological fear reactions. VR provides a person with a high level of sensory realism. Besides, it enables the experimenter to control the situation and most of the stimulus aspects. Both factors allow to simulate realistic phobic situations and to induce emotions in a controlled, standardized way (Hoffman, 1998; Loomis et al., 1999). Additionally, the measurement of verbal, motor, and physiological responses is possible whereas artifacts usually induced by uncontrollable factors in real environments are rare.

Corresponding Author:

Andreas Mühlberger, Ph.D., University of Würzburg, Department of Psychology, Biological Psychology, Clinical Psychology, and Psychotherapy
Marcusstr. 9-11, D-97070 Würzburg, Germany
muehlberger@psychologie.uni-wuerzburg.de

¹ University of Würzburg, Department of Psychology, Biological Psychology, Clinical Psychology, and Psychotherapy (Germany)

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Clinical psychology started to use VR for treatment of phobic patients. VR exposure treatment proved to be effective for several specific phobias (see reviews by Anderson, Jacobs, & Rothbaum, 2004; Cote & Bouchard, 2008; Krijn, Emmelkamp, Olafsson, & Biemond, 2004; Pull, 2005) like fear of flying (Mühlberger, Weik, Pauli, & Wiedemann, 2006; Mühlberger, Wiedemann, & Pauli, 2003, Wiederhold & Wiederhold, 2003), fear of heights (Ressler et al., 2004; Rothbaum et al., 1995), and fear of spiders (Cote & Bouchard, 2005; Garcia-Palacios, Hoffman, Carlin, Furness, & Botella, 2002).

The adoption of virtual environment for diagnostic issues in clinical psychology, however, has rarely been investigated. Most of the research including physiological measures has been done on fear of flying. VR flights were found to elicit in self-reported and physiological fear responses in flight phobic participants (e.g., Mühlberger, Herrmann, Wiedemann, Ellgring, & Pauli, 2001), which were greater in flight phobic participants than in control participants in the same situation (Mühlberger, Petrusek, Herrmann, & Pauli, 2005). Furthermore, these studies revealed that flight phobic participants and controls showed specific fear reactions associated with specific flight phases (e.g., turbulences) and a habituation of subjective fear and heart rate changes across four virtual flights. Interestingly, treatment responses were found to be predicted by heart rate responses as well as heart rate habituation during virtual flights. Another study confirmed larger skin conductance and heart rate responses during flights with motion simulation than during flights without motion simulation (Mühlberger, Wiedemann, & Pauli, 2005).

Two additional studies assessed subjective and physiological fear reactions in flight phobic participants. Firstly, Wiederhold, Jang, Kim, & Wiederhold (2002) found that skin conductance during virtual flights was higher in phobic than in non-phobic participants, and moreover that these enhanced responses habituated more strongly in flight phobic participants who were able to take real flights after a VR exposure treatment. Furthermore, Wilhelm et al. (Wilhelm et al., 2005) reported that VR exposure of height-anxious participants leads to an enhanced SCL, but not to a HR acceleration. The authors concluded that virtual reality exposure is more likely to activate the Behavioral Inhibition System (BIS) as reflected in skin conductance than the behavioral activation system (BAS) as reflected in heart rate activation. This might be caused by the restricted possibilities of active behavior during the virtual exposure.

Finally, Mühlberger, Bülthoff, Wiedemann, & Pauli (2007) assessed subjective and physiological fear reactions of tunnel-phobic participants. This study registered verbal and physiological fear responses in 15 high tunnel-fearful and 15 matched control participants in three virtual driving scenarios: an open environment, a partially open tunnel (gallery), and a closed tunnel. High tunnel-fearful participants were characterized by elevated fear responses, specifically during tunnel drives, as reflected in verbal fear ratings, heart rate reactions and startle responses. High tunnel-fearful and control participants could be differentiated on the basis of heart rate and fear ratings with an accuracy of 88% and 93%, respectively, whereas skin conductance did not differentiate groups.

All these studies indicate that virtual environments are valuable tools for the assessment of subjective and physiological fear reactions. They show that virtual test scenarios combined with physiological measures should be used in future experimental research as well as in psychotherapy. Nevertheless, behavioral fear responses were not assessed in these studies.

The goal of the current study was to demonstrate the usefulness of virtual environments in assessing subjective, physiological, and behavioral phobic fear of spiders. Therefore, we created a virtual behavior avoidance test (VR-BAT) and asked participants to approach a virtual spider. We expected VR exposure to improve approach behavior during the VR-BAT. Clear effects on other measures of fear during the VR-BAT were not expected since participants were expected to approach the feared VR-object as close as possible in both VR-BATs. Furthermore, we were interested in the interaction between changes of approach behavior, fear report, and physiological fear symptoms assessed during exposure and how these measures are associated with psychometric measures of fear.

METHOD

PARTICIPANTS

Participants were recruited through newspaper articles and were selected according to a telephone screening. Respondents who reported having a heart disease, pregnancy, currently taking psychiatric or neurological treatment, antidepressant or anxiolytic medication, or beta-blockers were excluded. Inclusion criteria were to rate fear of spiders on a scale from 1 to 10; only those participants who rated their fear as a 6 or more and stated that they were not able to touch a spider were accepted. As nearly all respondents were women, only female participants were selected. Furthermore, all participants were assessed with a standardised diagnostic interview. Therefore, parts of the SKID (Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997) were selected. All participants fulfilled the criteria for a specific phobia (spiders). Additionally, one participant had a major depression, one a dysthymia, one a somatisation disorder, one a panic disorder without agoraphobia, one a panic disorder with agoraphobia, two a agoraphobia, and two a social phobia.

After the interview, participants were randomly assigned to two groups. For each group approach motivation was supposed to be manipulated by pressing against the table from below (to induce approach motivation) or above (to induce avoidance motivation) with the non-dominant (left for 32 participants) hand (for details see Cacioppo, Priester, & Berntson, 1993). Because this experimental treatment had no significant influence on the dependent variables, these results will not be reported here. Instead, both groups will be analysed together. Thus, the presented analyses are based on 34 participants with fear of spiders. Average age was 42.5 (SD = 15.2).

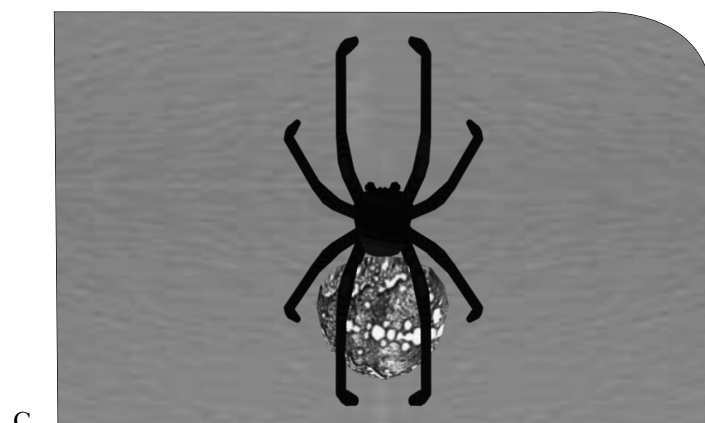
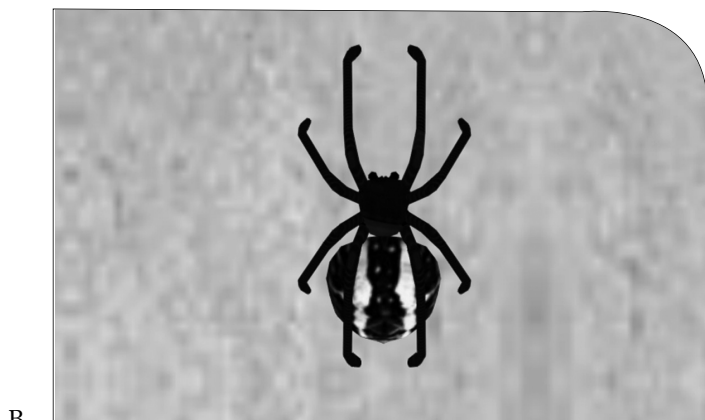
APPARATUS

The Virtual Reality (VR) environment included visual simulations of a room with two windows and two shelves at the left and right side, a door behind the participants, and a spider on the opposite wall (see Figure 1). The visual cues were presented by a head-mounted display (HMD; V6, Virtual Research Corporation). The head position was monitored with an electro-magnetic tracking device (Fast Track, Polhemus Corporation) in order to adapt the field of view to head movements. A PC with Windows operating system provided real-time texture mapping and implemented the real-time rendering of the environment with respect to the head position. A high amount of details and a frame-rate of at least 20 frames per second were achieved by renouncing stereoscopic rendering.



FIGURE 1

A



RELEVANT PSYCHOMETRIC MEASURES

The Spider Phobia Questionnaire (SPQ, Watts & Sharrock, 1984, German version by Rinck et al., 2002) consists of 43 items describing situations and reactions related to spiders. Each statement has to be rated as correct (yes) or incorrect (no). A mean score was calculated. Both Cronbach's α and 1 month retest reliability of the original SPQ are .94.

The Spider Beliefs Questionnaire (Arntz, Lavy, Van den Berg, & Van Rijsoort, 1993, German version by Pössel & Hautzinger, 2003) consists of 48 items describing dysfunctional beliefs towards spiders. Participants had to rate these beliefs as how strong they are convinced by them on a scale from 0 (not at all) to 100 (completely). A mean score was calculated. Cronbach's α and 1 month retest reliability of the original SBQ are .98 and .97, respectively.

The trait part of the State-Trait Anxiety Inventory (STAI, Spielberger, Gorsuch, & Lushene, 1970, German version by Laux, Glanzmann, Schaffner, & Spielberger, 1981) asks how a person feels habitually, and reflects habitual factors that may influence anxiety levels. Scores range from 20 to 80 with a higher score indicating a greater level of anxiety. Cronbach's α and 2 month retest reliability of the original STAI-T are .90 and .77 to .90, respectively.

Subjective Units of Discomfort (SUDs, Wolpe, 1973) ranging from 0 (no discomfort) to 100 (panic-like discomfort)

were used to assess fear responses. Participants were trained to use this scale, and ratings were requested during both VR-BATs and the exposure trials via earphone instruction.

The state version of the Body Sensation Questionnaire (BSQ, Chambless, Caputo, Bright, & Gallagher, 1984, German version by Ehlers & Margraf, 1993) was used to assess the experienced bodily symptoms during the BATs and the exposure trials. The BSQ asks how often the participant has experienced several common bodily symptoms for the past time period on scales from 1 (not at all) to 5 (all the time). A mean score was calculated.

PROCEDURE

Each participant was assessed individually during a 3 hour session. After written informed consent has been given, they completed a structured diagnostic interview and a questionnaire package that included a sociodemographic and a medical history questionnaire, several psychometric instruments which assessed fear of spiders, trait anxiety, and psychopathology. Then, electrodes were attached and participants were trained to use the joystick to move in the virtual room. In order to evaluate the influence of the approach trials participants completed a virtual reality behavior avoidance test (VR-BAT) before and after the exposure trials. During both pre- and post-VR-BAT participants were exposed to the virtual room including the spider located about 9.5 m away. Firstly, they were asked to stay still for 2 minutes while heart rate (HR) and skin conductance (SCL) were continuously measured, one SUD rating was assessed, and 12 startle probes were delivered (results not presented). After two minutes, participants were asked to approach the spider as fast and as close as possible. This second part of the assessment ceased after 3 minutes or once the participants fully approached the spider. Between pre- and post-VR-BAT participants had to approach a spider with the same size and form but with another texture 8 times (exposure trials). Each of these 8 trials lasted for 1 minute. After each trial the screen went blue and the next one started at the initial position. During each trial, again HR and SCL were continuously assessed. Furthermore, SUD ratings had to be given at 5 m distance between the participant and the spider. In case the participant did not get to within five meters of the spider, the SUD ratings were requested just before the end of the trial.

PHYSIOLOGICAL DATA ACQUISITION AND DATA REDUCTION

Electrocardiogram (ECG) and skin conductance level (SCL) were continuously registered by a Vitaport I system (Becker Inc.) at a sampling rate of 384 Hz. Skin conductance was recorded from two electrodes placed on the medial phalanges of the second and third finger of the dominant hand. The ECG was converted on-line to heart rate (HR) by an integrated R-wave detection algorithm. Phases of 60 second durations corresponding to SUD ratings were extracted and means for each VR-BAT and each exposure trial were calculated. Physiological signals were pre-analyzed offline with the BrainVision Analyser Software of BrainProducts Inc. Each trial of approach took a maximum of 3 minutes, but was automatically stopped if a participant maximally approached the spider. Approach was assessed by calculating the minimum distance (that is, maximal approach) between participant and the spider during each trial (a minimum approach of zero meters means a distance of 9.5 m, a maximal approach of 9.5 m result in a zero distance).

STATISTICAL DATA ANALYSIS

Psychometric measures of fear and spider phobia as well as VR-BAT measures (SUD, BSQ, HR, SCL, and Approach) were analyzed by a mixed-model Analysis of Variance (ANOVA) with time as within factor (pre, post). All fear measures during exposure trials (SUD, HR, SCL, and Approach) were analyzed by mixed ANOVAs with phase as within factor (8 assessment points). Significance level was set to $\alpha = .05$. If appropriate, Greenhouse-Geisser corrections of degrees of freedom (df) were applied. Significant effects were followed by specific ANOVAs or planned contrasts.

The concordance between the physiological variables (HR and SCL) or between the verbal (SUD, BSQ) and behavioral and physiological variables were assessed by correlations. For discriminate and concordant validity correlations were computed between VR-BAT responses and psychometric measures of fear. Bivariate Pearson correlation coefficients were separately computed for the pre and post VR-BAT. The correlations of change scores were based on dif-

ference between the response scores observed for the first and second exposure trial and the seventh and eight exposure trials. Furthermore, these difference scores were standardized by dividing them by their sum $((a-b)/(a+b))$, see e.g., Mühlberger, Wieser, & Pauli, 2008).

RESULTS

PSYCHOMETRIC MEASURES

Spider Phobia Questionnaire (SPQ): The mean SPQ scores before the first VR-BAT were 0.65 (SD = 0.14), after the last 0.64 (SD = 0.17). Overall, there was no reduction in fear of spiders due to the VR exposures, $F(1,33) = 0.91$, $p = .35$, $hp2 = .03$.

Spider Beliefs Questionnaire (SBQ): Mean SBQ score during the pre-VR-BAT was 52.52 (SD = 18.128), during the post-VR-BAT 47.11 (SD = 20.75). Overall, there was a reduction in negative beliefs towards spiders due to the VR exposures, $F(1,33) = 9.62$, $p = .004$, $hp2 = .23$.

VR-BEHAVIOR AVOIDANCE TEST: OVERALL CHANGES FROM PRE- TO POST- VR-BAT

Approach: Mean approach (max 9.5 m) during the pre-VR-BAT was 6.62 (SD = 1.70), during the post-VR-BAT 7.47 (SD = 2.14). After the VR exposures spider-phobic participants approached spiders closer than before the VR exposures, $F(1,33) = 6.26$, $p = .017$, $hp2 = .16$.

Fear responses: Mean fear ratings (SUDs) were 42.94 (SD = 27.55), and 38.09 (SD = 33.44) during the pre-VR-BAT and during the post-VR-BAT, respectively. This difference was not significant, $F(1,33) = 1.43$, $p = .24$, $hp2 = .04$. Overall, there was only a low reduction in fear due to the VR exposures. Mean BSQ scores were 1.63 (SD = 0.50), and 1.56 (SD = 0.69) during the pre-VR-BAT and during the post-VR-BAT, respectively. Overall, there was only a low reduction in symptoms due to the VR exposures, $F(1,33) = 0.82$, $p = .37$, $hp2 = .02$.

Physiological reactions: Mean HR during the pre-VR-BAT was 87.66 (SD = 12.16), during the post-VR-BAT 88.94 (SD = 11.68). Overall, there was no change in HR due to the VR exposures, $F(1,33) = 1.96$, $p = .17$, $hp2 = .06$. Mean SCL during the pre-VR-BAT was 5.75 (SD = 2.30), during the post-VR-BAT 6.90 (SD = 2.92). This difference was significant, $F(1,33) = 21.12$, $p < .001$, $hp2 = .39$. Taken together, there was an increase in SCL due to the VR exposures.

TABLE 1: Correlations between response levels

	BSQ	HR	SCL	Approach
pre-VR-BAT				
SUD	.68**	.17	.14	.55**
BSQ		.26	.11	-.38*
HR			.35*	-.08
SCL				-.16
post-VR-BAT				
SUD	.66**	-.01	-.16	-.62**
BSQ		-.06	-.19	-.25
HR			.27	.18
SCL				.20

NOTE: ** $p < .01$; * $p < .05$; SUD = Fear ratings, BSQ = Body Sensation Questionnaire, HR = Heart Rate, SCL = Skin Conductance Level, $N = 34$.

Correlations Between Levels of Fear Assessed During the VR-BAT

An important question for the assessment of fear is whether the three response levels reflect different aspects of the fear response. For this reason, we analyzed the associations between subjective, physiological, and behavioral fear responses separately for the pre and the post VR-BAT. As can be seen from Table 1, for the pre-VR-BAT significant correlations were found between HR and SCL and between SUD ratings and rating of experienced symptoms (BSQ) or approach behavior. For the post-VR-BAT, again strong associations between SUD ratings and rating of experienced symptoms (BSQ) or approach behavior were found.

Validity of Fear Responses Assessed During the VR-BAT to Predict Fear of Spiders

Another important question for the assessment of fear in VR is whether the responses are associated with psychometric measures of fear. We analyzed the correlations of subjective, physiological, and behavioral fear responses during the pre and post VR-BATs with trait anxiety (STAI-T), the SPQ and the SBQ (see Table 2). We expected high correlations between fear responses and specific measures of spider phobia (convergent validity) and low correlations between measures of general anxiety and spider phobia (divergent validity). Confirming this expectation SUD ratings and BSQ ratings during the BAT correlated significantly with both SPQ and SBQ measures, but not with general anxiety (STAI-T). Additionally, approach in the pre-VR-BAT and HR in the post-VR-BAT were associated with fear of spiders (SPQ). Consistent with theoretical assumptions, the more cognitive measure of beliefs about spiders (SBQ) was somehow less and not significantly associated with physiological and behavioral responses during BATs.

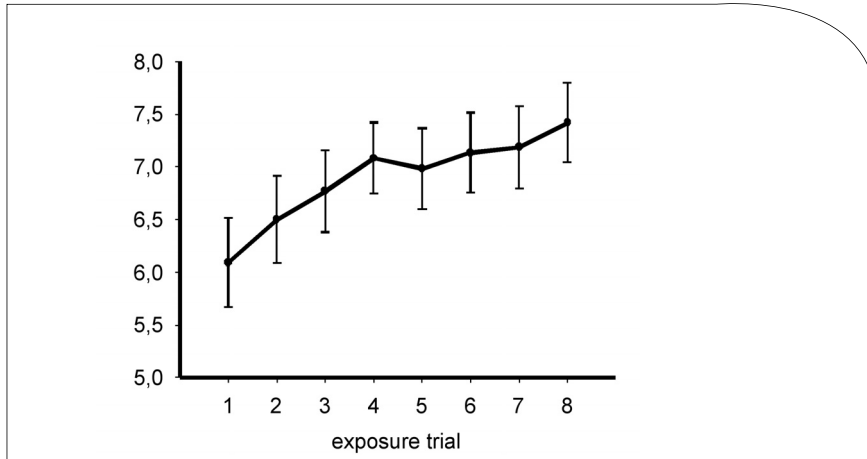
A multiple correlation between VR-BAT measures (SUD, BSQ, HR, and SCL) and the Spider Phobia Questionnaire (SPQ) revealed significant results for both the pre and post VR-BAT, $F(5,33) = 4.7$, $p = .003$ and $F(5,33) = 4.1$, $p = .007$. For the pre VR-BAT only the experienced bodily symptoms (BSQ) added significantly to this result, $p = .001$. Interestingly, for the post VR-BAT, the BSQ and the heart rate reached significance, $p = .009$ and $p = .040$.

