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Activities in Second Life

Combat Scenarios & Relaxation Training  
to Harden Medics Against Stress

Therapeutic Processes in Virtual Reality  
Exposure Therapy

Physiological Assessment During VR PTSD  
Treatment of a Motor Vehicle Accident Patient



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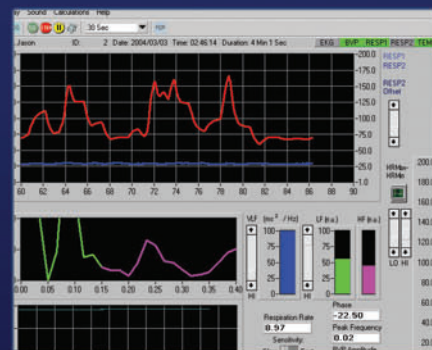


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Fall 2008  
Volume 1, Issue 3

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## EDITORIAL

Welcome to the third 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. Scientific research has broadened its fields to encompass new technologies such as virtual reality, human computer interfaces, robotics, telehealth and non-manual controls. These emerging fields are helping to expand and improve the accessibility and quality of healthcare across the globe.

I would like to take this opportunity to introduce our four new Associate Editors of JCR, Professor Cristina Botella, Professor Stéphane Bouchard, Professor Luciano Gamberini, and Professor Giuseppe Riva. Professor Botella is the Chair Professor of Psychological Treatments and the Director of the Psychological Assistance Services at the Department of Basic and Clinical Psychology at Jaume I University in Castelló de la Plana, Spain. Professor Stéphane Bouchard is the Chairholder of the Canada Research Chair in clinical cyberpsychology and a professor at the Department of Psychoeducation and Psychology at the Université du Québec en Outaouais. Professor Luciano Gamberini is an Associate Professor in the Department of General Psychology at the University of Padova, Italy; and Head of the Human Technology Laboratories. Finally, Professor Giuseppe Riva is an Associate Professor at the Catholic University of Milan and the Head Researcher of the Applied Technology for Neuro-Psychology Laboratory-Istituto Auxologico Italiano in Milan, Italy.

Recently, the JCR was chosen as the official journal of the CyberTherapy Conference series. This year, CyberTherapy 14 (June 2009) will be held in Lago Maggiore, Verbania, Italy. This year's conference will continue the tradition of offering a truly unparalleled scientific event. The JCR has also gained interest from International high-level conferences on healthcare along with healthcare officials around the globe.

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 the fields of cybertherapy 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 involved the many new and innovative expansions on cybertherapy and healthcare in more focused fields. This issue has articles covering new applications for virtual reality in the expanding fields of cybertherapy and healthcare in more focused fields. It is exciting to see the JCR progress into new aspects, applying new technology and scientific findings in our publications, to reflect the transforming field of cybertherapy.

This issue leads off with an article by Maria Toro-Tronconis et al. that discusses different types of learning and the virtual patients that are developed in Second Life, which follow game-based learning approaches. These patients are based on a four-dimensional framework, as well as other design considerations that look at emergent narratives and modes of representation.

The next article by Major Melba C. Stetz et al., examines the usefulness of Virtual Reality-Stress Inoculation Training (VR-SIT) in medical military personnel. The paper examines the psychological stress levels in 63 participants, which were either in a group to practice combat medical skills with virtual scenarios only, or practicing relaxation techniques only, both, or neither.

The following article by Katharina Meyerbröker and Paul M.G. Emmelkamp, illustrates a study that was designed to investigate processes involved in Virtual Reality Exposure Therapy (VRET) in patients with specific phobias. The influence of VRET on self-efficacy and negative self-statements without addressing these cognitions directly through treatment was also analyzed in this paper.

The fourth article by Pedro Gamito et al., looks at motor vehicle accidents (MVAs) and the serious psychological impact that is experienced by its victims and the mental disorders that arise from MVAs. This study looks at a 42 year-old patient that was exposed to a virtual highway with severe trigger events that would increase the anxiety levels in a victim of a MVA (traffic intensity, horns, proximity to the surrounding buildings, tunnels, crossovers).