TABLE 2: Correlations between psychometric measures and response levels

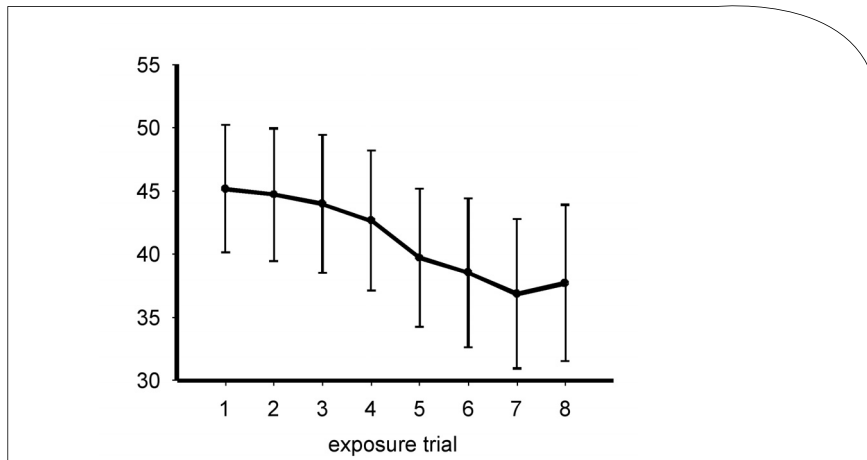
	SUD	BSQ	HR	SCL	Approach
	pre-VR-BAT				
STAI-T	-.19	-.10	.08	.19	-.01
SPQ	.35*	.64**	.20	.21	-.30*
SBQ	.32*	.66*	.24	.20	-.28
	post-VR-BAT				
SPQ	.43**	.52**	.30*	.05	-.25
SBQ	.32*	.61**	.25	.03	-.10

NOTE: ** $p < .01$; * $p < .05$; SUD = Fear ratings, BSQ = Body Sensation Questionnaire, HR = Heart Rate, SCL = Skin Conductance Level, STAI-T = Spielbergers State Trait Anxiety Inventory - trait part; SPQ = Spider Phobia Questionnaire, SBQ = Spider Belief Questionnaire, $N = 34$.

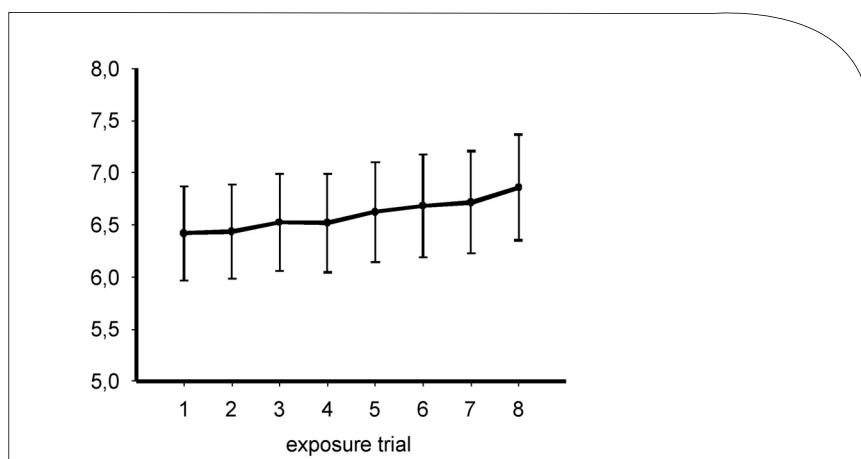
Process evaluation Approach: Mean approach (min. 0 m; max. 9.5 m) during the exposure trials is depicted in Figure 5. Overall, there was a clear and continuous increase in approach behavior during the exposure trials, $F(7,231) = 5.46$, $p = .007$, $GG-e = .28$, $hp2 = .14$, which seemed to flatten asymptotically during the second part of exposures. Contrasts revealed that all following exposure trials differed significantly compared to the first one, all $F(1,33) > 4.34$, $p < .045$.



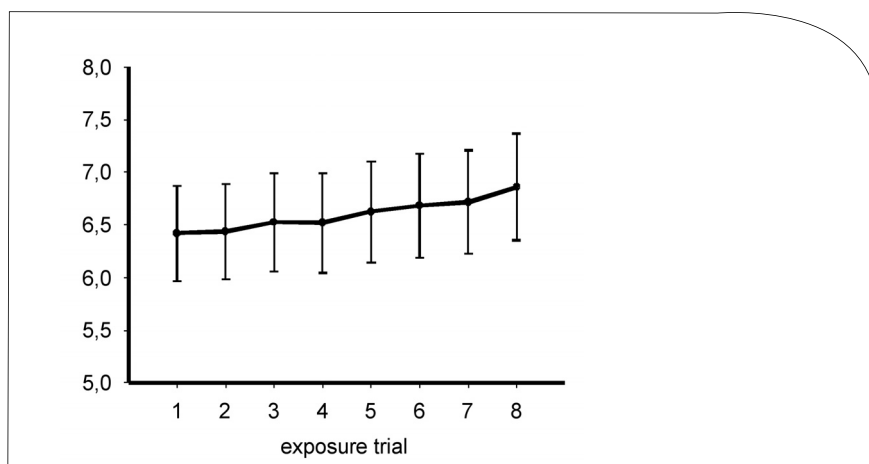
Fear responses: Mean fear reports (SUDs) during the exposure trials are depicted in Figure 2. Overall, there was a clear and continuous fear reduction due to repeated VR exposures, $F(7,231) = 4.92$, $p = .009$, $GG-e = .30$, $hp2 = .13$. Contrasts revealed that these changes were significant from the fourth to the eighth trial compared to the first one, all $F(1,33) > 4.81$, $p < .035$.



Heart Rate (HR): Mean HR during the exposure trials are depicted in Figure 3. Overall, there was a HR acceleration with repetition of trials, $F(7,231) = 11.73$, $p < .001$, $GG-e = .24$, $hp2 = .26$, which seemed to flatten asymptotically during later trials. Contrasts revealed that all later exposure trials differed significantly from the first one, all $F(1,33) > 8.26$, $p < .007$.



Skin conductance (SCL): Mean SCL during the exposure trials are depicted in Figure 4. Overall, there was an increase in SCL as exposure trials advanced, $F(7,231) = 4.47$, $p = .022$, $GG-e = .24$, $hp2 = .12$. Contrasts revealed that only the last exposure trial differed significantly from the first one, $F(1,33) > 5.34$, $p < .027$.



CORRELATIONS OF CHANGES IN THE THREE FEAR LEVELS DURING EXPOSURE TRIALS

An important question for the assessment of fear is whether the changes in each fear level are discordant, e.g., change differently (Rachman & Hodgson, 1974). A discordant change during the exposure trials would further strengthen the request for a multimodal assessment of fear response. However, one could suspect that an enhanced approach during the exposure trials would result in smaller changes in subjective and physiological fear response, while participants who decide to keep distance might show higher habituation of subjective and physiological fear responses. The visual inspection of the course of responses during the exposure trials suggests this view (see Figure 2 to 5). To follow up these assumptions we computed standardized difference scores between the first two and the last two exposure trials (see Methods). Correlation analyses using these scores showed that physiological changes were not associated with each other or the subjective fear or the behavioral approach. Only an enhanced approach toward the spiders was associated with reduced heart

rates. This is an interesting finding, since the enhanced approach from exposure trial to exposure trial was accompanied by increasing heart rates from trial to trial.

TABLE 3: Correlations between changes in each response level during exposure trials

	HR	SCL	Approach
SUD	.08	.01	-.08
HR		-.25	-.41**
SCL			.13

NOTE: ** $p < .01$; SUD = Fear ratings, HR = Heart Rate, SCL = Skin Conductance Level, $N = 34$, Correlations for relative scores $(a-b)/(a+b)$ of mean of trial 1 and 2 (a) and mean of trial 7 and 8 (b) are reported.

DISCUSSION

The eight, short one minute VR exposures conducted in the current study did not change the spider fear of spider phobic participants but altered their negative beliefs about spiders. This change could be regarded as positive treatment outcome. Furthermore, the pre to post comparison in the VR-BAT did not show any changes in the subjective and the physiological fear responses, but a closer approach to the virtual spider. This closer approach or the mere anticipation of it in the post-VR-BAT (being closer to a virtual spider) may have caused fear reports and physiological responses like in the pre-VR-BAT. In other words participants approached the spider to equally subjective and objective fear responses.

The correlational analyses within fear measures revealed discordances between fear reports and behavior as well as physiological fear responses (HR, SCL), but a moderate concordance within the two physiological measures and within the subjective and behavioral measures. These results again indicate the need for a broad assessment of fear responses.

Further correlational analyses between psychometric measures of fear and VR-BAT responses were conducted to evaluate the validity of these responses to assess fear. Results revealed a high correlation of subjective fear and bodily symptoms as well as approach behavior during the BATs with specific measures of spider phobia, but not with general anxiety indicating concordant and discriminate validity of the VR-BAT. The multiple regression analyses indicate that especially the bodily symptoms during the VR-BAT are valid predictors of the intensity of spider phobia. However, there are hints that a physiological measure as the heart rate has predictive value, too.

Interestingly, the process analyses of the eight exposure trials indicated lower fear reports and enhanced approach behavior as exposure trials advanced despite of continuously but asymptotically increasing physiological fear responses. Most likely the closer approach to the feared object may have caused an increase in physiological responses. Subjective fear ratings may have decreased because participants themselves decided to approach the feared object. Remarkably, the analyses of changes during the exposure trials showed that heart rate changed concordantly with approach behavior, but not with subjective fear. However, the discordance in the time course of subjective and behavioral compared to physiological responses indicates the need for a broad assessment of fear responses to understand the course of fear processing in detail.

A major shortcoming of this study is that only phobic subjects and only a very short treatment with few exposure trials have been evaluated. Nevertheless, our results clearly indicate that fear-related VR environments are able to reliably trigger disorder specific verbal, physiological, and behavioral fear responses in spider phobic individuals. Most importantly, this study is the first assessing physiological and behavioral responses and their interactions. Future studies should assess the usefulness of a virtual reality behavior avoidance test in a clinical setting and should directly compare equivalent in-vivo and VR situations as well as phobic and control participants to further demonstrate the validity of VR environments.

In conclusion, the virtual reality scenario seems feasible for the behavioral and physiological assessment of fear. As VR environments compared to real environments have the advantage of being much more controllable and replicable, they might be useful not only for the treatment of phobias but also for assessment and for experimental research on specific phobias.

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THE ROLE OF MEDIA IN SUPPORTING A STRESS MANAGEMENT PROTOCOL: AN EXPERIMENTAL STUDY

Daniela Villani¹ and Giuseppe Riva¹

Stress management (SM) is a term widely used with a seemingly obvious meaning but it is not clear how many different forms of SM exist and how efficacious they are according to the target problem. Stress is a multidimensional condition and we believe that it requires a wide-spectrum approach. We consider that a combination of stress management techniques can produce more significant outcomes than did single-strategy programs. For this reason we propose an integration of three approaches to cope with stress and improve emotional management from different points of view: the Emotion Focused Therapy; the Behavioral Therapy, and in particular Relaxation; the Rational Emotive Therapy.

In particular, we decided to use two mediated experiences – audio and immersive 3D video – to support the Relaxation phase. The critical role in mediated experiences is played by the sense of presence that allows the experience to evoke the same perceptual reactions and emotions as a real one.

To verify the efficacy of the SM protocol we carried out a controlled trial, comparing an experimental Video group, an Audio group (that only listened to the relaxing narrative), and a control group without treatment. Results showed the efficacy of integrating different approaches to cope with stress and suggested the importance of the sense of presence as a mediating variable between the experience and the efficacy of the relaxation process.

INTRODUCTION

Stress management (SM) is a term widely used with a seemingly obvious meaning, as recently noted by a review (Ong, Linden, & Young, 2004), but it is not clear how many different forms of SM exist and how efficacious they are according to the target problem. Analyzing more than hundred research articles, results showed that the most commonly employed components in a SM program involve multicomponent cognitive-behavioral therapy (CBT) or relaxation-oriented techniques.

Stress has been associated with a variety of chronic and acute illnesses (S. Cohen et al., 1998; S. Cohen, Miller, & Rabin, 2001), with increased health care costs and decreased productivity (Pelletier & Lutz, 1988). As a consequence, considerable research has been conducted with a variety of specific types of samples applying a variety of professional-to-participant interventions. A comprehensive review of work-site-based research (Murphy, 1996) identified that the most common single stress-management techniques applied were relaxation and cognitive reframing. Importantly, at the same time the review concluded that programs that apply a combination of stress management techniques produced more significant outcomes than did single-strategy programs.

Corresponding Author:
Villani Daniela, Università Cattolica del Sacro Cuore, Interactive Communication and Ergonomics of New Technologies – ICE-NET Lab,
Largo Gemelli 1, 20123 Milan, Italy, daniela.villani@unicatt.it

¹Istituto Auxologico Italiano, Applied Technology for Neuro-Psychology – ATN-P Lab. (Italy)

We believe that this represents a critical point to cope with a multidimensional condition such as stress that requires a wide-spectrum approach. Rather than concentrating on toning down or suppressing emotions, people need to guide their emotions toward constructive action or transform them into ones that are more favorable and more helpful to problem solving.

Looking at the several existing psychotherapeutic approaches, we can recognize that, usually, each approach focuses on a specific aspect of the human experience. According to Murphy, (Murphy, 1996) we consider that a combination of stress management techniques can produce more significant outcomes than did single-strategy programs. For this reason we decided to propose an integration of three approaches to cope with stress and improve emotional management from different points of view:

- the Emotion Focused Therapy (EFT), developed by Greenberg (2004), that considers emotion as a determinant key of self-organization;
- the Behavioral Therapy, focused on using learning principles to eliminate or to reduce maladaptive behaviors. In particular we consider the importance of Relaxation (Jacobson, 1938; Schultz & Luthe, 1969);
- the Rational Emotive Therapy, developed by Ellis (1962), based on the premise that many problems arise from irrational thinking.

In particular, we decided to use two different media (Video and Audio) to support the Relaxation process. As investigated in a recent study (Villani et. al., 2007), authors concluded that people might learn relaxation strategies within controllable mediated experiences.

A mediated experience may evoke the same perceptual reactions and emotions as a real one (Levin & Simons, 2000), and we consider that the sense of presence plays a critical role to reach this effect (Riva, Davide, IJsselsteijn, 2003; IJsselsteijn, Lombard, Freeman, 2001; Riva et. al., 2004). The phenomenon of presence has been researched in several domains, such as films, books and virtual environments, using different labels. In film theory, it is known as the diegetic effect (Burch, 1979; Tan, 1996), and in literature theory and research on the persuasiveness of narratives it is known as transportation (Gerrig, 1993; Green & Brock, 2000). On one side, in film, the diegetic effect is defined as the “experience of the fictional world as the environment” or that “the feature film creates the illusion of being present in the fictional world” (Tan, 1996, p. 52). Tan assumes that the diegetic effect is based on the general effect that paintings and photographs draw “the beholder in a position that is defined in relation to an imaginary space behind the window formed by the picture plane and the frame” (p. 53). The viewer of the film becomes an onlooker on an environment, “viewers experience the fictional events as if they were happening all around them” (Bordwell, Staiger, & Thompson, 1985, p. 37).

On the other side, everybody knows that reading a gripping novel can transport us far away from the armchair to the environment described in the text, and that we can be totally absorbed in this experience. Building on this spatial metaphor, Green and Brock (2000) have called this phenomenon transportation. In their definition of transportation, they assume that mental imagery evoked by a story has an impact on the attitudes of the reader when it is activated in the state of high transportation, because transportation inhibits a critical scrutinising of the content and the “message” of the imagery. According to the different perspectives developed until now, we consider that the sense of presence could be a key factor to support an optimal experience. In this direction, some authors (Plante, Cage, Clements, & Stover, 2006; Plante et al., 2003) have recently observed that individuals who interact in a mediated environment are enriched with a variety of positive visual and auditory stimulation, and report greater improvement in

self-efficacy and mood (McAuley, Talbot, & Martinez, 1999; Turner, Rejeski, & Brawley, 1997). This suggests that it is possible to use mediated incident for manipulating experience-related self-efficacy and mood.

As we stated before, we intended to use the mediated experiences as support to the relaxation process. For this reason they should be included in an emotional management protocol involving additional aspects to relaxation, that could be integrated also in external activities to the mediated experience, such as in introducing it or briefing it.

The research aimed to test the efficacy of a SM protocol integrating important strategies: a relaxation training; a monitoring record card to help participants to be aware of their own emotions, thoughts and behaviors; an imagination guided experience, related to a personal positive experience, to rehearse positive emotions.

To verify its efficacy we carried out a controlled trial. According to Freeman and colleagues categorization (Freeman, 2003; Ijsselstein et al., 2000), we fixed the “media content” that includes the theme, narrative represented by the medium (in this study it was constituted by the integration of different relaxation techniques) and we manipulated the “media form” dimension, that refers to physical, objective properties of a display medium (in this study two mediated experiences: audio and video). For this reason we compared two mediated conditions: an immersive 3D VIDEO group (without interaction) and an AUDIO-tape group, we also included a control group without treatment. In particular we aimed to test several hypotheses:

Hypothesis 1: The protocol that integrates different techniques to manage stress is effective in both conditions (Video and Audio) considered.

Hypothesis 2: There is a significant difference between the efficacy of the mediated experiences proposed. In particular we expected that Video group could obtain better outcomes.

Hypothesis 3: We hypothesized that a prediction relationship exists between the sense of presence experienced and treatment outcomes.

METHOD

PARTICIPANTS AND DESIGN

We recruited thirty-six participants, aged 18 to 35 years for the study from the principal Universities of Milan ($M=24.89$; $SD=5.19$). In agreement with Scherer’s theory (Sander, Grandjean, & Scherer, 2005), we maintain that the coherence between the content of the experience and the goal of the participant is critical. For this reason we selected the participants with a cut-off level of stress, corresponding to the higher quartile, measured through the MSP questionnaire (Tessier et al., 1990; Di Nuovo et al., 2000).

We randomly allocated groups of 12 participants to each of the 3 conditions by a true random number service (<http://www.random.org>). They voluntarily participated to the experiment after subscribing the informed consent. In order to study the efficacy of the whole protocol, supported by the technology in the Relaxation phase, a between subjects design was used with 2 experimental conditions, a control group, and repeated measurements (pre and post-sessions).

- In VIDEO Condition, participants watched a 3D animation Video in immersion (experienced with a head-mounted display) but without interaction. The Video took them to specific zones of a natural park, such as for example the river, the waterfall or the garden and they did the relaxation exercises supported by a relaxing narrative.
- In AUDIO-tape Condition, participants listened to the same relaxing narrative. In this condition imagination

skills were required from the participants to contextualize the relaxing experience.