Upcoming issues of JCR will continue to explore the ways in which technology influences and enhances the healthcare of citizens 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. Thank you once again for your continued support of this promising new publication.

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



## DESIGNING GAME-BASED LEARNING ACTIVITIES FOR VIRTUAL PATIENTS IN SECOND LIFE

Maria Toro-Troconis<sup>1,2</sup>, Ulf Mellström<sup>2</sup>, Martyn Partridge<sup>3</sup>, Karim Meeran<sup>3</sup>, Michael Barrett<sup>1,4</sup>, Jenny Higham<sup>1</sup>

Opportunities for building learning activities around real patients have decreased and various representative simulations have become an increasingly common alternative. The use of virtual patients is one such simulation developed to support the delivery of clinical teaching. Game-based learning has been considered a new way of delivering clinical teaching that is more suited to the new generation of 'digital natives'. Online multi-user virtual environments offer rich interactive 3D collaborative spaces where users can meet and interact. This paper discusses different learning types and the virtual patients developed in Second Life that follow game-based learning approaches based on a four-dimensional framework, as well as other design considerations that look at emergent narratives and modes of representation. Attitude towards game-based learning was assessed by measuring four components, including 21 statements, each scored on a 5-point Likert scale. General recommendations on delivery of game-based learning for virtual patients in Second Life are presented.

### INTRODUCTION

Medical education faces difficult challenges in the 21st century. Increasing pressure upon doctors to deliver service targets, the European Working Time Directive and changes in the way in which we deliver healthcare, coupled with higher numbers of students entering medical education, have increased the demands on academics, resulting in less time for teaching (Olson LG et al. 2005). Opportunities for building learning activities around real patients have decreased, and various forms of representative simulation, many of which use digital technology, have become an increasingly common alternative in healthcare education (Begg et al. 2005b).

The convergence of information and communication technologies has led to a rapid expansion of digital applications that support all aspects of teaching and learning in medicine (Youngblood and Dev 2005).

Many high-quality e-learning materials are being produced by medical schools and healthcare organizations (Ruiz et al. 2006). 'Virtual patients' is one of the models developed to support the delivery of clinical teaching. Healthcare students are familiar with the concept of virtual patients, as they are frequently exposed to actors performing the role of patients in clin-

#### Corresponding Author

Maria Toro-Troconis BSc, Dip O&H, MSc, MPhil, School of Medicine, Sir Alexander Fleming Building, Imperial College London, South Kensington campus, London SW7 2AZ, United Kingdom  
+44 7594 9815  
m.toro@imperial.ac.uk

1 School of Medicine, Imperial College London

2 Department of Human Work Sciences, Section of Gender, Technology and Organisation, Luleå University of Technology, Sweden

3 Department of Respiratory Medicine, NHLI Division, Imperial College London

4 Department of Investigative Medicine, Division of Investigative Science, Imperial College London

5 Department of Histopathology, Division of Investigative Science, Imperial College London

ical examinations. In the area of medicine, however, there are limitations to what these cases can offer in terms of either a game-informed learning experience or a real patient experience, as the narratives that accompany and describe many current virtual patient scenarios are simplistic and linear (Begg et al. 2005b).

#### ***VIRTUAL PATIENTS - GAME-BASED LEARNING***

All learners in their 20's belong to the 'games generation', being 'native speakers' of the digital language of computers, video games, DVD players, mobile phones, eBay, iPods and the internet (Holloway, 2003). They are 'digital natives' (Prensky 2001).

Anecdotal evidence from teachers suggests that the impact of gaming on millions of digital natives who grew up playing best-selling games such as SimCity is starting to be felt (Squire 2002). The designers of computer and video games have perfected a way of learning that goes well with the new skills and preferences of these digital natives. Video and computer games are in many ways a 'perfect' learning mechanism for this group (Prensky 2006).

The term game-based learning has emerged as a generic name for the use of games for learning or educational purposes. It has also been termed 'serious games' which include fully immersive environments (or 'metaverses'), in which learners can take on virtual presence in virtual worlds (Joint Informations Systems Committee, 2007). As Greenfield (1984) observed, early work has shown rich inferential learning taking place as a result of game play. Gee (2003) also observed how successful game play and experiential learning opportunities have been shown to share common aspects (Aarsand, 2007).

Virtual patient scenarios offer opportunities for 'game-informed learning'. This is due to their experiential and problem-based learning approaches as prime pedagogic drivers. The process of game play is so similar to the learning processes outlined in problem-based learning that they are almost interchangeable (Begg et al. 2005a).

Branching stories that represent virtual patient scenarios are not new in medical education. Some medical schools have successfully included their delivery across the medical curriculum, pointing out that they offer opportunities for 'game-informed learning'. They shift the emphasis from case-based scenarios towards a more controlled position in which the learner is able to steer the case (Begg et al. 2005a).

The reason for using game-based models is simple: people learn better when they don't know that they are learning. Game-based learning tends to be a pleasant break from traditional linear content (Aldrich 2005).

As Begg et al. (2005a) observed, the lack of an immersive contextual framework tends to fail to engage students within the activity. The authenticity of the environment and the value of the actions taken by the learner will reflect on the level of immersion and, therefore, the reality of the learning experience. However, development of three-dimensional representations is challenging, and it requires a lot of information in order to create a credible 'metaverse' (Ryan 2001).

It is believed that branching virtual patient scenarios offer a more challenging and engaging learning experience that the learner can relate to; however, they lack immersion (Begg et al. 2005a). This lack of immersion in current virtual patient delivery, as well as the familiarity of our 'digital natives' with virtual and game-based environments, has been the motivation for this piece of research.

The research conducted was based on the background described. The project aims to assess attitude towards game-based learning for virtual patients in Second Life, measuring four components – affective components, perceived control, perceived usefulness and behavioural components. The surveys, including 21 statements each, were scored on a 5-point Likert scale.

The project also aims to explore the experience of computer and videogame play among medical students and to identify any gender-related differences and social predispositions that might exist between high gamers and low gamers in their approaches to game-based learning in Second Life.

- High gamer includes all participants who responded having played computer or videogames a few days ago or a few months ago.
- Low gamer includes all participants who responded having played a few years ago or never.

#### ***A FRAMEWORK FOR THE DESIGN OF GAME-BASED LEARNING***

The problem of adapting complex games or developing new game-based learning activities, as described by De Freitas and Martin (2006), would be alleviated if systematic frameworks and toolkits were developed that ease the implementation and integration of game-based learning activities in the curriculum.

The framework for evaluating games and simulation-based education developed by De Freitas and Martin (2006) will be adapted for this research.

The framework requires consideration of four main dimensions in advance of using games and simulations. These focus on the:

- 1 particular context where learning takes place, including macro-level contextual factors
- 2 attributes of the particular learner or learner group
- 3 internal representational world of the game or simulation
- 4 pedagogic considerations, learning models used, approaches, etc.

According to De Freitas and Martin, the four dimensions provide a framework for consideration of both existing and future educational games and simulations, as well as other forms of immersive spaces, such as virtual reality. This framework provides a close relationship with the systems of Activity Theory (Kuutti, 1996).

#### ***SECOND LIFE - MULTI-USER VIRTUAL ENVIRONMENT***

We have outlined the factors that are currently driving the design, development, and evaluation of game-based learning activities for virtual patients in a multi-user virtual environment (MUVE). One example of such an environment is Second Life (<http://www.secondlife.com>), which is currently being developed and used by our team. Online MUVEs offer rich interactive 3D collaborative spaces where users can meet and interact (Livingstone 2007). Second Life users are represented by avatars and can be moved in the environment using mouse and keyboard controls. Users can communicate using instant messages, voice chat or text-based 'notecards'.

There has been increasing investigation and trials of the potential of Second Life for learning (Helmer 2007). Second Life has common community and collaborative features with recent contemporary developments such as Facebook, YouTube, Wikipedia, Sloodle and Flickr, which place it in the Web 2.0 spectrum.