- Control group participants didn't follow any treatment.

MEASURES

The dependent variables were stress and anxiety. We also evaluated the sense of presence experienced by the participants using different technologies. Our proposed Integrated Multimodal Assessment – combining quantitative and qualitative methodologies – was used to provide a more robust mechanism to identify the affective state of the participants. Several questionnaires were used:

- The *MSP (Mesure du Stress Psychologique)* Questionnaire (Tessier et al., 1990; Di Nuovo et al., 2000) is a self-report measure that evaluates stress levels perceived within the last three months. It considers six dimensions: loss of control and irritability, psychophysiological feelings, sense of effort and confusion, depressive anxiety, pain and physical problems, hyperactivity and accelerated behaviors. We used this questionnaire to select the sample with a cut-off level of stress, corresponding to the higher quartile.
- The *PS (Perceived Stress)* Questionnaire (Levenstein et al., 1993) measures the stress perceived in the last month focusing on these areas: harassment, overload, irritability, worries and tension. In particular the PSQ is widely used to investigate minor physical symptomatology in basically healthy individuals and we used all the scales identified by the authors.
- The *State Trait Anxiety Inventory* (Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, & Jacobs, 1983) is a self-report measure that assesses anxiety levels. According to the authors, State Anxiety reflects a “transitory emotional state or condition of the human organism that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity.” Trait anxiety considers the tendency to perceive stressful situations as dangerous and threatening that reply to the several situations with different intensity.
- The *VAS - Visual Analogue Scale* (Gross and Levenson, 1995), typically is an instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. We decided to use 8 adjectives questionnaire to describe different emotions, in particular: happiness, anger, rage, disgust, relaxation, fear, sadness and surprise.

From a physiological point of view, we consider stress to be accompanied by the generalized activation of the nervous central system, autonomous nervous system, and neuromuscular system. This implies an increase in muscular tension, heart rate, blood pressure, palmar sweating, peripheral vasoconstriction, and the rate and irregularity of respiration. For this reason, we selected different physiological parameters to test the activation of the subjects in correspondence of emotional arousal at the begin and at the end of each session. We used the BioGraph Infinity Procomp and in particular we considered:

- Respiration Rate and Respiration Amplitude. The sensor is applied with a band on the chest of the participant round to the thorax.
 - Heart Rate and Heart Amplitude. The sensor is applied on the middle finger through a small rubber strap.
 - Skin Conductance. We used two small sensors positioned on the index and the ring fingers of the hand through the use of two rubber straps.
 - Electromyography. The EMG sensor is positioned on the forearm of the participant.
- To measure the level of subjective presence we used:
- The *ITC- Sense of Presence Inventory (ITC-SOPI)* (Lessiter et al., 2001), that is a subjective presence measure

including two parts, *after* and *during* a media experience. It considers four dimensions: Physical space (a sense of physical placement in the mediated environment, and interaction with, and control over, parts of the mediated environment), Engagement (a tendency to feel psychologically involved and to enjoy the content), Ecological Validity (a tendency to perceive the mediated environment as life-like and real), and Negative effects (adverse physiological reactions).

TOOLS AND STRATEGIES

The immersive 3D animation video condition involved different natural zones related to different relaxation exercises: lake, river, waterfall, garden and forest. In Figure 1 and Figure 2 two images of the video are presented.

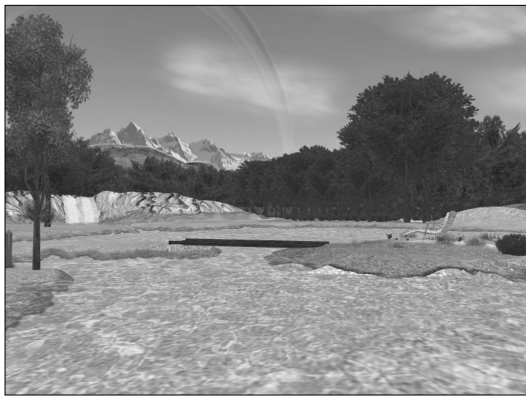


FIG. 1. Video: view of lake and waterfall



FIG. 2. Video: view of garden and lake

The relaxation phase is only one of the strategies of the protocol, which included different strategies to learn how to cope with stress. We selected three techniques aiming to increase self-awareness, learn to control and to relax, substitute negative emotions and induce positive emotions:

- 1) A self-monitoring record card to help participants be aware of their own emotions, thoughts and behaviors. The record card refers to the ABC (*Activating Event, Belief Consequent Emotion*) model developed by Ellis (Ellis and Harper, 1961) that describes the sequence of events ultimately leading to the experienced feelings. The self-monitoring card recommends that people break down their experience into these three areas in order to discover if distortions or “irrational beliefs” are present.
- 2) A relaxation training. After analyzing the literature in this field and the results achieved in the previous study, we decided to use different techniques to induce relaxation, involving Autogenic training (Schultz & Luthe, 1969), Progressive Muscular Relaxation (Jacobson, 1938), and breathing techniques. In particular this approach is supported by the use of different technologies.
- 3) A guided imagery experience. According to the phase of “transforming emotion” included in the EFT (Greenberg, 2004), positive imagery represents a good strategy of effecting an emotional response. Through practice people can learn how to generate opposite emotions through imagery and use them as an antidote to negative emotions.

For this reason we decided to include a guided imagery experience, one of the most well-studied integrative therapies (Lehrer et al., 1980; Lehrer et al., 1994), related to a personal positive experience, to induce positive emotions. More and more, patients are relying on the use of guided imagery to provide a significant source of strength, support, and courage in order to manage the daily stresses.

The treatment was actually similar between the two groups, except for the Video / Audio difference.

The computerized and mediated materials consisted of:

- a portable computer (Fujitsu Siemens AMILO Processor, Pentium 4 ATI Radeon 9007, 128 Mb graphic memory);
- a Head-Mounted Display: Sony Glastron PLM S-700
- an Audio-tape with headphones (Sony MDR-EX51LP Fontopia in-the-ear headphones).

PROCEDURE

Participants sat in a swivel armchair that was in front of a computer and were tested once per session. At the beginning of the sessions, they provided their informed consent and received a set of instructions about the experiment. Table 1 presents the protocol schema, the experiment consisted of 6 sessions. The first 4 sessions were carried out within two weeks. The last two sessions were carried out after one month (first follow up) and after three months (second follow up) to assess the maintenance of the obtained results.

In the 1st session we carried out a *Baseline Assessment* (Pre-treatment), consisting of:

- A 3-minute physiological measurement (baseline);
- Administration of the questionnaires to assess anxiety and stress levels (VAS, STAI-state and trait, PSQ);
- Delivery of a document about Theory of stress, emotions and emotional regulation and information about the content of the research and the used strategies.
- Introduction of the self-monitoring record card referred to the ABC model.

In the 2nd session we carried out the *Therapeutic session*:

1st week	2nd week	1st Follow up (after 1 month)	2nd Follow up (after 3 months)
1st session - baseline assessment - self-monitoring record card ABC	3rd session - Assessment before Session 3 - Use of self-monitoring record card ABC - Relaxation phase - Assessment after Session 3	5th session - Assessment before Session 5 - Questions about strategies used - Self- Relaxation phase - Assessment after Session 5	6th session - Assessment before Session 6 - Questions about strategies used - Self- Relaxation phase - Assessment after Session 6
2nd session - Assessment before Session 2 - Imagination phase - Relaxation phase - Assessment after Session 2	4th session - Assessment before Session 4 - Relaxation phase - Assessment after Session 4 - Delivery of Audio CD		

- *Assessment before Session 2 (before Treatment)*: A 3-minute physiological measurement (baseline) and Administration of the questionnaires to assess anxiety levels (VAS, STAI-state);
- Imagination phase. The guided imagery experience, related to a personal positive experience, was used to induce positive emotions.
- Instructions for participants in the Video condition to use the specialized equipment.
- Relaxation phase. Participants in all conditions listened to the relaxing narrative and did the relaxing exercises, based on PMR, Autogenic Training, and deep breathing techniques.
- *Assessment after Session 2 (Post-treatment)*. A 3-minute physiological assessment was conducted. Then participants completed the questionnaires (VAS, STAI-State) to assess anxiety levels.

In the 3rd session we carried out the *Therapeutic session*:

- *Assessment before Session 3 (before Treatment)*: A 3-minute physiological measurement (baseline) and Administration of the questionnaires to assess anxiety levels (VAS, STAI-state);
- Conversation about the filling out of the Self-monitoring record card ABC.
- Instructions and Relaxation phase. Participants in all conditions listened to the relaxing narrative and did the relaxing exercises, based on PMR, Autogenic Training and deep breathing techniques.
- *Assessment after Session 3 (Post-treatment)*. A 3-minute physiological assessment was conducted. Then participants completed the questionnaires (VAS, STAI-State) to assess anxiety levels.

In the 4th session we carried out the *Therapeutic session*:

- Assessment before Session 4 (before Treatment): A 3-minute physiological measurement (baseline) and Administration of the questionnaires to assess anxiety levels (VAS, STAI-State);
- Instructions and Relaxation phase. Participants in all conditions listened to the relaxing narrative and did the relaxing exercises, based on PMR, Autogenic Training and deep breathing techniques.
- *Assessment after Session 4 (Post-treatment)*. A 3-minute physiological assessment was conducted. Then participants completed the questionnaires (VAS, STAI-State and Trait, PSQ, MSP) to assess anxiety and stress levels.
- Delivery of Audio CD with the narratives listened within the sessions in order to continue the relaxation training at home.

Participants in the control condition did not receive the treatments, but were only assessed on 1st and 4th sessions. These participants completed the questionnaires to assess their emotional states, anxiety and stress levels.

Follow up 1 (after 1 month) and follow up 2 (after 3 months) were carried out in the same way. At the beginning of these sessions, we conducted the physiological assessment. Then we questioned about the use of the strategies learned in daily life and we proposed that the participants filled in the questionnaires. During the session, we asked the participants to apply one of the learned strategies to relax them-selves. At the end we carried out the physiological assessment after session.

RESULTS

In statistics, an exact (significance) test is a test where all assumptions upon which the derivation of the distribution of the test statistic is based upon are met, as opposed to an approximate test, in which the approximation may be made as close as desired by making the sample size big enough. This will result in a significance test that will have a false rejection rate always equal to the significance level of the test. For example an exact test at significance level 5% will in the long run reject a true null hypothesis exactly 5% of the time (Fisher, 1925), avoiding Type I Errors.

While exact p values are preferred for scientific inference, they often pose formidable computational problems and so, as a practical matter, asymptotic p values are used in their place. For large and well-balanced data sets, this makes very little difference, since the exact and asymptotic p values are very similar. But for small, sparse, unbalanced, and heavily tied data, the exact and asymptotic p values can be quite different and may lead to opposite conclusions concerning the hypothesis of interest.

In this situation, the Monte Carlo method (Manley, 1991) provides an unbiased estimate of the exact p value, without the requirements of the asymptotic method. The Monte Carlo method is a repeated sampling method. For any observed table, there are many tables, each with the same dimensions and column and row margins as the observed table. The Monte Carlo method repeatedly samples a specified number of these possible tables (about 10,000) in order to obtain an unbiased estimate of the true p value.

For these reasons, given the small sample of the study, we compared samples using the Exact Tests procedure with Monte Carlo estimate (SPSS 13 Exact Tests Module).

- First, before treatment we compared the participants involved in the three conditions (Video, Audio and Control) and we didn't find significant differences between groups.
- Then, we analyzed the degree of change of the dependent variables achieved with the treatment separately for each group (within groups effects).
- As a third analysis set, we focused on testing whether the degree of change was different among the three groups (between groups effects).
- A final analysis tested whether a relationship existed between sense of presence and efficacy of the treatment through multiple regression analyses. Eakin and colleagues (1989) developed an explicit relationship between sample size, sampling error, and related costs for the application of multiple regression models in observational studies. Their method reveals that, in most cases, the imprecision of estimates and minimum total cost are relatively insensitive to increases in sample size beyond $n=20$. Because of the intrinsic variation of the regression model, even if larger samples are optimal, the relative change in the total cost function is small when the cost of imprecision is a quadratic function. For this reason, even with our small sample ($n=12$) we decided to use a multiple regression to evaluate the possibility of using Presence subscales to predict the outcome of the treatment. In the analysis we followed the procedure suggested by Prescott (1987) to overcome Type I errors (SPSS 13 Regression Models Module):
- we used as estimation procedure a bayesian estimation (Oman, 2002) instead of the ordinary least squares one;
- we considered as significant only Multiple Regressions with an adjusted R Square higher than 0.65.

We analyzed data from the following "moments/time points" in the treatment: T1 (baseline); T2a (before Session 2); T2b (after Session 2); T3a (before Session 3); T3b (after Session 3); T4a (before session 4); T4b (after Session 4 - post the whole treatment); T5 (1st follow up); T6 (2nd follow up).

HYPOTHESIS 1

Some significant changes were found related to the self-reports using the analyses within groups, as showed in Table 2 (we reported in the Table only the more significant and representative results). To compare different moments of the treatment for each condition we used the Friedman and Wilcoxon tests (paired samples).

Since the time separating the four sessions involved in each condition was 3-4 days, some participants started each session with different anxiety state levels in comparison to the ones achieved at the end of the previous session. For

this reason we considered the outcomes obtained both in each session and in the whole treatment (T1-T4). As represented in table 2, we found that during the three guided sessions (session 2, 3 and 4):

- Either in VIDEO and AUDIO condition there are significant changes in State Anxiety reduction (STAI). Only the VIDEO group significantly reduced State Anxiety steadily in all sessions.
- Furthermore, we found a significant increase of Relaxation State (VAS) in VIDEO and AUDIO conditions. Also in this case, only the VIDEO group reached relaxation steadily during all sessions.

No significant changes were found in Control condition and they were not reported in the table.

(T1-T4b): Analyzing the period of time between the beginning of the treatment and the end of the guided sessions for each condition, it appears that AUDIO group reached significant changes.

In fact, AUDIO group shows:

- a significant reduction of Overload ($F=1.976$, $p<.05$) and Irritability ($F=2.264$, $p<.05$), both measured by the PSQ questionnaire.

Psychological Dimensions	Condition	Session 2	Session 3	Session 4	T1-T4b
Anxiety State (STAI)	VIDEO	Z=2.380, p<.01 (M2a=44.90; DS2a=10.77; M2b=37.70; DS2b=8.04)	Z=2.151, p<.05 (M3a=42.70; DS3a=8.12; M3b=39.20; DS3b=7.55)	Z=2.670, p<.005 (M4a=44.40; DS4a=8.72; M4b=38.40; DS4b=6.82)	Z=2.091, p<.05 (M1=44.80; DS1=8.66; M4b=38.40; DS4b=6.82)
	AUDIO	Z=1.837, p<.05 (M2a=37.50; DS2a=12.32; M2b=31.40; DS2b=9.06)	Z=2.710, p<.005 (M3a=40.80; DS3a=9.94; M3b=35.30; DS3b=8.18)	-----	-----
Relaxing State (VAS)	VIDEO	Z=2.565, p<.005 (M2a=3.60; DS2a=1.51; M2b=5.00; DS2b=1.33)	Z=2.121, p<.05 (M3a=4.10; DS3a=1.10; M3b=4.70; DS3b=1.06)	Z=2.126, p<.005 (M4a=3.90; DS4a=.88; M4b=4.70; DS4b=1.25)	-----
	AUDIO		Z=2.636, p<.05 (M3a=4.30; DS3a=1.49; M3b=4.80; DS3b=1.23)	Z=2.828, p<.005 (M4a=4.30; DS4a=1.34; M4b=4.80; DS4b=1.29)	Z=1.997, p<.05 (M1=3.70; DS1=1.64; M4b=4.80; DS4b=1.29)

In the time occurring between the fourth session and the two follow up (T4-T5; T4-T6), participants received an audio CD to listen to the relaxation exercises and to improve their ability.

(T4b-T5; T4b-T6): Monitoring the results obtained after the guided sessions and analyzing the outcomes achieved at the follow up sessions the situation appears different. Both AUDIO and VIDEO groups gained good improvements during the period of time after the guided sessions.

AUDIO group shows:

- a significant reduction of the Harassment, measured by the PSQ questionnaire, between T4 and T5 ($F=2.058$, $p<.05$) and between T4 and T6 ($F=2.329$, $p<.05$);
- a significant reduction of the Psycho-physiological feelings, measured by the MSP questionnaire, between T4 and T5 ($F=2.226$, $p<.05$) and between T4 and T6 ($F=1.826$, $p<.05$);
- a significant reduction of the Hyperactivity and accelerated behaviours, measured by the MSP questionnaire, between T4 and T5 ($F=2.333$, $p<.05$) and between T4 and T6 ($F=2.047$, $p<.05$).

VIDEO group shows:

- a significant reduction of the Lack of joy, measured by the PSQ questionnaire, between T4 and T5 ($F=1.902$, $p<.05$) and between T4 and T6 ($F=1.785$, $p<.05$);
- a significant reduction of the Fatigue dimension, measured by the PSQ questionnaire, between T4 and T5 ($F=2.232$, $p<.05$);
- a significant reduction of the Tension, measured by the PSQ questionnaire, between T4 and T6 ($F=1.845$, $p<.05$);
- a significant reduction of the Depressive Anxiety, measured by the MSP questionnaire, between T4 and T5 ($F=2.555$, $p<.005$) and between T4 and T6 ($F=2.116$, $p<.05$).

Furthermore, participants of Video group learned the ability to control their physical reactions. In particular they showed a good capacity to reduce heart rate both in the first follow up ($Z=-2.589$, $p<.05$) and in the second follow up session ($Z=-2.354$, $p<.05$).

HYPOTHESIS 2

Our second hypothesis was related to finding differences between groups. We investigated whether the degrees of change in anxiety, relaxation, emotional states and traits were different among the three groups (VIDEO, AUDIO and Control) through the Mann Withney (3 independent samples) test.

Considering the physiological parameters, significant differences were found during the first follow up. The VIDEO group showed a higher level of heart rate reduction ($Z=-2.216$; $p<.05$) compared to the other groups.

Considering the stress dimensions:

- between the first and the fourth session (T1-T4b), the AUDIO group showed a higher reduction of Strain and Confusion feeling (MSP) ($Z=-1.998$; $p<.05$) and a higher reduction of Irritability (PSQ) ($Z=-2.042$; $p<.05$) compared to the other groups.
- between the first session and the first follow up (T1-T5), the VIDEO group showed a higher reduction of Depressive Anxiety (MSP) ($Z=-2.503$; $p<.05$) compared to the other groups.

The absence of numerous significant differences between groups could be interpreted that all participants followed the same steps of the protocol. They used the same techniques (cognitive, relaxation and imagery) and they could have found the mediated experience to be positive: they listened to the same narrative and did the same relaxation exercises.

es. A deep explanation will be treated in the discussion paragraph.

HYPOTHESIS 3

At the end, we were interested in investigating whether a causal relationship existed between presence factors and emotional changes. To reach this aim we carried out the regression analyses with the VIDEO group. Some interesting results emerged, as showed in Table 3, and thus helps us understand the direction of the relationship existing between the sense of presence experienced by the participants and the treatment outcomes.

In the third session:

- the sense of presence is a good predictor of the Anxiety state (measured by STAI) at the end of the session;

In the fourth session:

- the sense of presence is a good predictor of the Relaxation state (measured by VAS) at the end of the session.