The following outlines some of the advantages and disadvantages of using Second Life as a learning environment in medical education.

#### ***ADVANTAGES***

- The use of a pre-existing engine which makes the development of game-based learning activities easier

- A media-rich social learning environment
- Anonymity may help when training in sensitive medical subjects such as mental and sexual health
- It is a 'safe place to fail'. Students can interact with virtual patients, trying different treatments and investigations

#### ***DISADVANTAGES***

- Learning curve: basic orientation takes more than 4 hours; mastery of the environment takes far longer
- High bandwidth demands
- Requires a high-specification computer with good graphics card
- Demand for in-house information technology (IT) support
- Current architecture limits the number of concurrent users in any region

#### ***SECOND LIFE – GAMES IN EDUCATIONAL CONTEXTS***

There is little agreement among educational technologists on why we should use games, how they should be designed to support learning, or in what instructional situations games make the most sense (Gredler 1996). The instructional context that envelops gaming – how the game is conceptualized, the kind of constructivist learning activities embedded in game play, and the quality and nature of debriefing – are all critically important elements of the gaming experience (Squire 2002).

According to De Freitas (2006), learning in immersive worlds is beginning to have a wider range of uses and applications. The Second Life community demonstrates how interactions within and between groups are opening up new opportunities for learning beyond the physical constraints of the classroom. This provides novel challenges and opportunities to explore ways to create innovative approaches to learning.

Some authors recognize Second Life as a game-based application providing a space in which games can be created, allowing highly structured linear experiences as well as more open-ended ones. However, some do not classify it as a game because of its lack of predefined goals (Livingstone 2007).

Second Life marks a paradigm shift in the possibilities open to those wishing to adopt game-based approaches (Helmer 2007). It may provide the infrastructure to develop the next generation of virtual patients, offering not only 2D linear or branching structures, but also immersive 3D experiences.

Second Life already provides a ready-made games engine. The challenge for medical education and for the research currently being carried out by our team is to identify game-based activities that can drive experiential, diagnostic and role-play learning activities within the 3D world, aiming to support learning about patients' diagnoses, investigations and treatment.

#### ***LEARNING TYPES AND THE LEARNER AS A CONSEQUENT AGENT***

Different learning types are identified and discussed by Helmer (2007). Demonstration learning involves the least interaction and is most closely aligned with traditional educational experiences. Experiential learning involves a higher level of engagement, providing a more immersive, time-based experience than a demonstration. Diagnostic activities, involve interaction with a simulated environment, designed to promote inquiry, analysis and identification. Role-play should cover engagements that have embedded learning objectives. It is already one of the primary activities in Second Life. Construc-

tive learning involves giving learners the opportunity to create or 'build' elements within the environment. Murray (1997) discussed three potential influential factors of emergent narrative that might allow the learner feel their interactions have real consequences. These have already been put into context by Begg et al. (2005b) and are described under the next three headings, putting the development of Second Life into context.

#### ***EMERGENT NARRATIVE - LINEAR CONTENT***

The progress of the story is defined and influenced by the choices the learner makes. The navigational pathways in the virtual patient case in Second Life will be enriched by the 'metaverse'. Introductions in the form of audio, video and 'notecards' allow the learner to progress through the case.

#### ***THE RESPONSIVE ENVIRONMENT***

The learner will expect the environment to respond to his/her input. These expectations will not be limited to one path in Second Life. Learners will be able to follow different routes and move from different areas within the virtual hospital, e.g. laboratory and radiology department. Different activities will then be triggered and the results of investigations will be released to learners depending on their choices, using Scaffolding information in the form of audio, video and 'notecards'. Some forms of Assessment, mainly using multiple-choice questions, will also be provided.

#### ***THE PSYCHO-SOCIAL MORATORIUM - CYCLICAL CONTENT***

Successive attempts will be made to achieve the main objective of the case. Each attempt will be increasingly informed by knowledge acquired in previous attempts.