Session	Dependent Variables	Model	Variables	t	P
3	Anxiety State (STAI)	R square=.787 R adjusted=.666 F=6.478 p<.05	Negative Effect	t= 3.789	p<.01
			Physical space	t= -3.031	p<.05
			Ecological Validity	t= 3.329	p<.05
4	Relaxation State (VAS)	R square=.800 R adjusted=.686 F=6.996 p<.05	Engagement	t= -4.751	p<.005
			Physical space	t= 5.030	p<.005

It is important to underline that the results coming from the regression analysis involve the same emotional changes obtained from the analysis within subjects. In particular, both anxiety reduction and relaxation increases were found in VIDEO condition during the guided sessions. Regression analysis showed that there is a prediction between the sense of presence perceived by the participants and these achieved outcomes.

DISCUSSION

As we stated at the beginning, relaxation is only one of the strategies to include in a stress management protocol. According to Murphy, (Murphy, 1996) we considered that a combination of stress management techniques can produce more significant outcomes than single-strategy programs. For this reason, we developed a protocol that integrates different techniques to cope with stress and improve emotional management according with the three emotional processing principles of the emotion-focused therapy (Greenberg 2004):

1. To increase “awareness of emotions”, we used the self-monitoring record card. This card, referred to the ABC model (Ellis, 1962), helped participants to be aware of their own emotions and to learn how to break down their experiences in Activating events, Belief and consequent Emotion, in order to discover if distortions or “irrational beliefs” were present.
2. To enhance “emotion regulation”, we applied the Relaxation training involving Autogenic Training (Schultz & Luthe, 1969), Progressive Muscular Relaxation (Jacobson, 1938) and breathing techniques. In particular, we decided to use two different media - VIDEO and AUDIO - to support the relaxation phase.
3. According to the “transforming emotions” phase, we used the guided imagery experience as a good strategy of affecting the emotional response. The aim was to support participants to learn how to generate opposing emotions through imagery and use them as an antidote to negative emotions.

The study aimed to verify three hypotheses. Our first hypothesis was to verify the efficacy of the whole protocol, supported by different media.

According to previous results (Banos et al., 2004; Riva et al., 2007) showed that mediated experiences can induce affective responses, as they are real, these results also confirmed the efficacy of VIDEO and AUDIO-tape as affective media that produce the expected emotional state. In fact, both media during the three guided-sessions (session 2, 3 and 4) supported the Relaxation process and outcome.

After the guided sessions, participants received an audio CD to listen to the relaxation exercises and to continue the relaxation training. After one month and after three months participants of both mediated groups confirm a reduction of several stress dimensions. Furthermore, only the participants of the VIDEO group showed a good ability to control their physical reactions, in particular to reduce heart rate. The best ability of VIDEO group in managing the bodily function could be interpreted considering that the sense of presence did not necessarily require the consciousness of the subject.

According to Vincelli (1999), thanks to visual presentation of the mediated content, the experience is more vivid and real than the one that most subjects can create through their own imagination and memory. Probably, the visual presentation of a calm scenario has helped participants to practice and master relaxation and acceptance techniques.

Although the results obtained confirmed the efficacy of the proposed protocol, we were also interested (Hypothesis 2) in finding significant differences between the mediated proposed experiences. In particular we expected that Video group could obtain better outcomes. On the contrary we did not find a lot of significant differences between groups. This result could be ascribed to the complexity of the protocol that involved different aspects. The outcomes achieved are probably the consequences of the different strategies used (cognitive, relaxation and imagery) and in the whole protocol the media supported only the relaxation phase. As we stated before, the content of the experience was the same and all participants could have found positive the mediated experience: they listened to the same narrative and did the same relaxation exercises. In this sense, according to the Stimulus Evaluation Check theory of (SEC) Scherer and colleagues (Sander et al., 2005; Scherer, 2001), the intrinsic pleasantness and goal conduciveness could have induced similar effects in the different mediated experiences proposed. Furthermore, relaxation therapies and guided meditation practices can have induced and extended the duration of pleasant experiences (Smith, 1990).

A mediated experience may evoke the same perceptual reactions and emotions as a real one (Levin & Simons, 2000), and we consider that the sense of presence plays a critical role to reach this effect (Riva, Davide, Ijsselstein, 2003;

Ijsselsteijn, Lombard, Freeman, 2001; Riva et. al., 2004). The regression analyses showed that predictions exist between presence factors and the emotional changes obtained during the guided sessions and helped us to understand the direction of these relationships.

In particular, the sense of presence perceived by the participants in VIDEO condition is a good predictor of the Anxiety state reduction and the Relaxation state increasing.

The results obtained are very encouraging. The protocol supported by mediated experiences appears to be effective. In addition, we can state that a relation exists between presence and treatment outcomes.

Due to the limitation of the small sample ($n = 36$), the results should be interpreted with caution until they are replicated. However, the good findings coming from the previous works and from this one encourage us to open the doors to new applications of the mediated experiences, such as promoting positive emotions and well being.

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LOW-COST VIRTUAL MOTOR REHABILITATION FOR NEUROPHYSICAL DISABILITY IMPROVEMENTS IN IMPAIRED PATIENTS

Mariano Alcañiz¹, José A. Gil¹, Javier Chirivella¹, Enrique Noé¹,
 Carolina Colomer², and Joan Ferri¹

Motor rehabilitation needs, in most cases, specialists that indicate exercises to do, and, generally, the specialist must follow the patient most of the time. Moreover, there are not objective measures to evaluate in detail the correction of exercises and the exercises patient's evolution. To improve the motor rehabilitation process, we present a new low-cost system that allows in the first stage, the use of last generation tools for the development of customizable standing exercises. This new system is being validated in an important rehabilitation center with very promising results. The first validations that are taking place indicate that it contributes with important improvements, permitting a smallest dependence of the patient in relation to the specialist, providing objective measures of evolution of the patients in the realization of exercises, and increasing the motivation of the patients in the rehabilitation process.

INTRODUCTION

Patients with brain injury can suffer balance disorders caused by various and mixed factors, which include alterations in mechanical components, such as strength and tone, sensory organization or motor coordination systems.

Recovering the strategies that allow maintaining balance and postural control is of crucial importance to achieve autonomy in daily activities.

There are three main factors in motor recovery: early intervention, task-oriented training and repetition intensity ([1]). Motor rehabilitation programs are oriented to satisfy the two last factors. In order to obtain this, motor rehabilitation programs must include exercises set out to reinforce the appropriated balance strategies necessary in each individual case and clinical period. The precise repetition of the exercises, their complexity, speed, intensity and number of repetitions determine the further results. Therefore, a strict supervision and exhaustive data record is basic.

The use of virtual reality techniques and last-generation tools in the process of rehabilitation can suppose an important help in this process, as current references show up ([2], [3], [4]). However, the integration of virtual rehabilitation systems in clinic centres is not yet extended, partly due to the cost of some of the existing systems, which need very expensive components (high quality Head Mounted Displays, high-performance PC platforms, expensive gesture and posture recognition devices, etc.).

Corresponding Author:

Prof. Mariano Alcañiz Ph.D., Full Professor Computer Graphics, Director LabHuman (formerly Mediclub)
 Human Centred Technology Laboratory (LabHuman)- edificio 8K. Technical University of Valencia. 46022 Valencia (Spain)
 Email: malcaniz@labhuman.upv.es, URL: www.labhuman.org

¹Human Centred Technology Laboratory (LabHuman)- edificio 8K. Technical University of Valencia (Spain)

²Servicio de Daño Cerebral SL- Grupo NISA. Río Tajo, 1. 46011 - Valencia (Spain)

The importance of the cost is demonstrated by the amount of systems currently being developed that consider this factor ([5], [6], [7]).

In this paper we present a low cost virtual rehabilitation system with promising features to improve motor rehabilitation process for standing position.

II. SYSTEM COMPONENTS

A virtual rehabilitation system can be typically divided in two main components: Hardware and Software system. A. Hardware System

As said before, one of the targets in the project has been to achieve a low cost system; the chosen elements and the overall design take this target as a main objective. The simplest configuration of our system consists of:

- Two common web cams.
- Two infrared pass filters.
- Two infrared led rings.
- Two catadioptric Velcro strips.
- A PC (it is not necessary a high-performance PC).
- Two stereo audio speaker.
- A monitor.

It can be improved with a bigger screen or positional audio; optional components:

- A bigger screen (a bigger monitor or a projector and a screen).
- A passive stereoscopic screen (two projectors, polarized filters and glasses). This is not necessary, and we recommended, at the most, a projector and a screen, but the system is ready to take advantage of the stereoscopy if it exists in the room.
- A Dolby 5.1, 6.1 or 7.1 for positional audio.
- Self-synchronizable web cams.
- A Round carpet (about one meter of radius).

1) TRACKING SYSTEM

The used tracking system is based on two stereoscopic webcams that will take two different views of the patient; these two views will be analyzed by the software that, by triangulation from two different view points, calculates feet positions.

Because the system must be compatible with projected screens in dark projection rooms, the optical system can not be based on visible light. We solve this problem using cameras that are sensible just to infrared light; this is achieved by removing infrared blocking filters if the camera have any, and replacing them by infrared pass filters.

Once the cameras are sensible just to infrared light, it is needed to illuminate the patient with that kind of light. A light emitting diodes ring is attached next to each camera in order to get back reflected light from catadioptric material that the patient can wear, in our case attached to his/her feet.

In this way we can assure very well controlled work conditions, and good quality and contrasted images, as good to make unnecessary to segment them. The catadioptric marks will appear a white spots over a black background (Fig. 1).

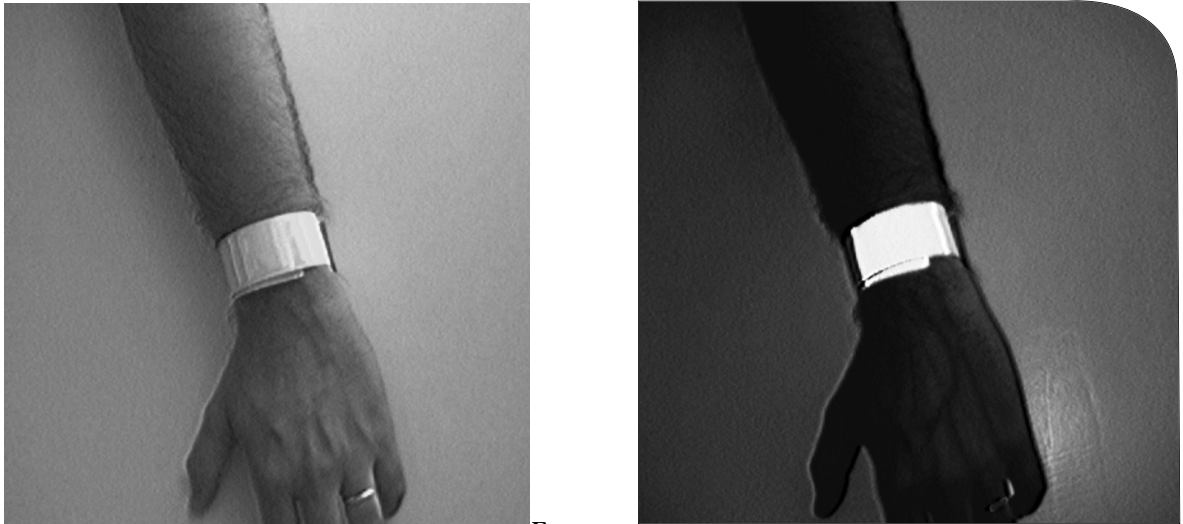
**FIG. 1.**

Image taken by a camera sensible to the visible light (left) and taken by a camera sensible to infrared light (right).

When the patient is moving, it is important to assure that each pair of captured pictures correspond to a same instant of time, this means that is better to use synchronizable cameras; anyway, the system can work relatively well if the refresh rate of the cameras is at least 15 frames per second.

In every optical tracking system the first installation phase is the camera registration procedure where the system is said where exactly the cameras are located. Depending on the quality of these measures the further tracking will be more or less precise. In order to avoid this specialized protocol to be done by non technical personal a camera stand has been designed to assure the relative positions and orientations form a camera two the other, the center of coordinates of the system will be placed based on the camera set position and not the opposite.

2) USER INTERFACE

Another benefit of optical tracking is that the elements the patient needs to put on are really light, small, and simple to attach, in one word “wearable”. In this case the patient just needs to attach two catadioptric velcro strips to his/her ankles and start interaction. The only question to take care is to avoid that trousers cloth must not block the catadioptric spot, his is done easily.

3) OPTIONAL IMPROVEMENTS

AUDIO

Even if it is not necessary, and a stereo system is suitable to run the application, positional audio is programmed to be used when a speaker system is connected to the computer. As patient steps on blocks around him/her, the corresponding sound is synthesised to be perceived from the corresponding direction.

LOCATION CARPET

In order to help the patient to establish a connection between real and virtual environment, a round carpet can be placed that has its corresponding geometry on the virtual side. In this way virtual feet and real ones are placed on two very similar scenes and the comprehension of the situations becomes totally intuitive (Fig. 2).

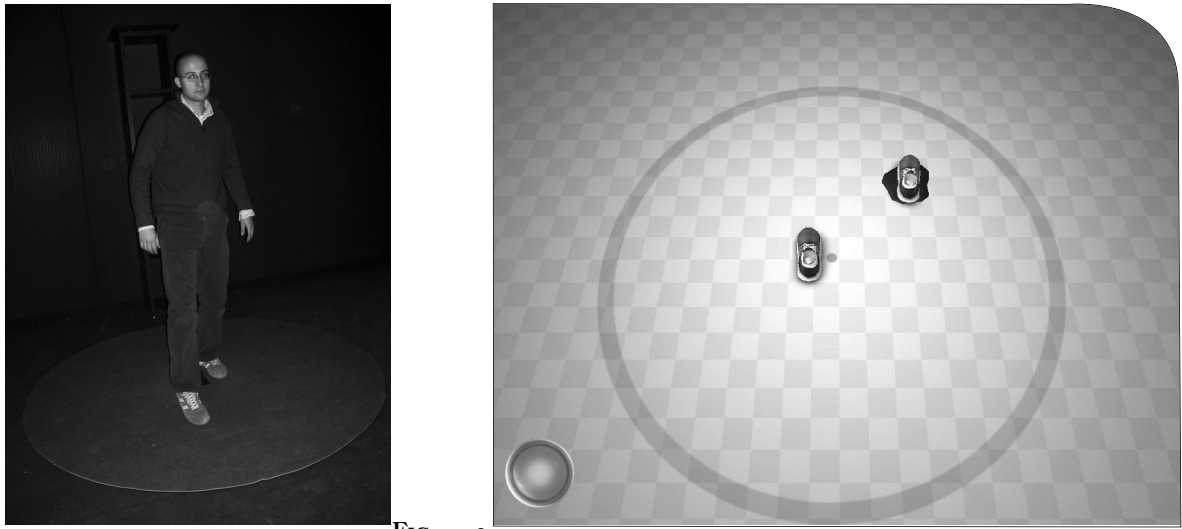


FIG. 2.

Real vs. Virtual environment.

B. SOFTWARE SYSTEM

The application was all programmed in C++, using free libraries in order to obtain a cheaper system.

III. BEGINNING THE GAME

In the course of the development of the system, we have referred internally the application like The Game. In this way, we have kept in mind the idea to develop a more amenable system for the user, increasing patients' motivation and implication.

From a user viewpoint, The Game has mainly three stages clearly differentiated: setup, session, and results. We will give an explanation about these parts, specially focusing on the second one, which is the main part of The Game.

A. SETUP STAGE

On the first stage, the specialist will configure the parameters of the application. These parameters control everything about the items, such as how they look like, where and how they are placed, and also about the timing of the session. That provides the specialist flexibility enough to change the application's behavior in a way it can adapt to a wide range of patients.

B. SESSION STAGE

The session stage is when the patient is actively interacting with the system. This constitutes the main and most complex part of the application. In here, one or several sub-sessions will take place, with interleaved breaks. In each of these sub-session, items will appear randomly on the ground, and the patient will try to reach them. For that, the user will move its own foot, and the system will reply that movement with virtual foot in the program (see Fig. 2). Since at anytime, the user can see on the screen its own movement, it is very easy to control.

We can see there are two different parts in the program at this stage: items' management and foot tracking. The first one deal with updating the items any time, such as creating new ones, destroy current ones, or make them disappear. The foot tracking is coupled with the camera system and goes from capturing the patient images by the camera's systems to get the real positions of the foot. These two processes are decoupled in the application, which means that they can (and usually they do) run at different speed. For instance, in our tests we worked with cameras running at 30 feet per second (fps), so the real positions where obtained at that speed. However, the application was running at 85 fps and just limited by the screen refresh rate, so the items animation and foot movement was really smooth.

About the item's management process, it consists in creating and destroying items. New items will be created until the session is over. Every new created item will be given a life time and size, randomly obtained according to the setup parameters. The placement is similarly randomly decided, but is driven by the probabilities specified for every quadrant and the distance to center parameters. However, the application takes control and ensures that new items are not created over already existing ones or over a foot, since both situations would arise in misleading results.

On the other side, elements also have to be destroyed. This will happen when an item has overcome its life time or when it is reached by a feet. In the first case, the item will smoothly disappear (in a graphical sense), while it will be deformed in the second one. In the second situation, a sound will be emitted; this enables the user to know that the item was reached. It is important to note that after the patient has destroyed one item it has to bring back the foot to the center. If he does not do that, is not possible to destroy another item. This restriction prevents the user to destroy an item involuntary, and allows the specialist to know accurately the behavior of the patient. The user will destroy an item, return it to the center, destroy another item, and go back to center and so on. This minimizes the amount of false positives in the results.

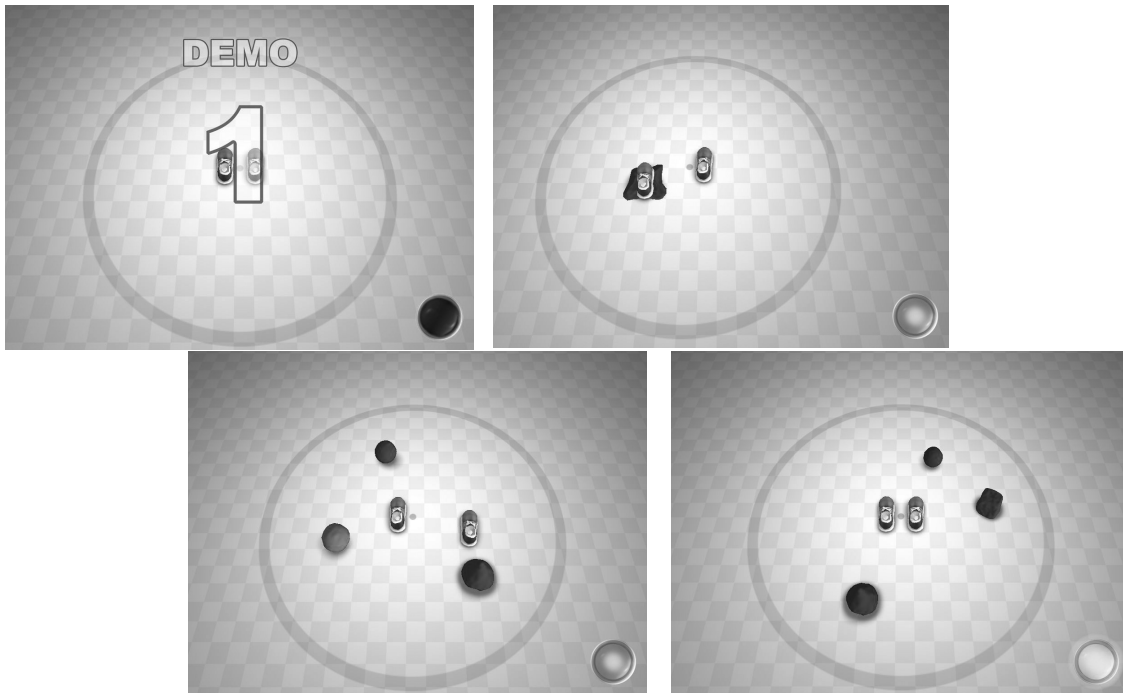


Fig. 5. Different situations during the session stage.

Then we have the process of tracking the user feet motion. For that purpose we used two cameras located in front of the user, which tracks two marks. Conveniently located on the users legs, just above the user ankles. Every time we have a new image available in both cameras, we calculate the current 3D position of the foot, with a triangulation process.

It is also possible to place more cameras to cover a wider range of angles. More cameras would allow not only a wider range, but also a more accurate position tracking.

C. RESULTS STAGE

When all the sessions are finished, the results will be generated and a summary of the results will be shown. This summary presents information already classified in a useful way to the specialist. This information is as follows:

SUMMARY OF THE RESULTS GENERATED AFTER THE SESSIONS.

	Right foot	Left foot	Not reached	Total
Left side	Items appeared on the left side, reached with the right foot	Items appeared on the left side, reached with the right foot	Items appeared on the left side, not reached	Total of items appeared on the left side
Right side	Items appeared on the right side, reached with the right foot	Items appeared on the right side, reached with the left foot	Items appeared on the right side, not reached	Total of items appeared on the right side
Total	Total of items reached with the right foot	Total of items reached with the left foot	Total of items not reached	Total of items processed
Percentage	Percentage of items reached with the right foot	Percentage of items reached with the left foot	Percentage of items not reached	Percentage of items processed (100%)

Also, an XML results file is automatically generated. This will contain summarized information as above for the whole session, but also for every one of the sub-sessions the user passed. In addition, for every sub-session all the information of the items is stored. This includes the place the item was in the 3-D space, its life, size, if it was destroyed by left or right feet (or not destroyed) and when, and distance to the center. With that information available the specialist can further study the session, and get more detailed statistics.

IV. CLINICAL STUDY

The system is actually integrated in SDC, an important Brain Injury Service from Nisa Hospitals ([10]). SDC's specialists have performed a clinical study of the system, with the next features:

C. MEASURES

Balance was assessed using clinical scales (Berg Standing Scale, Tinetti Balance and Gait Assessment) and a computed dynamic posturography NED/Sve IBV System (Limits of Stability and Sway Control) ([7]).

A parametric comparison between clinical and posturographic measures before and after training was performed; also a third clinical and posturographic measure was done a month after the treatment, to control the maintenance of the results. A significance level of $p < 0.05$ was used in all comparisons.

D. PARTICIPANTS

Six patients with acquired brain injuries, aged between 18 and 65 years old, participated in the study. All patients suffered from hemiparesis and balance disorders due to traumatic brain injury or stroke (chronicity 179.6 ± 18 days).

All the subjects had a residual hemiparesis due to a traumatic brain injury and/or a brain vascular disease (ischemic or hemorrhagic). Reasons for exclusion were presence of cognitive deficits, presence of comprehensive disorder, or presence of behavioral or psychiatric disturbances- all of which would interfere with the treatment and inability to physical exercise due to reduced general health status.

Since the exercise was designed to improve motor function in moderately and mildly impaired patients, inclusion criteria require enough standing balance (defined by a Berg Balance Scale ≥ 33) and fairly good global mobility (Clinical Outcome Variable Scale ≥ 65).

E. PROCEDURE

The virtual rehabilitation program consisted of three sessions weekly for one month. Each session had a duration of thirty minutes. Before initiation, all subjects completed a first session to familiarize themselves with the software and to adjust the set-up parameters including the number, location and duration of the stimulus.

F. RESULTS

The system has been tested in the Nisa Hospitals' Brain Injury Service ([8]). The results obtained with the virtual rehabilitation program can be found in Table 1.

Clinical Scales	Initial	Final	Control	p
Berg	45.5 \pm 6.7	50.3 \pm 5.2	52.5 \pm 5.4	<0.05
Tinetti Balance	13.8 \pm 3.0	15.9 \pm 0.4	15.8 \pm 0.4	n.s.
Tinetti Gait	9.2 \pm 2.5	10.7 \pm 1.8	11.5 \pm 0.8	<0.05

Posturography				
Stability Limits	76.5 \pm 10.7	82.7 \pm 11.2	83.2 \pm 11.3	<0.05
Antero-posterior	83.2 \pm 11.1	94.0 \pm 5.4	92.5 \pm 7.7	<0.05
Medial-lateral	79.2 \pm 7.4	85.8 \pm 5.9	87.2 \pm 9.6	<0.05

TABLE 1: Results

In table 1, the measures are divided in two main sets: clinical scales and posturographic measures. For each measure we show initial values -before the application of the program-, final values -immediately after the program-, and control values -measures taken a month after the finalization of program-.

All patients showed a significant improvement in physiological parameters involving standing balance (computer posturography).

This improvement was associated with a better outcome on clinical balance scales (Berg Balance Scale, Tinetti Scale). Moreover, functional improvement was evident after a short period of rehabilitation and this improvement was sustained over time, even after cessation of the program.

V. DISCUSSION

The system presents very promising features in motor rehabilitation for the specialist. Although it is in the clinical study phase, SDC's specialists certify important advantages of the system in the clinical area:

- It is a good tool to help specialists: the system permits the specialists to see more patients.
- The parametrization of the system permits personalization for each user and during each session.
- As the evolution of each patient in each session is registered, a patient's objective tracking is obtained.
- As the application follows a ludic scheme, the rehabilitation grows increasingly amusing, gaining the patient's improved implication and motivation.

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- NedSVE / IBV. System for the evaluation of balance disorders developed by the Instituto de Biomecánica de Valencia. <http://www.ibv.org/>

NEW TECHNOLOGIES AND RELAXATION: AN EXPLORATIVE STUDY ON OBESE PATIENTS WITH EMOTIONAL EATING

Gian Mauro Manzoni, Psy.D.^{1,2}; Alessandra Gorini, Ph.D.^{3,4}; Alessandra Preziosa, Ph.D.¹; Francesco Pagnini, M.S.²; Gianluca Castelnovo, Ph.D., Psy.D.⁵; Enrico Molinari, Ph.D.^{1,5}; and Giuseppe Riva, Ph.D.^{3,5}

Since stress and negative emotions are critical factors in inducing overeating in obese patients, psychological and behavioural interventions for obesity should include stress management techniques. A three weeks relaxation protocol supported by the use of new technologies, including virtual reality (VR) and portable mp3 players, was developed in order to reduce stress and related emotional eating episodes in obese patients. Sixty female obese inpatients reporting emotional eating were included in the study and divided in three experimental groups (virtual reality-VR, imaginative-IM and waiting list). Psychometric and physiological variables were collected. Results show that relaxation training was effective in improving perceived self efficacy in eating control, as well as in decreasing depressive symptoms, anxiety and physiological arousal both in the VR and IM conditions.

This study suggests that relaxation training for obese patients with emotional eating is effective, even if the lack of differences between the two conditions suggests some important critical considerations.

INTRODUCTION

The interest in eating-related issues reflects worldwide statistics showing that approximately 1.6 billion adults (age 15+) are overweight and at least 400 million are obese. The World Health Organization (WHO) further projects that by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese (WHO, 2006). Given that overweight and obesity lead to serious health consequences, developing and implementing effective interventions for substantially reduce weight and the associated risks for health is compelling.

Beside some important and well established aetiological factors such as excessive food intake and lack of physical activity, that are the principal targets in the majority of traditional weight reduction programs based on diet and exercise training, an important variable that must be taken into account for the treatment of obesity regards the way in which food intake relates with bio-psychological stress (Gluck, 2006; Volkow & Wise, 2005). This relationship is well illustrated in the behavioural phenomenon of emotional eating, that is defined as eating in response to one's mood or emotion (Bekker, van de Meerendonk, & Mollerus, 2004), as opposed to eating in response to physiological cues of hunger, eating on a schedule, or eating socially.

Corresponding Author:

Manzoni Gian Mauro, Istituto Auxologico Italiano IRCCS, Psychology Research Laboratory, San Giuseppe Hospital, Verbania, Italy.
 gm.manzoni@auxologico.it

¹ Istituto Auxologico Italiano IRCCS, Psychology Research Laboratory, San Giuseppe Hospital, Verbania, Italy.

² Department of Psychology, University of Bergamo, Italy.

³ Istituto Auxologico Italiano IRCCS, Applied Technology for Neuro-Psychology Laboratory, Milan, Italy.

⁴ Research Institute Brain and Behaviour, Maastricht University, The Netherlands.

⁵ Department of Psychology, Catholic University of Milan, Italy.

Typically, emotional eaters eat in response to negative emotions (Lindeman & Stark, 2001), as eating in response to positive emotions has not been demonstrated to be as damaging to efforts to maintain a healthy weight. For emotional eaters, the emotion related eating behaviour may be a form of inappropriate coping mechanism for alleviating and dealing with stress and negative emotions (Carver, Scheier, & Weintraub, 1989; Popkess-Vawter, Wendel, Schmoll, & O'Connell, 1998; Solomon, 2001; Timmerman & Acton, 2001; Troop, 1998). A recent study conducted by Ozier and coll. (Ozier et al., 2008) has found that individuals who eat in response to emotions and stress are more likely to be overweight or obese. This finding is in accord with similar data (Blair, Lewis, & Booth, 1990) showing that patients who decreased their emotional eating lost substantially more weight than those who did not. Similarly, other two studies have demonstrated that there is a relationship between emotional eating and binge eating with higher caloric intake (Braet & Van Strien, 1997; Waters, Hill, & Waller, 2001). Furthermore, Geliebter and Aversa (Geliebter & Aversa, 2003) has found that overweight individuals have substantially greater eating ratings, indicating a greater urge to eat in response to negative emotions and situations, than normal weight subjects. These studies support the hypothesis that overweight and obese individuals might lack appropriate strategies to cope with daily stressors and/or that their existing coping mechanisms are ineffective (Crowther, Sanftner, Bonifazi, & Shepherd, 2001), since they lead them to use eating or overeating as a maladaptive way of coping.

If stress and negative emotions are critical factors that may induce eating, overeating and choice of palatable and thus high caloric food, then psychological and behavioural interventions for obese patients with emotional eating should also include stress management and emotion-shifting strategies. Together with the traditional cognitive-behavioural techniques like cognitive restructuring, self-monitoring and social support (Forety & Carlos Poston II, 1998). Ong et al. (Ong, Linden, & Young, 2004) found that one of the most common treatment for stress management is cognitive-behavioral therapy (CBT) associated to relaxation-oriented techniques. However, relaxation is difficult to be achieved in real life situations and the traditional relaxation methods usually take a very long time to be learned. Furthermore, given that all the main relaxation techniques resort to the use of positive mental images to facilitate the induction of the response of psycho-physical calm. The effectiveness of the interventions depends, to a large extent, on the ability of individuals to produce the relaxing images proposed by the therapist or by specific audio-narratives (Vincelli, 1999). Regarding this issue, Freeman et al. (J. Freeman, Lessiter, Keogh, Bond, & Chapman, 2004) explored whether the effects on mood and anxiety of a therapeutic narrative based on standard controlled breathing techniques were enhanced through its presentation within an audio-visual virtual environment. The results show that the presentation of the narrative within the virtual "relaxation island" in a one session experience resulted in significantly greater increase in relaxation compared to presentation of the narrative alone.

In a more recent pilot study Riva et al. (Riva, Manzoni, Villani, Gaggioli, & Molinari, 2008), starting from these promising results, found that a brief relaxation training protocol (2 sessions) performed using relaxing narratives and virtual reality (VR) immersion was more effective than the same protocol provided through a DVD video in reducing anxiety in a sample of obese female inpatients with a history of emotional eating. Riva et al. (Riva, Preziosa, Grassi, & Villani, 2006) also explored the effects on stress of mobile phones playing audio-visual relaxing narratives in a sample of Italian commuters. Once again, they showed that the use of new technologies (a combination of VR environments and mobile phones) was more effective in reducing stress level than commercial relaxing videos. In particular, commuters who experienced the mobile relaxing narratives – virtual audio-visual experiences implemented on UMTS/3G phones – were able to obtain a significant reduction of their stress levels that the other participants did not achieve.

These results, although preliminary, suggest that new technologies, in particular VR and portable devices playing mobile narratives, may be an effective mood induction media, which can play a significant part in dealing with stress and common psychiatric disorders such as anxiety and depression (Waterworth & Waterworth, 2004). Starting from these observations and willing to overcome the above mentioned limits related to the traditional relaxation training methods, we designed an

exploratory study to observe the effect of a three-week relaxation training protocol partially provided through a relaxing VR environment and supported by portable mp3 players on stress and negative emotions in a sample of obese female patients with emotional eating. Furthermore, at the end of the treatment, different virtual environments representing critical situations were developed to expose the patients to the stimuli that usually produce negative emotional reactions, in order to test their ability to put in practice the acquired knowledge about relaxation. The effects of this treatment were compared to an eyes-closed, imaginative, narrative-only condition and with a waiting list condition. In particular, we wanted to investigate if VR and mp3 players can facilitate relaxation training in a sample of obese female patients with emotional eating.

MATERIALS AND METHOD

PARTICIPANTS

Sixty female obese inpatients with emotional eating were consecutively recruited from a reference population admitted for clinical and rehabilitative residential treatment at San Giuseppe Hospital, Istituto Auxologico Italiano, Verbania, Italy, during a seven-months period. Obesity status was ascertained by a Body Mass Index (BMI) ≥ 30 (WHO, 2006). Height was measured before treatment with a stadiometer and weight was assessed with the participant in lightweight clothing with shoes removed, on a balance beam scale.

In order to be included in the study, patients had to meet the following inclusion criteria:

- sex: female
- age: 18-60
- primary diagnosis: obesity, in accord to the WHO criteria.
- presence of recurrent episodes of emotional eating, as assessed through the Emotional Overeating Questionnaire (EOQ) (Masheb & Grilo, 2006).

Diagnostic interviews were conducted by an independent clinical psychologist as part of his clinical work. Patients affected by other psychiatric, psychological or neurological disorders were excluded from the study. No patients dropped-out the study.

Patients who met the inclusion criteria and gave their written informed consent to participate were randomly assigned to 3 conditions: (a) virtual reality (VR) condition; (b) imaginative condition (IM); (c) waiting list condition (WL). The randomization scheme was generated by using the Web site Randomization.com (www.randomization.com).

Detailed epidemiological, clinical and demographic characteristics of the sample are summarized in table 1. No significant differences were found in all these variables between the three groups of patients.

The study received ethical approval by Ethical Committee of the Istituto Auxologico Italiano.

EXPERIMENTAL PROCEDURE AND CLINICAL PROTOCOL

The experimental design consisted of three independent factors (three groups) and multiple repeated measures (pre-post sessions and pre-post treatment measurements).

During the initial diagnostic interview, participants were provided with detailed information about the study and the treatments. The inpatient program (IP) lasted 5 weeks. The additional treatments (VR- and IM-based relaxation training) were administered by two chartered clinical psychologists and one chartered psychotherapist under the supervision of a senior psychotherapist. The three therapists were randomized between the two conditions.

Epidemiological, clinical and demographic characteristics of the sample

Group	VR (n=20)		IM (n=20)		WL (n=20)	
	Mean	SD	Mean	SD	Mean	SD
BMI	41.74	3.94	41.82	4.72	43.21	6.48
Age	42.80	11.44	48.55	7.96	39.65	14.52
	Frequency	%	Frequency	%	Frequency	%
Marital Status						
Single	8	40	4	20	10	50
Married	10	50	14	70	9	45
Divorced	2	10	2	10	1	5
Education						
Less than 5 years	0	0	2	10	2	10
Between 5 and 8 years	7	35	4	20	6	30
Between 8 and 13 years	9	45	11	55	8	40
More than 18 years	4	20	3	15	4	20
Job Activity						
Student	0	0	1	5	3	15
Housewife	6	30	6	30	4	20
Employed	11	55	10	50	11	55
Unemployed	3	15	3	15	2	10

INTEGRATED MULTIMODAL MEDICALLY-MANAGED INPATIENT PROGRAM

All patients underwent a 5-week medically-managed, residential program consisting in a moderately low-calorie diet (80% of the basal energy consumption estimated according to the Harris-Benedict equation), physical training, psychological support and participation in nutritional groups. The individual psychological sessions, lasting 45 minutes each, were administered once a week for five weeks and were cognitive-behavioral oriented. Contents were mainly based upon: stimulus-controlling techniques, drawing up a list of activities to dysfunctional eating behavior, problem-solving techniques aimed at coping with interpersonal situations capable of triggering emotional eating episodes, analysis and modification of dysfunctional thinking and cognitive distortions, and self-empowerment.

RELAXATION TRAINING

The experimental protocol, consisting in 4 sessions per week (12 sessions in total), lasted 3 weeks. It usually started at the beginning of the second week of the inpatient program and ended the week before the last one. The two experimental conditions (VR and IM) differed only in some sessions and the protocol was organized as following:

- Session 1 (VR and IM groups): initial assessment and brief introduction to the rationale and goals of the protocol;
- Sessions 2-4 (VR and IM groups): the patient starts to learn the relaxation techniques guided by a relaxing recorded narrative played by a computer;

- Session 5 (VR and IM groups): each patient discusses with the therapist recent episodes of emotional eating (self-monitoring) and her impressions and comments about the protocol;
- Sessions 6-8 (VR group): the patient is immersed in the Green Valley, a virtual relaxing environment, and is asked to relax herself following the relaxing narrative, after moving around the environment according to the directions suggested by the audio narrative;
- Sessions 6-8 (IM group): the patient is asked to imagine a relaxing environment representing a green valley and to relax herself listening to the audio narrative;
- Sessions 9-11 (VR group): the patient is exposed to a pre-selected virtual environment referring to a real-life situation that usually causes stress and consequently emotional eating episodes (i.e. a kitchen, a restaurant, an office, etc.). Immediately after the virtual exposure to the stressful environment, a relaxing narrative guides the patient through the relaxation process;
- Sessions 9-11 (IM group): the patient is asked to imagine a real-life situation that usually provokes stress and, consequently, emotional eating. After that, a relaxing narrative guides her through the relaxation process;
- Session 12 (VR and IM group): conclusion and final assessment.

Each session lasted about one hour; it usually started with a brief introduction and homework revision, and finished with some comments about the experience (debriefing). Starting from session 2 until the end of the treatment, participants received a portable mp3 player containing the narratives they listened during the sessions (also called mobile narratives). They were asked to use it as many times as they wanted to practice relaxation by their own without the therapist. This task was useful to speed up and boost the learning of the relaxation techniques.

In order to facilitate relaxation, during the treatment sessions patients were seated on a comfortable armchair in a dark room. Participants included in the IM group listened to the narrative with their eyes closed, while those in the VR group wore an head mounted display (HMD) for immersion into the virtual environment.

PSYCHOMETRIC ASSESSMENT

The following psychometric questionnaires were administered only during the first and the last sessions:

- Beck Depression Inventory – BDI (Beck & Steer, 1993);
- Weight Efficacy Life-Style Questionnaire – WELSQ (Clark, Abrams, Niaura, Eaton, & Rossi, 1991).