Learners will be encouraged to return and try again. Diagnostic capabilities are driven by credit in Linden \$ given at the beginning of the case. A series of Triggers will be implemented to allow the learner to progress through the case. A database-driven solution will be implemented in order to record and track learners' activity and progression. This means that when learners return to the case, they will be able to continue at the point they left. Cyclical content will be implemented when:

- timing is critical (doing the same things too early or too late)
- incremental signs inform the learner when things are going well or badly
- magnitude is important – the instances where doing the same thing a bit more or a bit less matters.

The four-dimensional framework described by De Freitas and Martin (2006), plus the learning types described by Helmer (2007), as well as the different aspects of emergent narrative described by Murray (1997) have provided the basis for the design of game-based learning activities for the first virtual patient in Second Life under two different categories: context and learner specification, and narrative and modes of representation.

#### ***VIRTUAL PATIENTS IN SECOND LIFE - A GAME-BASED LEARNING APPROACH***

A virtual patient that follows a game-based learning approach has been developed. A region has been developed in Second Life (<http://slurl.com/secondlife/Imperial%20College%20London/150/86/27/>), where a virtual teaching hospital has been created. Different aspects of the learning types already described by Helmer (2007) have been implemented.

The following sections provide more information about the way the framework has driven the development of game-based learning activities within the 'metaverse'.

#### ***CONTEXT, LEARNER SPECIFICATIONS AND PEDAGOGIC CONSIDERATIONS***

The design of game-based learning activities in Second Life (Table 1) focused on the first, second and fourth dimensions outlined by De Freitas and Martin (2006).

**TABLE 1.** Framework for the design of game-based learning activities – context and learner specifications. Context Learner specifications

Context	Learner specifications
<ul style="list-style-type: none"> <li>• Game-based activities will be delivered in Second Life to third-year undergraduate medical students at Imperial College London.</li> <li>• A module on respiratory medicine focused on pneumothorax will be embedded in Second Life using game-based learning activities.</li> <li>• This module has already been embedded in the curriculum as part of the Year 3 e-lecture program.</li> <li>• Significant technical support and resources will be required during the first delivery of this module in Second Life.</li> </ul>	<ul style="list-style-type: none"> <li>• Third-year students. Average age 22 years.</li> <li>• The game-based activities can be used by learners working singly or in groups.</li> <li>• The virtual presence of the tutor is not required.</li> </ul> <p>At present, it can only be played as part of the pilot project.</p>
Pedagogic considerations	
<p>Use of theories, such as Kolb's theory of experiential learning (1984) where the learner 'touches all the bases', i.e. a cycle of experiencing, reflecting, thinking, and acting leading to observations and reflections. These reflections are then assimilated into abstract concepts with implications for action.</p> <p>Learning outcomes</p> <p>By the end of the activity learners will be able to:</p> <ul style="list-style-type: none"> <li>• Identify and select the right investigations leading to the right diagnosis.</li> <li>• Provide the right diagnosis for different respiratory emergency cases.</li> <li>• Provide the right treatment based on the final diagnosis.</li> </ul>	

### **NARRATIVE AND MODES OF REPRESENTATION**

Some aspects of the third dimension described by De Freitas and Martin (2006), as well as some of the learning types outlined by Helmer (2007), are described in relation to aspects of Second Life in Table 2. This table also identifies different aspects of the emergent narrative described by Murray (1997), which allows the learners to feel that their interactions have real consequences. Different narratives and modes of representation for the sections, introduction and medical history can be seen in Figure 1. Different narratives and forms of representation, which allow the participant to buy the investigations required, can be seen in Figure 2.

**FIGURE 1.** Narratives and modes of representation for game-based activities – Sections: introduction and medical history**FIGURE 2.** Narratives and modes of representation for game-based activities – Sections: investigations

**TABLE 2.** Framework for the design of game-based learning activities – narrative and modes of representation.

Virtual patient section	Narrative and modes of representation for Virtual Patients in Second Life				
	Introductions	Scaffolding	Diagnostic capabilities	Assessment	Triggers
Introduction	'Notecards' will be provided at the beginning of the case.	An introductory 'notecard' with the learning outcomes of the activity is provided in the reception area.	The time on the case will be recorded as soon as the learner enters the case. All actions triggered by the learner will be recorded.	Assessment will not be provided in this section.	Introduction to the activity delivered as a 'notecard'.
Medical history	Audio and 'notecards' will be provided at the beginning of the case.	Participants are not allowed to access patient information until they wash their hands.	No other diagnostic capability will be provided in this section, but the time will continue to be recorded.	Assessment will not be provided in this section.	Hand wash.
Differential diagnosis	Audio, diagrams and 'notecards' will be provided.	As soon as the participant selects one investigation he/she will be prompted with a question about the differential diagnosis.	No other diagnostic capability will be provided in this section, but the time will continue to be recorded.	A multiple-choice question on an interactive board is provided.	Different signs by the patient's bed will trigger patient information in different formats.
Investigations	Audio and 'notecards' will prompt the learner to select the investigations they consider appropriate. Learners' accounts will be credited with Linden Dollars (L\$). They will use those L\$ to purchase the investigations required. They will be reminded to wash their hands when go into the investigation areas.	Once the participant pays for the investigation(s), the results can be picked up from the different test areas, such as: radiology department, laboratory, etc.	A series of objects that represent tests will be set at varying prices, which would relate to relative real-life values. The correct set of tests will leave the avatar with some L\$ spare from the initial amount given. If the avatar purchases all the tests this will cost them more than the amount of money they have been given (over budget).	Multiple-choice questions on an interactive board will be provided when the results are picked up from the different investigation areas.	By selecting the different investigations available they will be able to purchase them and move into the investigations area to find out the results.
Working diagnosis	Diagrams and 'notecards' will be provided.	The participant will be able to click on the 'working diagnosis' sign by the patient's bed and a question about the final diagnosis will be presented.	No other diagnostic capability will be provided in this section, but the time will continue to be recorded.	A multiple-choice question on an interactive board is provided.	The 'working diagnosis' sign by the patient's bed will trigger this section.
Management plan	Audio, diagrams and 'notecards' will be provided.	The participant can visit the Management Plan area and find out about how to manage the patient's condition.	No other diagnostic capability will be provided in this section, but the time will continue to be recorded.	Multiple-choice questions on an interactive board will be provided.	Learning stations will be set-up for each condition within the Management Plan area. Interaction with the stations will trigger information in different formats.

## METHODS

### SUBJECTS

This investigation involved 42 undergraduate medical students (21 years old). The gender distribution of the respondents was 42.85% female ( $n = 18$ ) and 57.14% male ( $n = 24$ ).

### INSTRUMENTS

The survey 'My feelings when playing games', developed by Bonnano and Kommers (2008) was applied. The survey comprises 21 statements. Six statements related to the affective component, five statements about perceived usefulness, six statements about perceived control and four statements about behavioral components. All statements describe behaviors while

using games. The statements were adapted depending on the groups: 'My feelings when learning in Second Life' and 'My feelings when learning via e-modules'. Situations with positive feelings as well as situations with negative feelings such as fear, lack of control and hesitation have been addressed. A five-point Likert scale was used.

Gaming competence was addressed by identifying participants under two different computer/videogame categories: high gamers or low gamers.

- High gamer includes all participants who responded having played computer or videogames a few days ago or a few months ago.
- Low gamer includes all participants who responded having played a few years ago or never.

### PROCEDURE

Data about gaming competence were collected at the beginning of the investigation aiming to identify gaming tendencies among undergraduate medical students.

The sample analyzed included 118 full-time undergraduate medical students of average age 22 years. The majority of respondents (47%) were male, and 34% of all students completed the survey.

The majority of participants surveyed were classified as high gamers (70%). The majority of male participants were high gamers (87% of all males surveyed), while only about half of the female participants were high gamers (54%).