In addition, the following psychometric questionnaires were administered before and after each treatment session:

- State Anxiety Inventory–STAI (Spielberger, Gorsuch, & Lushene, 1970);
- Visual Analogue Scales (VAS): a variation of Gross & Levenson's measure (Gross & Levenson, 1995) assessing relaxation (VAS-R).

PSYCHOPHYSIOLOGICAL ASSESSMENT

Immediately before and after each treatment session, the Procomp Infiniti Biofeedback system was used to record the heart rate (HR) in order to obtain an objective measure of the internal state of the patients.

THE RELAXING NARRATIVES

The narratives consisted of a combination of different relaxation techniques mainly based on the Progressive Muscular Relaxation (PMR) (Borkovec & Costello, 1993) and the Applied Relaxation (AR) (Ost & Breitholtz, 2000). The PMR directly targets muscular tension and relaxation, while the aim of AR is to demonstrate relaxation as an effective coping strategy for significantly reducing anxiety under many daily-life circumstances. During the second week of treatment, in the VR group the narratives were presented together with the Green Valley in order to create an audio-video experience that enhanced the effect of the relaxing experience (D. Freeman, 2003; J. Freeman et al., 2004).

THE VIRTUAL ENVIRONMENT SOFTWARE

Two different virtual environments included in the open-source software NeuroVR 1.5 were used (Riva, Gaggioli et al., 2007). For the relaxation sessions, the Green Valley, a very relaxing environment showing a mountain landscape around a calm lake, is presented together with a relaxing narrative and soft sounds (birds' songs, water flowing, etc). Participants were asked to walk around the lake, to observe the nature and, after few minutes, to virtually seat on a comfortable deck chair, in order to become easily relaxed.



A screen shot of the Green Valley



A screen shot showing a buffet in a restaurant

For the final part of the protocol, patients were presented with specific virtual stressful environments simulating real-life situations that usually cause stress and emotional eating episodes: a kitchen, a restaurant, a supermarket, an office and so on. Each of these environments could be modified by the therapist with objects and persons depending on patients' personal characteristics and needs.

TECHNOLOGICAL DEVICES

The VR system is composed by:

- a laptop (Asus G2S; Intel® Core™2 Extreme Processor X7800);
- an Head Mounted Display (HMD), Sony Glasstron PLM S-700, equipped with a visual device for a 3D view of the virtual environment and an audio device (earphones) to listen to the narratives;
- a position tracker, Intersense Intertrax2 256 Hz, that allows the user to modify his/her point of view in the virtual environment according to his/her movements in the real world;
- a joystick.

STATISTICAL ANALYSIS

Power analysis with $\alpha=0.05$ showed a statistical power of 0.80 and a total sample size of 51 to detect a large difference ($f=0.45$) between the three groups (VR, IM and WL). Power analyses were made using GPOWER (Faul & Erdfelder, 1992).

Normality of distributions was tested with Kolmogorov-Smirnov test, which showed the violation of the assumption for many variables in all the three groups. As noted by Hogan and Peipert (Hogan & Peipert, 1998), when the variables are not normally distributed, but rather skewed in some direction or kurtosis, as in this case, it is more appropriate to compare the median than the mean. The most common statistic test for doing so is the Mann-Whitney U statistic, which typically requires large samples for powerful group comparisons.

Having a larger sample size ($n=60$) and expecting to find a large difference between the two experimental groups and the WL condition, we decided to use exact non-parametrical tests with Monte Carlo estimate both for between and within groups comparisons. In statistics, an exact (significance) test is a test where all assumptions upon which the derivation of the distribution of the test statistic is based are met, as opposed to an approximate test, in which the approximation may be made as close as desired by making the sample size big enough. For example, an exact test at significance level 5% will in the long run reject true null hypothesis exactly 5% of the time (Fisher, 1925), avoiding Type I Errors. The Monte Carlo method (Manley, 1991) provides an unbiased estimate of the exact p value, without the requirements of the asymptotic method. From the Mann Whitney U statistic for the pre and post treatment analysis, we calculated Cohen's d , in which a value of 0.20 may be interpreted as a small effect, 0.50 as a medium effect, and 0.80 and greater as a large effect (Cohen, 1988). The Kruskal-Wallis test with post hoc analysis (Siegel & Castellan, 1992) was used for between groups comparisons of independent measures and the Wilcoxon rank-sum test was used for repeated measures. Chi-square test was used for categorical data, with $\alpha=0.05$, two-tailed. Data were analyzed using SPSS 11.0.

RESULTS

Pre-treatment characteristics of the three groups were compared. As a check of the random assignment to conditions, Kruskal-Wallis test were carried out on all the epidemiological and clinical variables. None of the tests showed significant statistical differences between the three groups.

PRE AND POST TREATMENT ANALYSIS

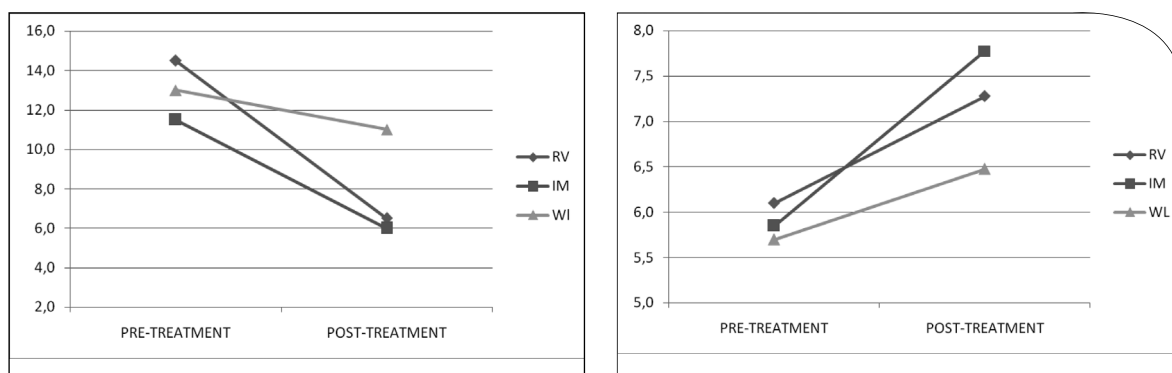
The Wilcoxon Rank-Sum test on the pre vs post treatment scores showed significant changes in the three groups for the WELSQ and the BDI (see table 2).

	Group	N	Median (PRE)	chi square ¹ (PRE)	P (PRE)	Median (POST)	chi square ¹ (POST)	P (POST)
WELSQ	VR	20	6.1	2.13	0.343	7.275**	7.65	0.022
	IM	20	5.85			7.775**		
	WL	20	5.7			6.45**		
BDI	VR	20	14.5	0.97	0.616	6.5***	5.3	0.069
	IM	20	11.5			6**		
	WL	20	13			11**		

Wilcoxon Rank-Sum test on the pre vs post treatment scores.
(Wilcoxon Rank-Sum test between the pre and post scores: *= $p<0.05$;
= $p<0.01$; *= $p<0.001$)

Between groups, analyses on post-treatment scores showed significant differences between the WL group and the two treatment groups for the WELSQ (VR vs WL: $U=125$, $p<0.05$, effect size $d=0.81$; IM vs WL: $U=101.5$, $p<0.01$, effect size $d=1.13$) and the BDI (VR vs WL: $U=127$, $p<0.05$, effects size $d=0.78$; IM vs WL: $U=126$, $p<0.05$, effect size $d=0.79$), while no significant differences were found between the VR and IM groups (see figures 3 and 4).

With respect to weight data, median weight significantly decreased within the three groups ($p<0.01$), but no significant difference in weight reduction was found among them.



BDI median scores for the 3 groups before and after treatment

WELSQ median scores in the 3 groups before and after treatment

PRE- AND POST- SESSIONS ANALYSIS

The Wilcoxon Rank-Sum test showed a significant decrease of state anxiety (STAI-Y1) and a significant increase of relaxation (VAS-R) before and after each treatment session both in the VR and in the IM groups, while no differences were found between them.

Accordingly to these data, we found significant decreases in heart rate values both in the VR and IM groups after each session.

DISCUSSION

This explorative study evaluates the effectiveness of a relaxation training supported by the use of virtual environments and portable mp3 players in a sample of female obese inpatients with emotional eating. During the first part of the treatment, patients included in the VR group were immersed in a very relaxing virtual environment in which calm images associated to relaxing narratives helped them to reach a good level of relaxation. During the second part of the protocol, the same patients experienced some critical situations related to the maintaining/relapse mechanisms (Kitchen, Supermarket, Pub, Restaurant, etc) and were guided to react to them with the previous acquired relaxation techniques. Patients included in the IM group followed a very similar relaxation training in which virtual environments were replaced by imagination. In both cases, at the beginning of the treatment, participants received an mp3 player and were instructed to listen to the narratives anytime they felt stressed, anxious or sad (or at least once a day). These mobile devices allowed patients to practice relaxation techniques regularly, even when they did not have the possibility to meet the therapist (for example during the week-end days).

The analyses performed on the psychological variables at the beginning and at the end of the treatment indicated that the relaxation training increased the perceived self-efficacy for eating control as measured with the WELSQ and reduced the depression level as shown by the BDI scores in both the experimental groups (VR and IM). We argue that these positive results do not exclusively depend on the residential weight control treatment, since we found them only in the two experimental groups, but not in the WL group. In particular, the effectiveness of relaxation training on the perceived self-efficacy for eating control means that patients improved beliefs about being able to cope functionally with critical situations and supports the hypothesis that obese patients with emotional eating tend to use eating to cope with stressful situations and related negative emotions (Lindeman & Stark, 2001; Ozier et al., 2008; Volkow & Wise, 2005). These results are quite impressive since they have been obtained in only three weeks of relaxation training.

Weight significantly decreased in all the three groups, without difference among them. This result was largely expected because, during the residential treatment, food intake, physical exercise and eating behavior were strictly controlled.

Regarding the within sessions effects, the relaxation training was effective in reducing state anxiety, as measured by the STAY-Y1, and in increasing the relaxation level, as measured by the VAS-R, in the two groups of patients. Similar results have been found in the last three sessions when they were exposed to virtual simulated or imagined stressful situations and asked to relax using the previous acquired techniques. Coherently with the psychological observations, along the entire treatment, we observed a significant decrease in heart rate values indicating an objective reduction of the physiological arousal. Regarding the two different conditions (VR vs IM), they appear to have different effects neither on post-treatment nor on within-sessions outcomes. This result is in contradiction with Freeman's (J. Freeman et al., 2004) and Riva's findings (Riva et al., 2008) that showed that VR is more effective than the narratives alone in facilitating relaxation.

A possible explanation of this apparent lack of effectiveness of VR immersion regards the use of a quite uncomfortable head-mounted display, of a position tracker often characterized by a poor movements accuracy and of a virtual environment not totally feasible in its technical and graphical features. Since in their study Freeman et al. (J. Freeman et al., 2004) provided immersion using a large projection screen instead of an head-mounted display, we hypothesize that the HMD with an embedded position tracker, usually adopted for VR exposure, is not indicated for relaxation purposes. Moreover, the virtual environment we used is graphically less realistic compared to the one used by Freeman (J. Freeman et al., 2004) and Riva (Riva et al., 2008). Furthermore, it is characterized by few moving objects that are not strictly matched with subjects' physical rhythms (i.e. breathing and heart rate). Probably, these critical features negatively moderated the expected enhancing interaction effect of the relaxing narratives and the audio-visual virtual environment. However, this is only a speculation because we did not measure the sense of presence and thus we can say nothing about the subjective quality of experience.

In conclusion, some useful considerations emerge from this exploratory study. First, a brief relaxation training (12 sessions for 3 weeks) provided to obese female inpatients with recurrent emotional eating episodes seems to improve their perceived self-efficacy in eating control and depressive symptoms. We argue that these improvements may have a positive effect on eating behavior (i.e. reduced emotional eating episodes) and on long-term weight loss. However, we need further clinical trials in order to test this hypothesis. Second, even if we did not find any difference between the two conditions (VR and IM), we suppose that VR may play a significant role in providing relaxation when it is well technically and graphically arranged. In his book on "emotioneering" Freeman (D. Freeman, 2003) suggests some possible "recipes" for emotional induction through media, but it is not clear how to manipulate the aspects of form and content of interactive media to induce an emotional response (Riva, Mantovani et al., 2007). From the present experience we conclude that, for relaxation training purposes, providing immersion by an head-mounted display with an embedded tracker device is probably not feasible, that graphical realism is a critical concern and that key moving objects linked to the subjects' physical rhythms (i.e. breathing and heart rate) are necessary.

ACKNOWLEDGMENTS

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PAIN CONTROL DURING WOUND CARE FOR COMBAT-RELATED BURN INJURIES USING CUSTOM ARTICULATED ARM MOUNTED VIRTUAL REALITY GOGGLES

Christopher Maani, MD¹, Hunter G. Hoffman, Ph.D², Peter A. DeSocio, DO¹, Michelle Morrow¹, Chaya Galin¹,
Jeff Magula², Alan Maiers¹, and Kathryn Gaylord¹

We describe the first two cases where virtual reality was added to usual pain medications to reduce excessive pain during wound care of combat-related burn injuries. Patient 1 was a 22 year old male who suffered 3rd degree burns on 32% of his body, including his right hand, during a roadside bomb terrorist attack in Iraq. The nurse administered wound care to half of the right hand during VR and the other half of the same hand during no VR (treatment order randomized). This patient was the first to use a unique custom articulated robotic-like arm mounted VR goggle system. Three 0-10 graphic rating scale pain scores for each of the two treatment conditions served as the primary dependent variables. The patient reported less pain when distracted with VR. "Time spent thinking about pain" dropped from 100% during no VR to 15% during VR, "pain unpleasantness" ratings dropped from "moderate" (6/10) to "mild" (4/10). Wound care was "no fun at all" (0/10) during no VR but was "pretty fun" (8/10) during VR. However, Patient 1 reported no reduction in worst pain during VR. Patient 2 suffered 2nd and 3rd degree burns when his humvee was hit by a terrorist's rocket propelled grenade in Iraq. During his wound care debridement, "time spent thinking about pain" was 100% (all of the time) with no VR and 0 (none of the time) during VR, "pain unpleasantness" ratings dropped from "severe" (7/10) to "none". Worst pain dropped from "severe" (8/10) to mild pain (2/10). And fun increased from zero with no VR to 10 (extremely fun) during VR. Although preliminary, using a within-subjects experimental design, the present study provided evidence that immersive VR can be an effective adjunctive nonpharmacologic analgesic for reducing cognitive pain, emotional pain and the sensory component of pain of soldiers experiencing severe procedural pain during wound care of a combat-related burn injury.

INTRODUCTION.

U.S. soldiers injured in Iraq with significant burns are treated at the U.S. Army Institute of Surgical Research (USAISR) at Brooke Army Medical Center in San Antonio, TX. The mean length of inpatient stay for burn patients at this medical center is approx 25 days. (Kauvar et al.) Recovery often involves extensive outpatient physical therapy rehabilitation. Soldiers often move to San Antonio to continue their outpatient physical therapy for six months, a year or longer. Currently, wounded warfighter inpatients with severe burn wounds may have their bandages removed each day, so the wound can be inspected, cleaned and kept free of infection. Wounded warriors with severe burns remain conscious during daily wound care. Typically, they receive strong short-acting opioid analgesics and anxiolytics about twenty minutes prior to debridement (cleaning of dead skin from their healing burn wound). Despite early, aggressive

Corresponding Author:

Hunter G. Hoffman, Ph.D, Human Interface Technology Laboratory and Department of Mechanical Engineering, University of Washington, WA,
www.vrpain.com, hunter@hitl.washington.edu

¹ U.S. Army Institute of Surgical Research, Brooke Army Medical Center, Fort Sam Houston, TX.

² Human Interface Technology Laboratory and Department of Mechanical Engineering, University of Washington, WA.

use of opioid analgesics, patients frequently experience severe to excruciating pain during daily burn wound care. (Carrougner et al.) Excessive pain can increase the amount of time it takes caregivers to complete the wound care, and can increase how long the patient remains in the hospital before discharge. Clinical and laboratory studies of civilians have shown large drops in subjective pain during virtual reality, (Hoffman et al., 2008 & Hoffman, 2004) and fMRI results with healthy volunteers show reductions in pain-related brain activity during VR analgesia. (Hoffman et al., 2004) If VR reduces procedural pain in patients with combat-related injuries, this would be a valuable advance in combat casualty care with potential widespread military applications in the future. The two patients in this case report are the first to quantify whether VR distraction can reduce high levels of subjective pain reports in soldiers with combat-related burn injuries undergoing wound care and dressing change. Both patients used a unique articulated robotic-like arm that allowed the VR goggles to be placed near the patient weightlessly, eliminating the need for the patient to put on a VR helmet and reducing the amount of surface contact needed with the patient (see Figure 1A and 1B).

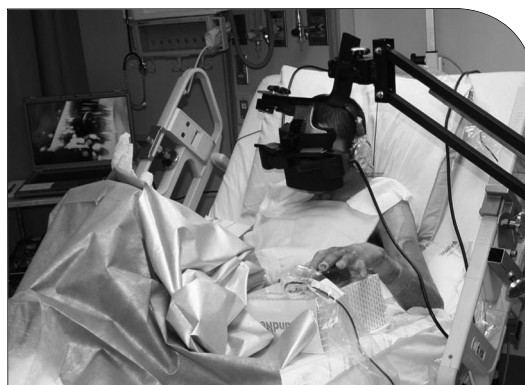


FIGURE 1A AND 1B. U.S. Army soldier receiving immersive Virtual Reality to reduce his pain during severe burn wound care, using our unique articulated arm mounted VR goggles designed by Hoffman and Magula, that hold the displays near the patient's eyes. Photos and copyrights Hunter Hoffman, UW.

SUBJECT

Patient 1 was a U.S. Army soldier medically evacuated from Iraq to USAISR after suffering severe burns covering 32% of his body approximately 45 days prior to this intervention. While a passenger in a vehicle that was attacked by an improvised explosive device (roadside bomb), he experienced full thickness burns on his hands, arms, anterior and posterior chest and distal thighs. In the following weeks, donor skin was harvested from unburned portions of his body and transplanted as skin grafts to many of his severe burn wounds. In keeping with the standard practice, continuous wound care and frequent dressing changes were required to optimize the healing process.

A 10 minute segment of wound care to the patient's right hand, identified from previous days' procedures as being

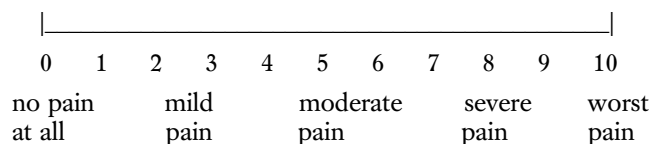


FIGURE 2. A snapshot of SnowWorld (the virtual world burn patients interact with during wound care). Image by worldbuilder Ari Hollander, www.imprintit.com, copyright Hunter Hoffman, UW., www.vrpain.com.

excessively painful, was divided into two equivalent five minute wound care segments. Pre-medication with two per-cocet tablets by mouth approximately 20 minutes prior to wound care served as the opioid analgesic for this session. During one of the five-minute sessions he received no VR distraction (i.e., standard pre-medication only). During the other five-minute treatment session, the participant looked into the articulated arm mounted VR goggles and underwent wound care while experiencing immersive, interactive VR (randomized to receive VR first or second).

During two brief pauses in the wound care procedure (once after each five minute wound care period), the patient completed three subjective pain ratings using Graphic Rating Scales (GRS) labeled 0 – 10 with respect to the preceding 5 minutes of wound care. "Please indicate how you felt during the past five minute session by rating your response on the following scales." Each question was accompanied by a pictorial example of the labeled graphic rating scale such as the "worst pain" rating shown below.

How much TIME did you spend thinking about your pain during the past five minutes? I thought about my pain during Virtual Reality 0 = none of the time, 1-4 = some of the time, 5 = half of the time, 6-9 = most of the time, and 10 = all of the time. How UNPLEASANT was your pain during the Virtual Reality (a similar 10-cm line with numeric and word descriptors beneath it: 0 = not unpleasant at all, 1-4 = mildly unpleasant, 5-6 = moderately unpleasant, 7-9 = severely unpleasant, and 10 = excruciatingly unpleasant)? Rate your WORST PAIN during the past 5 minutes.



How much FUN did you have during Virtual Reality (10-cm line with numeric and verbal descriptors: 0 = no fun at all, 1-4 = mildly fun, 5-6 = moderately fun, 7-9 = pretty fun, 10 = extremely fun)? To what extent (if at all) did you feel NAUSEA for any reason during Virtual Reality (10-cm line with numeric and verbal descriptors: 0 = no nausea at all, 1-4 = mild nausea, 5-6 = moderate nausea, 7-9 = severe nausea, and 10 = vomit)? While experiencing the virtual world, to what extent did you feel like you WENT INSIDE the computer-generated world (10-cm line with numeric and verbal descriptors: 0 = I did not feel like I went inside at all, 1-4 = mild sense of going inside, 5-6 = moderate sense of going inside, 7-9 = strong sense of going inside, 10 = I went completely inside the virtual world)? After wound care with no VR, each patient was asked the same questions but "during Virtual Reality" was replaced by "without Virtual Reality". After-wound care with no VR, patients were not asked the question about presence.

Such pain rating scales have been shown to be valid through their strong associations with other measures of pain intensity, as well as through their ability to detect treatment effects. (Jensen, 2003 & Jensen et al., 2001) The specific measures used in the current study were designed to assess the cognitive component of pain (amount of time spent thinking about pain), the affective component of pain (unpleasantness), and the sensory component of pain (worst pain). Affective and sensory pain are two separately measurable and sometimes differentially influenced components of the pain experience. (Gracely et al., 1978) Gracely et al., have shown ratio scale measures such as the labeled Graphic Rating Scales used in this study to be highly reliable. In addition, a GRS rating of 'fun' during wound care was measured. (Hoffmann et al., 2008)

Patient 2, a 21-year-old male, was injured when his humvee was hit by a terrorist's rocket propelled grenade in Iraq. The explosion caused 2nd and 3rd degree burns on 15% of his body: lower back, flank, buttox, bilateral hands, bilateral upper arms. A 12-minute segment of wound care to the patient's left and right arms identified from previous days'

procedures as being excessively painful was divided into two equivalent six-minute wound care segments. Pre-medication with one fentanyl lollypop (400 mic) and two percocet tablets by mouth approximately 20 minutes prior to wound care served as the opioid analgesic for this session. During one of the six-minute wound care sessions he received no VR distraction (i.e., standard pre-medication pharmacologies only). During the other six minute wound care session the participant looked into the articulated arm mounted VR goggles and underwent wound care while experiencing immersive, interactive VR (randomized to receive VR first or second). During two brief pauses in the wound care procedure (once after each six minute wound care period), the patient completed three subjective pain ratings using Graphic Rating Scales (GRS) labeled 0 – 10 with respect to the preceding 6 minutes of wound care, using the same measures described above for patient 1.

For both patients, the VR system consisted of a Voodoo Envoy laptop with NVIDIA GForce Go 7900 GTX (512 MB) video card; Intel Core 2 Duo (T7400) CPU @ 2.16 GHz, 2 GB RAM @ 994 MHz. While in High Tech VR, each subject followed a pre-determined path, “gliding” through an icy 3-D virtual canyon (Figure 2). He ‘looked’ around the virtual environment and aimed via a mouse. He pushed a mouse trigger button to shoot virtual snowballs at virtual snowmen, igloos, and penguins (see www.vrpain.com). Each subject saw the sky when he looked up, a canyon wall when he looked to the left or right, a flowing river when he looked down, and heard sound effects (e.g., a splash when a snowball hit the river) mixed with background music by recording artist Paul Simon. Participants looked into a pair of Rockwell Collins SR-80 VR goggles (see www.imprintit.com) with a custom made neoprene blinder on top and sides, which largely blocked his view of the real world. These VR goggles afforded approximately 80° diagonal field of view for each of the rectangular eyepieces with 100% overlap between the right and left eye images. The goggles were held in place near the patient’s eyes by a custom made articulated arm mounting system.

RESULTS

As shown in Figure 3 below, Patient 1 reported less pain when distracted with VR (e.g., “time spent thinking about pain” dropped from “all the time” during no VR to “some of the time” 1.5 (15%) during VR, “pain unpleasantness”

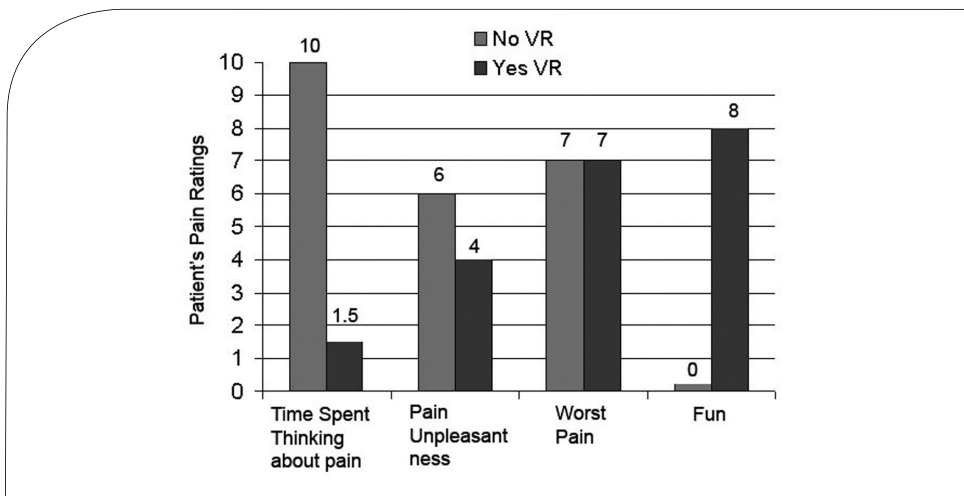


FIGURE 3. Patient 1 reported large reductions in amount of time thinking about pain during VR (shown in blue) compared to no VR (shown in red) during severe burn wound care of burn injury resulting from an Improvised Explosive Device (roadside bomb) attack/explosion.

ratings dropped from "moderate" (6/10) to "mild" (4/10). VR did not reduce Worst pain (0% drop) in Patient 1. Wound care during VR was "pretty fun" (8/10) vs. "no fun at all" (0/10) during no VR and the patient reported having a "moderate sense of going inside the computer-generated world" (6/10).

As shown in Figure 4 below, Patient 2 reported that during his wound care debridement, Time spent thinking about pain was 100% with no VR and 0 with VR, "pain unpleasantness" ratings dropped from "severe" (7/10) with no VR to "none" during VR. Worst pain dropped from "severe" (8/10) with no VR to mild pain (2/10) during VR. And fun increased from zero with no VR to 10 during VR. Patient 2 reported having "a strong sense of going inside the computer-generated world" (8/10). Both patients and their wound care nurses noted that they would prefer VR be available for subsequent dressing changes as they found it to be helpful as an adjunctive modality for pain control. Patient 2 was very determined to continue playing SnowWorld as long as possible. And the wound care nurse of patient 1 spontaneously remarked she was pleasantly surprised to see that when in VR, the patient was not pulling his hand away from her as she worked on his hand, a "protective" behavior he consistently exhibited during daily wound care of his hand with No VR.

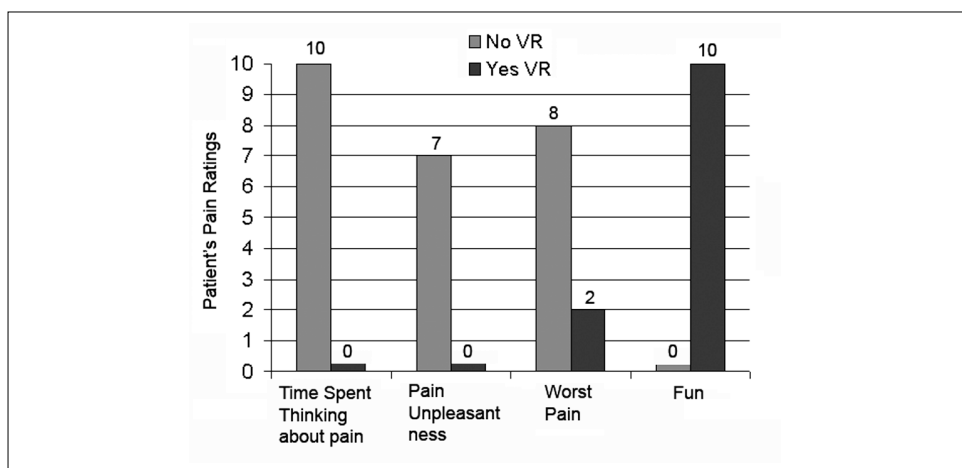


FIGURE 4. Patient 2 reported large reductions in pain during VR (shown in blue) compared to no VR (shown in red) during burn wound care of a severe burn injury resulting from a rocket-propelled grenade attack/explosion.

DISCUSSION

The results of these two case studies demonstrate that immersive VR reduced the reported amount of time patients with a combat-related burn injury spent thinking about their pain and VR reduced pain unpleasantness. VR did not reduce patient one's worst pain rating during his burn wound care. But VR did reduce patient two's worst pain from severe (a rating of 8) down to mild (a rating of 2). Although case studies are scientifically inconclusive and controlled studies are needed, these results provide the first available evidence that VR can reduce severe acute pain during medical procedures (wound care and dressing changes) in patients with combat-related burn injuries. Because excessive acute pain during medical procedures for combat-related injuries remains a widespread medical problem, and our preliminary results support the notion that VR might prove valuable for pain control in combat trauma patients, additional research on this modality with this patient population is warranted.

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APPLYING THE TECHNOLOGY ACCEPTANCE MODEL TO VR WITH PEOPLE WHO ARE FAVORABLE TO ITS USE

Manon Bertrand¹ and Stéphane Bouchard¹

This study aims to test how the Technology Acceptance Model (TAM; Davis, 1989, 1993; Venkatesh, 2000) applies to the use of virtual reality in clinical settings. The sample is composed of 141 adults interested in using this technology. We adapted the standard items used to test the TAM and added a perceived cost factor as it was expected to play a role on Intention of Use. Structural equation modeling was used and, after removing several parameters, an adequate fit to the data was found. The final model revealed that Intention to Use VR is predicted only by Perceived Usefulness. These results pinpoint what should be better documented in order to foster the dissemination of virtual reality among clinicians.

INTRODUCTION

Virtual reality (VR) is a therapeutic tool that has proven effective in the field of training, health, and the treatment of mental health problems (Murphy, 2003). Its effectiveness has been demonstrated on many occasions (Bouchard, Côté, & Richard, 2006; Tate & Zabinski, 2004) and it seemed interesting, based on this observation, to attempt to identify in an empirical way the elements that play a role on the intention to use or not to use VR in clinical practice. In order to do so, we chose to adapt the Technology Acceptance Model (Davis, 1989; Davis & Venkatesh, 1996; Venkatesh, 2000) to VR.

Since the mid 70's, various researchers have been interested in factors that explain or predict the use of different technologies. The Technology Acceptance Model (TAM) represents one of the explanatory models having most influenced the theories of human behavior (Venkatesh, Morris, Davis, & Davis, 2003).

The TAM was specifically developed with the primary aim of identifying the determinants involved in computer acceptance in general; secondly, to examine a variety of information technology usage behaviors; and thirdly, to provide a parsimonious theoretical explanatory model (Davis, Bagozzi, & Warshaw, 1989). It is rooted in social psychology and draws on Fishbein's and Ajzen's reasoned action model (1975), which establishes that the intent to produce a behavior depends on two basic determinants: attitude toward behavior and subjective norms. Subjective norms refer to the reasons for producing a certain behavior or not and make the link between the latter and an expected result, whereas attitude toward behavior refers to the positive or negative value the individual associates to the fact of producing the behavior.

The TAM suggests that attitude would be a direct predictor of the intention to use technology, which in turn would predict the actual usage of the technology. Davis and Venkatesh (1996) however, suggest that attitude would not play a significant role but rather that perceived ease of use (expectation that a technology requires minimum effort) and perceived usefulness

Corresponding Author:

Manon Bertrand, D.Ps., Université du Québec en Outaouais, CP 1250, Succ. Hull, Gatineau, Qc. J8X 3X7, Canada

¹Université du Québec en Outaouais (Canada)

(perception that the use of a technology can enhance performance of a task at hand) would determine the intention to use a technology. Venkatesh (2000) adds that the TAM is a good model but that it does not help understand and explain the acceptance of a technology in a way that promotes the development of a strategy having a real impact on the usability and acceptance of the technology. He therefore proposed a modified model. To the TAM, he added determinants to perceived ease of use, that is, four personal anchoring factors (computer self-efficacy, perception of external control, anxiety towards computers, and computer playfulness) and two adjustment-based factors that develop with experience (perceived enjoyment and objective usefulness). These anchors represent general beliefs about computers and their use. Furthermore, they would seem to play a critical role in the formation of the perceived ease of use of a new system and would be independent of the latter.

A number of meta-analyses on the TAM have demonstrated that it is a valid, robust and powerful model. Lederer, Maupin, Sena, and Zhuang (2000) have recorded more than 15 published studies that examined the existing relations between perceived ease of use, perceived usefulness, attitude towards use, and usage of information technologies over a period of 10 years (from 1989 to 1999). The results of these studies support the use of the TAM as a predictive or explanatory model of the usage of different technologies. King and He (2006) identified 88 studies published on the TAM. The results of this meta-analysis confirm that the model can be used in a wide variety of contexts and that the impact of ease of use on the intent to use is mainly brought about by perceived usefulness. In a critical review of the TAM, Legris, Ingham and Colletette (2003) retained 22 studies that tested the model in its integrity with a well-defined methodology as well as complete and available results. Their conclusions follow the same direction as those of King and He (2006), that is, the TAM is a theoretical model used in different contexts to help understand and explain the use of information technologies. The studies retained were testing among others, the use of technologies such as word processing and telemedicine software, electronic mail, the internet, personal computers and university resource centers.

The robustness of the TAM, his parsimony, and the interesting results of the meta-analyses aforementioned, convinced us to opt for this model. As the aim of the study is to understand what can encourage therapists to use virtual reality, we have retained the following elements from the TAM: a) the central concepts of perceived usefulness, perceived ease of use, and intention of use; b) the concept of attitude toward use, and c) the four anchoring factors of the model determining the perception of ease of use (Venkatesh, 2000). We also decided to add to our acceptance model of VR (Figure 1) the variable of perceived costs associated with the use of virtual reality. This last variable should permit documenting the impact of costs associated with the use of virtual reality. Furthermore, we chose to keep attitude as a mediator of intention of use, given the diverse opinions on the subject (Davis, 1993; Davis, Bagozzi, & Warshaw, 1989; Schepers, & Wetzels, 2007; Sun, & Zhan, 2006; Venkatesh, 2000; Venkatesh & Davis, 2000).

Schepers and Wetzels (2007) listed 53 studies using either one of six basic TAM constructs (attitude, intention of use, real use, subjective norms, perceived usefulness, perceived ease of use). Of these 53 studies, 15 of them found a significant relationship between perceived usefulness and attitude, varying from 0.29 to 0.84, 15 out of 16 discovered a significant relationship between perceived ease of use and attitude, varying from 0.05 to 0.73, and 14 noted that there was a significant relationship between attitude and intention of use, varying from 0.11 to 0.75. Sun and Zhan (2006) also studied the principal relations existing between the different basic constructs of the TAM. They retained a total of 72 studies all of which measured the perceived ease of use, 71 measured perceived usefulness, 22 measured attitude, 47 measured intention of use, while 39 measured real usefulness. They were thus able to confirm the existence of significant paths between attitude and intention of use as well as perceived usefulness: intention of use and real use, perceived usefulness and attitude as well as intention of use, and perceived ease of use and attitude as well as intention of use.

HYPOTHESES:

1. The model proposed in Figure 1 will be valid for describing the data relating to the intention of using virtual reality to treat mental health problems.
2. The parameters linking computer self-efficacy, perception of external control, anxiety toward computers and computer playfulness to perceived ease of use will be significant.
3. The parameters linking perceived usefulness and attitude will be significant.
4. The parameters linking perceived ease of use to perceived usefulness and attitude will be significant.
5. The parameter linking attitude toward use of virtual reality to the intention of use will be significant.
6. The parameter linking the cost variable to the intention of use will be significant.

METHOD

SAMPLE

The sample is composed of 141 adults familiar with virtual reality. They originate from different countries : 49% from Canada, 23% from the United States, 12% from Spain, 3.5% from France, 2% from Israel, 2% from Italy, 1.4% from the United Kingdom and 0.7% from each of the following countries : Australia, Germany, Greece, Japan, Korea, Luxembourg, Scotland and Sweden. Two individuals refused to indicate their country.

The participants were invited to fill a questionnaire measuring the variables of the model (questionnaire available on demand). These individuals come from various backgrounds and were contacted in two different ways. The first method consisted of inviting the participants to the Cybertherapy Congress, held in Gatineau, Québec in June 2006, to fill in a paper version of the questionnaire and to return it to us on site or by mail. Close to 190 questionnaires were distributed and 51 were returned (27%). The second method consisted of inviting people on mailing lists (VRPsych List, Presence, Société Québécoise de Psychologie) to answer the questionnaire directly on-line. Ninety-five individuals responded to the questionnaire electronically, which represents 67% of the sample of the present study. In all cases a consent form was tendered and accepted by the participants.

The average age of the respondents is 39.6 years, 58% are women, 78% describe themselves as belonging to a cognitive-behavioral approach, 14% as being eclectic, 1.6% humanistic and .8% psychodynamic or in neuropsychology. People in our sample work at 32% in the public sector, 23% in the private, 19% work in the public and private sector, 8.7% were research assistants and research coordinators and 7% do not work at all. Twenty-one percent of respondents are directors of a clinic or of a virtual reality laboratory. The respondents have on average 11 years of clinical experience and, during the last year, 63% have rarely or never used virtual reality.

INSTRUMENT

The questionnaire measures perception toward the use of virtual reality for the treatment of mental health problems (see Annex A). This questionnaire written in English is adapted from the questionnaires of Davis (1993), Venkatesh (2000) and Venkatesh and Davis (2000). The only modification to the nine sub-scales of the questionnaire consists of applying the items to the context of VR (e.g. "Using Virtual Reality to Treat Mental Disorders Enhances My Effectiveness in My Clinical Practice"). Items were also added to address perceived costs of using VR. All the items, except those measuring attitudes, utilise a seven-point Likert scale ranging from "strongly agree" to "strongly disagree" with a middle neutral point.

Ease of use of virtual reality. Perceived ease of use is measured with the help of an already validated scale by Davis (1989) with Cronbach's alpha reliability coefficient of 0.87 (King & He, 2006) and of 0.80 in our sample. The perceived ease of use comprises four items.