The majority of the participants had never heard of Second Life (66%). However, 50% of male participants had heard of Second Life, in comparison to only 13% of female participants.

From this group, a stratified sample ( $n = 42$ ) was selected according to gender and high and low gamer categories. One group ( $n = 23$ ) was given access to the game-based learning activity for a virtual patient on respiratory medicine developed in Second Life following the framework described in this paper. The second group ( $n = 19$ ) was given access to the same content, covering the same virtual patient, but delivered as an interactive e-module. The surveys 'My feelings when learning in Second Life' and 'My feelings when learning via e-modules' were given to the groups, and were to be completed at the end of each 40-minute session. The scores for the separate statements were coded in Stata version 10, using reverse scoring for unfavorable statements.

The results based on computer and videogame player categories by gender for the Second Life group are shown in Table 3 and those for the e-module group in Table 4.

The Second Life group was given an introduction (20 min) at the beginning of the session. The introduction covered basic navigational techniques in Second Life, e.g. how to access notecards.

Second Life	Total number	Total %	Male (%)	Female (%)
Low gamer	7	30	4	26
High gamer	16	70	48	22
Total	23	100	52	48

TABLE 3. Computer and videogame player categories by gender for Second Life group.

e-module	Total number	Total %	Male (%)	Female (%)
Low gamer	3	16	10	6
High gamer	16	84	53	31
Total	19	100	63	37

TABLE 4. Computer and videogame player categories by gender for e-module group.



A focus group was also carried out with only the Second Life group at the end of the activity in order to address the social dimension for collaborative work when learning in Second Life, as well as to address other accessibility and usability issues not covered in the survey.

### RESULTS

Data about gender, gaming competence and identified attitude components were entered in SPSS using the appropriate codes. A number of variables were constructed by computing individual scores for the different statements related to the affective components, perceived use, perceived control and behavioral components. The main results for the separate statements are given in Table 5.

Chi-square or Fisher's exact test was used to compare categorical variables between both groups. The questions were combined into groups 1–3 (disagree) and 4–5 (agree). Statements in Table 5 with reverse scoring are shaded.

The scores for each statement related to the various attitudinal components presented in Table 6 and Table 7 were summed forming four computed variables, computed affective components, computed perceived use, computed perceived control and computed behavioral components.

The scores for each statement related to the various attitudinal components presented in Table 6 and Table 7 were summed forming four computed variables, computed affective components, computed perceived use, computed perceived control and computed behavioral components.

TABLE 5. Statistical data for the 21 separate variables.

No	Question	Description	Chi-square/Fisher's exact
1	A1	Given the opportunity to use an <i>e-module/Second Life</i> as a learning tool, I am afraid that I might have trouble in navigating through it.	0.009
2	U1	Learning using <i>e-modules/Second Life</i> helps me relax and thus do my work better.	All disagree
3	C1	I could probably teach myself most of the things I need to know about accessing and learning using <i>e-modules/Second Life</i> .	0.002
4	B1	I would avoid learning using <i>e-modules/Second Life</i> .	0.613
5	A2	I hesitate to use an <i>e-module/Second Life</i> as a learning tool in case I look stupid.	0.149
6	U2	Learning using <i>e-modules/Second Life</i> can enhance the learning experience to a degree, which justifies the extra effort.	0.492
7	C2	I am not in complete control when I use <i>e-modules/Second Life</i> for learning.	0.012
8	A3	I don't feel uneasy about using <i>e-modules/Second Life</i> .	0.004
9	C3	I can make the computer do what I want it to do while learning using <i>e-modules/Second Life</i> .	$P < 0.0001$
10	B2	I would only use an <i>e-module/Second Life</i> for learning if I were told to.	All disagree
11	C4	I need an experienced person nearby when I'm learning using an <i>e-module/Second Life</i> .	0.105
12	A4	Learning using <i>e-modules/Second Life</i> does not scare me at all.	0.468
13	U3	Most things that one can get from learning using <i>e-modules/Second Life</i> can be obtained or arrived at through other means.	0.049
14	B3	I would avoid learning a topic if it involves an <i>e-module/Second Life</i> .	0.075
15	C5	If I get problems using an <i>e-module/Second Life</i> , I can usually solve them one-way or the other.	$P < 0.0001$
16	A5	I hesitate to use an <i>e-module/Second Life</i> as a learning tool as I'm afraid of making mistakes I can't correct.	0.024
17	U4	Learning using <i>e-modules/Second Life</i> provides more interesting and imaginative ways for learning.	$P < 0.0001$
18	B4	I would access an <i>e-module/Second Life</i> regularly for learning.	1.000
19	C6	I do not need somebody to tell me the best way to use an <i>e-module/Second Life</i> for learning.	0.014
20	A6	Using an <i>e-module/Second Life</i> makes me feel uncomfortable	0.011
21	U5	<i>E-modules/Second Life</i> make(s) it possible to learn more productively.	$P < 0.0001$