Perceived usefulness of virtual reality. Perceived usefulness is measured with the four- items scale developed and validated by Davis (1989) with a reliability coefficient of 0.89 (King & He, 2006) and of 0.92 in our sample.

Intention of use. The intention of use of virtual reality in the treatment of mental health problems is measured with the help of two items scale validated by Davis (1989). It has a reliability coefficient of 0.86 (King & He, 2006) and of 0.96 in our sample.

Attitude toward usage of virtual reality. Attitude is measured with the help of a semantic differential scale, as suggested by Ajzen and Fishbein (1980) and Davis (1989), which allows to operationalize the attitude toward a behavior : « all things considered, my use of virtual reality in my clinical practice is : good-bad ; wise-foolish ; favorable-unfavorable ; beneficial-harmful ; positive-negative » everything on a seven-point scale with a neutral value in the middle. This scale has a reliability coefficient of 0.85 (King & He, 2006) and of 0.97 in our sample.

Perception of personal efficacy to use a computer. Self-efficacy to use a computer refers to the perception an individual has of his capacities and abilities to use the technology. This scale comprises 10 items with an internal consistency of 0.85 (Venkatesh, 2000) and of 0.83 in our sample. In order to carry out the analyses, we reduced the number of items to enter in our model to five, by calculating the mean of paired items having the highest and lowest item-total correlation.

Perception of external control toward computers. Perception of external control is defined as the feeling of control an individual has toward the use of a computer based on the availability of knowledge, resources and opportunities required for its use (Venkatesh, 2000). This scale comprises five items and has a mean internal consistency of 0.85 (Venkatesh, 2000) and of 0.63 in our sample.

Anxiety toward computers. Anxiety toward computers is described as the apprehension, or even the fear, an individual has toward the possibility to have to use a computer (Venkatesh, 2000). This scale comprises nine items and a mean internal consistency of 0.87 (Venkatesh, 2000). In order to carry out the analysis we reduced the number of items to enter in the model by calculating the mean of the items having the highest item-total correlation, the lowest correlation and another one located mid-way, and we obtained an alpha coefficient of 0.82.

Intrinsic motivation to use a computer. Intrinsic motivation refers to the perception of pleasure and satisfaction felt while using a computer. This scale is composed of three items and has a mean internal consistency of 0.85 (Venkatesh, 2000) and of 0.94 in our sample.

Perceived costs of virtual reality. Perceived cost is defined as the concerns associated with the costs of purchasing the necessary equipment for the use of virtual reality. This scale comprises two items and has a mean internal consistency of 0.77 in our sample.

RESULTS

The hypotheses previously presented were evaluated with the EQS software version 6.1 for Windows and the complementary analyses (internal consistencies, correlations, etc.) were computed with SPSS. Our initial sample consisted of 147 respondents. Six were removed because their questionnaires revealed too many missing values (between 5 and 14 on a total of 44 questions). Of the 141 respondents remaining, three had a single missing value (overall, three missing data on a total of 6204), all to the question « I find it easy to apply virtual reality for my specific needs to treat mental disorders in my clinical practice » and for which we replaced, independently for all of them, the missing data by the mean value of the other items in the perceived ease of use construct. One participant did not indicate his/her age, six did not indicate or not their principal theo-

retical orientation, four omitted to indicate their place of practice, one respondent did not indicate the number of years of clinical experience and the number of years of experience with virtual reality, and three did not indicate whether they were director of a clinic or a research center.

A descriptive analysis of the data and their distribution revealed that there was no extreme univariate or multivariate data. There was evidence indicating that the univariate and multivariate normality assumption was not respected according to Mardia's normalized coefficient (12.95, $p < 0.001$). The analyses were thus performed with the maximum likelihood method and the fit tested with the Satorra-Bentler scaled chi square (Satorra & Bentler, 1988; S-B_2). The standard errors of measure of the parameters were also adjusted by EQS owing to the problem of normality. In order to assess the quality of the estimated model, the following indices and criteria values were used as suggested by Byrne (1994), Tabachnick and Fidell (2007) and Hu and Bentler (1998) : CFI (>0.95), NNFI (>0.95), RMSEA (< 0.05) and SRMR (<0.08). All these indices were corrected for normality with the help of the Satorra-Bentler (S-B_2) index, with the exception of the SRMR. The percentage of variance explained by the final model was obtained with the help of the GFI, as suggested by Tanaka and Huba (1989). The descriptive data at the different scales and their intercorrelations are presented in Tables 1 and 2.

As 67% of our sample consisted of online respondents, ANOVAs were conducted for all variables (see Table 3) in order to document whether any differences existed between the participants responding online and those filling out a paper questionnaire. As we can note in Table 3, the participants who completed the online questionnaire obtain more favorable scores in relation to virtual reality and its use (more positive attitude, stronger intent, less anxiety, etc.), than those who completed the paper questionnaire. In order to assess whether these differences have an impact on the relation between the constructs at hand, we compared the correlation patterns between the different variables. These analyses reveal that the correlation patterns remain similar, leading to the belief that the differences between the paper version and the online respondents do not affect the relations between the variables in the model. To be on the safe side, the final model was also tested separately for the participants having completed the online questionnaire or the paper version, and the conclusions remain identical. Therefore, all the participants having completed the paper and online versions were grouped into a single sample for the entire analyses.

ANOVAs and correlations were also performed to document if there were any significant differences between participants who have rarely or never used virtual reality (67%) and participants who used it more frequently (33%). These analyses did not reveal any meaningful difference, except for a stronger relationship among frequent users of VR between perceived self-efficacy and intention of use virtual reality and perceived usefulness.

The initial model studied revealed many non-significant parameters and could not adequately fit the data. These problems were predictable by looking at the correlation matrix between the constructs (see the weak, but significant correlations in Table 2), most notable for cost, self-efficacy and attitude. To remedy these problems, these constructs were removed from the model. A revised model (see Figure 2) was tested afterwards, while retaining the path between perceived ease of use and intention of use.

To obtain a refined model, the covariance between the following standard errors was permitted: items 9 and 10, items 13 and 7, items 14 and 8, items 9 and 8. This model was found to be valid, as evidenced by the adequacy indices such as Satorra-Bentler's chi-square χ^2 (176, $N = 141$) = 226.8, $p < 0.01$, robust CFI (0.98), RMSEA = 0.045, NNFI = 0.96 and SRMR = 0.06. However, the parameter linking perceived usefulness to intention to use virtual reality remained non-significant ($\beta = -0.06$, ns). It was thus removed in order to arrive at a model that also turns out to be very adequate but more parsimonious [Satorra-Bentler chi-square χ^2 (177, $N = 141$) = 227.4, $p < 0.01$; Robust CFI = 0.98; RMSEA = 0.045; NNFI = 0.96; SRMR = 0.06]. This model allows predicting 85% of the variance of the intention to use virtual reality for clinical purposes.

DISCUSSION

In this study, TAM was adapted and used to describe factors predicting the intention to use virtual reality as a therapeutic tool by mental health professionals. Significant support was found for a model and good fitting. Several important findings emerge from this study. Among others, the perceived usefulness seems to be the only significant predictor of intention of use. Basic factors such as attitude, perceived cost and perceived ease of use have no direct effect. At most, perceived ease of use influences intention of use only indirectly through perceived usefulness. In addition, personal factors (perception of external control, anxiety towards computers, intrinsic motivation) play an important role in the formation of perceived ease of use of virtual reality but do not have a direct impact on intention of use.

Generally speaking, and taking into account the strong proportion of variance demonstrated by the model (85%), the TAM can predict well the intention of a favorable population to use virtual reality as a tool for treating mental health problems. We note however that two constructs in the original models from Davis and Venkatesh (Davis, 1989; Venkatesh & Davis, 2000) did not permit to predict the intention to use virtual reality. A direct path is not found between perceived ease of use and intention of use, between perceived ease of use and attitude, as well as between attitude and intention of use. These results seem to support Davis' (1989) contention that, from a point of view of causality, perceived ease of use could be an antecedent to perceived usefulness rather than a direct parallel determinant of usage. The explanation, according to Davis (1989), would be that the users adopt a technology firstly on the basis of the tasks it can perform for them and then consider the level of difficulty associated with its operation, at least in the case of professional uses of a technology. He adds that an increase in experience with the technology influences the intention of use on account of the fact that in the beginning the user assesses the ease of use on the basis of self-efficacy and, with time, it becomes instrumental. Virtual reality, being a different technology than those analysed in previous studies on the TAM could explain in part the slight differences encountered in this study. In addition, the samples of these studies comprised mostly students, employees, a few professionals and internet users (Sun & Zhan, 2006). These individuals were likely trained or had the opportunity to acquire experience with these various technologies, which is not the case for a good part of our sample.

Of the four personal factors retained in our model, three are determinants of the perceived ease of use (perception of external control, anxiety towards computers, computer playfulness). Our results are in line with those obtained by Venkatesh (2000). It seems here that the users had general beliefs associated with the use of computers and these could remain stable and constant as long as experience with the system matches expectations.

There are a few inherent limitations to this study. First, 32% of the participants work in the private sector, 19% in the private/public sector, and that 21% are directors of virtual reality clinics or laboratories, implies that a good number are professionals and in a better position to decide on the type of treatment or the kind of tools they want to use in their practice. Second, the sample is composed of individuals who are favorable (to a variety of degrees) to virtual reality, which prevents the generalization of our results to the general population of mental health professionals. These people are considered as "in favor of the use of VR" in the sense that people who answered our questionnaire already have an interest in the use of virtual reality; they are attending conferences on virtual reality or are members of mailing lists dedicated to virtual reality (i.e. VRPsych List and Presence). Third, and as mentioned by Sun and Zhan (2006), the model does not take into consideration the impact of moderators such as the voluntary dimension and professional autonomy. The addition of these moderators would result in a more practical explanatory model and one closer to the reality of mental health professionals. Fourth, the final model presented in Figure 3 aims to predict the intention of use and not the real use of virtual reality. Knowing that intention of use mainly predicts usage (Davis, 1989; Davis et al., 1989; Venkatesh & Davis, 2000), we can only expect that real use effectively corresponds to intention of use. Future research using the model while adding the dimension of real use could help verify such a hypothesis. However, trying to predict intention of use among people who do not know what VR is would

add quite a lot of error variance.

For many years, mental and physical health specialists as well as rehabilitation specialists have been working towards the development and application of virtual reality as a therapeutic tool in the treatment of people suffering from various ailments. This technology is effective and useful. Rothbaum (2004) mentions that: a) thanks to the ease of use of virtual reality, treatment acceptance and adoption can improve (for example, many patients expose themselves more readily in *virtual reality* than in *in vivo*); b) environments based on real situations can provide a realistic, ethical, and secure clinical context for the patient; and c) the content of the virtual environment can be reused for patients with different problems. Until now, it was difficult to understand why this technology was underutilized outside of research facilities despite its demonstrated effectiveness and the advantages associated with its use. Now we understand this phenomenon somewhat better and we have data upon which we can base our dissemination efforts.

The results of the present study lead us to believe that mental health professionals favorable to virtual reality are more influenced by the practical advantage of the VR technology than its perceived cost or ease of use, as we had been lead to believe in the past (Bouchard et al., 2006). It therefore appears that professionals would willingly buy or use this technology for their practice if researchers could document and demonstrate to them the added value of virtual reality as well as the useful and practical aspects in the application of treatments. Research on dissemination could benefit from Rogers' (1995) theory of innovation dissemination. According to Stirman, Crits-Christoph and DeRubeis (2004), Rogers' theory distinguishes itself as a theoretical model of dissemination because its central factors are highly predictive of successful adoption. These factors being : a) the perceived advantage (implying that the rate of adoption of an innovation is associated to the advantages it seems to have on procedures) ; b) the consistency or compatibility that exists between innovation and procedure (the more a therapist has to adapt to a procedure the less he/she would be ready to accept the change) ; c) the complexity of the procedure ; d) the introduction of the innovation that must be gradual and e) being able to see it in the surrounding (noticeable). These five factors allow us to go even further in our reflection and to contemplate in an interesting way the dissemination of virtual reality among professionals.

No study to date had sought to understand why mental health professionals made little use of virtual reality as a tool for treatment. Having demonstrated its effectiveness on many occasions and in different contexts (Bouchard et al., 2006; Riva, 2005), the inquiry was obvious. The proposed model thus provides interesting answers and avenues for reflection, allowing us from now on to note that for favorable professionals, perceived usefulness is what influences them primarily in their intention to use virtual reality in their practice. This takes into account factors such as anxiety towards computers and computer playfulness. These results differ from previous studies using the TAM (Davis, 1989; Sun & Zhan, 2006, Venkatesh & Davis, 2000). The latter had, for the most part, identified attitude and perceived ease of use as important predictors of intention of use. Attitude is not even part of the final TAM model adapted to virtual reality.

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CYBERFOCUS

New technologies are developing at a rapid pace. To help you stay abreast of the latest trends in advanced technologies and healthcare, this feature showcases upcoming events which will provide you with the opportunity to connect with leading experts worldwide and remain on the cutting edge of the most recent developments.

The CyberFocus column welcomes your contributions. To supply relevant information for this feature, please send an e-mail to: office@vrphobia.eu.

CyberTherapy 13

June 22–June 25, 2008

San Diego, California, USA

www.interactivemediainstitute.com

The Journal of CyberTherapy & Rehabilitation is the official journal of the CyberTherapy Conference. The 13th Annual International CyberTherapy Conference (CT13) brings together researchers, clinicians, policy makers and funding agencies to share and discuss advancements in the growing discipline of CyberTherapy & Rehabilitation, which includes training, education, prevention, rehabilitation, and therapy. The Conference acknowledges the transformative effect that technology has had and will have on the healthcare field. Technologies featured at the conference include VR simulations, videogames, telehealth, the Internet, robotics, brain-computer interfaces, and non-invasive physiological monitoring devices. Conference attendees have the opportunity to play a role in designing the future of mental healthcare. Interactive exhibits at the Cyberarium allow participants to experience the technologies firsthand.

Peach Network 2nd Annual Summer School

July 9 – July 11

Dubrovnik, Croatia

<http://peach.tel.fer.hr/index.php>

IEEE International Conference on Advanced Learning Technologies

June 30 – July 4

Santander, Cantabria, Spain

<http://www.ask4research.info/icalt/2008/>

11th European Congress of Psychology

July 7 – July 10

Oslo, Norway

<http://www.ecp2009.no/>

EuroScience Open Forum (ESOF) 2008

July 18 - July 22

Barcelona, Spain

<http://www.esof2008.org/>

XXIX International Congress of Psychology

July 20 - July 25

Berlin, Germany

<http://www.icp2008.de/>

SIGGRAPH 2008: 35th Int'l Conf. On Computer Graphics & Interactive Techniques

August 11 - August 15

Los Angeles, CA, USA

<http://www.eabct2008.org/welcome.html>

American Psychological Association

August 14 - August 17

Boston, MA, USA

<http://www.apa.org/convention07>

Virtual Rehabilitation 2008 (formerly IWVR)

August 17 - August 19

Vancouver, BC, Canada

<http://www.virtual-rehab.org>

HCI 2008 International: 10th International Conference on Human-Computer Interaction

September 2 - September 5

Amsterdam, The Netherlands

<http://mobilehci2008.telin.nl/#>

7th ICDVRAT

(International Conference Series on Disability, Virtual Reality and Associated Technologies)

September 8 - September 10

Maia, Portugal

<http://www.icdvrat.reading.ac.uk/>

38th EABCT Annual Conference

(European Association for Behavioural and Cognitive Therapies)

September 10 – September 13

Helsinki, Finland

<http://www.eabct2008.org/>

Workshop/Symposium “Neuroimaging of Developmental Diseases”

September 12 – September 16

Dubrovnik, Croatia

<http://cms.mef.hr/druga.php?grupa=050901000000>

16th World Congress of Psychiatry

September 20 – September 25

Prague, Czech Republic

<http://www.wpa-prague2008.cz/Text/home-page?MenuItemId=75>

Society for Psychophysiological Research: 48th Annual Meeting

October 1 - October 5

Austin, Texas, USA

http://www.sprweb.org/current_mtng/meeting.html

Presence 08 (The 11th Annual International Workshop): From Virtual Reality to Human Computer Confluence

October 16 - 18

Padova, Italy

www.presence2008.org

ACM Symposium on User Interface Software and Technology

October 19 - October 22

Monterey, California, USA

<http://www.uist.org>

The World of Health IT Conference & Exhibition

November 4 - 6

Copenhagen, Denmark

<http://cfp.worldofhealthit.org/>

eChallenges e-2008

October 22 - October 23

Stockholm, Sweden

<http://www.echallenges.org/e2008/>

ABCT 2008

November 13 - November 16

Orlando, Florida

<http://www.aabt.org/Future%20Conventions.html>

ICAT 2008: Artificial Reality and Telexistence

December 3 - December

Singapore

<http://www.icatsingapore.org/>

2009 Conferences at a Glance

SPIE: Medical Imaging 2009

February 7 - February 12

Orlando, Florida, USA

<http://spie.org/x1375.xml>

SPIE: Defense and Security Symposium

March 16 - March 21

Orlando, Florida, USA

<http://spie.org/x1375.xml>

British Forum for Ethnomusicology (BFE)

April 16 - 19

Liverpool, United Kingdom

<http://www.bfe2009.net>

Society of Behavioral Medicine: 2009

April 22 - April 25

Montreal, QC, Canada

<http://www.sbm.org/meetings/>

Med-e-Tel 2009

April 1 – April 3

Luxembourg, Luxembourg

<http://www.medetel.lu/index.php?rub=news&page=newsletter>

The 6th Annual World Health Care Congress

April 14 – April 16

Washington, D.C., USA

<http://www.worldcongress.com/events/>

British Forum for Ethnomusicology (BFE)

April 16 - 19

Liverpool, United Kingdom

<http://www.bfe2009.net>

ATA 2009: 14th Annual International Meeting and Exposition

April 26 - April 28

Las Vegas, Nevada, USA

<http://www.americantelemed.org/news/newres.htm>

CyberTherapy14

June 22 - June 24

Verbania, Italy

<http://www.interactivemediainstitute.com/conference2007/index.htm>

11th European Congress of Psychology

July 7 - July 10

Oslo, Norway

<http://www.ecp2009.no>

American Psychological Association

August 6 - August 9

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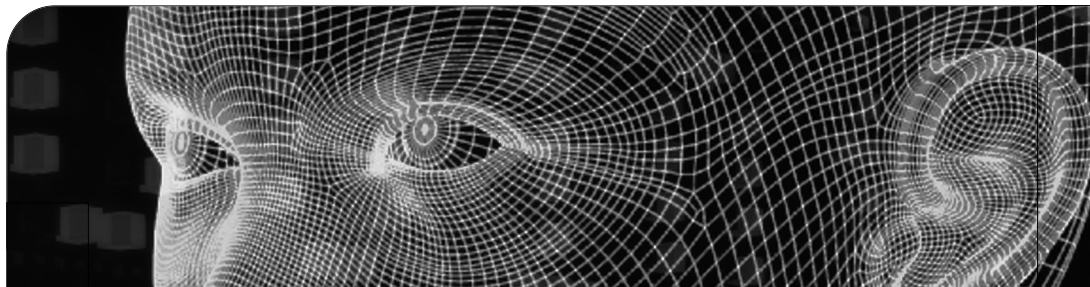
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ABCT 2009

November 19 - November 22

New York, NY, USA

<http://www.aabt.org/Future%20Conventions.html>



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