TABLE 6. Computed variables – Second Life group

	Second Life <i>p</i> -value	Median (IQR) (females)	Standard Deviation (females)	Median (IQR) (males)	Standard Deviation (males)
Computed <i>Affective</i> variable	0.925	20 (18-23)	2.24	20.5 (19-23)	3.73
Computed components for <i>perceived use</i>	0.0751	14 (12-15)	1.91	11.5 (10.5-13)	1.94
Computed components for <i>perceived control</i>	0.2878	20 (19-21)	1.43	21 (18-22)	2.45
Computed <i>behavioural</i> components	0.6130	9 (6-10)	2.27	10 (8-10)	2.53

TABLE 7. Computed variables E-module group

	Second Life <i>p</i> -value	Median (IQR) (females)	Standard Deviation (females)	Median (IQR) (males)	Standard Deviation (males)
Computed <i>Affective</i> variable	0.3038	22 (20-24)	1.79	23.5 (21.5-25)	2.08
Computed components for <i>perceived use</i>	0.6988	14 (13 -16)	1.60	15.5 (13.5-16.5)	2.02
Computed components for <i>perceived control</i>	0.2739	17 (17-18)	0.786	17 (16-18)	1.78
Computed <i>behavioural</i> components	0.5472	8 (6-9)	1.79	7.5 (5-9)	1.99

#### IS THERE EVIDENCE OF AN ASSOCIATION BETWEEN THE TWO GROUPS ON THE DIFFERENT ATTITUDINAL COMPONENTS?

Discussion is organized around the four major components relating to the students' attitudes, and the statistical significance of some of the statements is discussed in relation to the pedagogical implications.

##### **AFFECTIVE COMPONENT**

The affective component addresses feelings of fear, hesitation, and uneasiness experienced before and while learning in Second Life. Members of the e-module group were less apprehensive about accessing a virtual patient via e-module than the Second Life group, and they felt more confident when using and navigating through an interactive linear virtual patient case (Q1:  $P = 0.009$ ). Pedagogically, this might be due to the fact that the virtual patient case is delivered in a linear way using an interface the students are used to.

Neither group is inhibited by beliefs arising from negative perceptions of looking stupid with others when accessing a virtual patient via e-module or in Second Life (Q5:  $P = 0.149$ ). Learning in these environments is perceived by both groups as an intelligent and socially accepted activity. Therefore, game-based learning in Second Life should be promoted as a stim-

ulating academic activity.

Regarding hesitation in the use of an e-module or Second Life (Q16:  $P = 0.016$ ), it is interesting to note that the e-module group is 100% hesitant to use it, whereas the Second Life group is more confident (17/23, 73.91%).

It is interesting to see how the e-module group showed feelings of uneasiness when accessing the virtual patient case. These students have been exposed to the same interface during their current e-lecture programme, which is normally very well received by the students and is very highly rated. It is worth pointing out that there are important instructional design differences when delivering interactive e-modules and when delivering virtual patients.

Although the students like navigating through an e-module, they might find it difficult to navigate through a virtual patient case provided in a linear format. This is something worth exploring further in future research projects.

Both groups felt uneasy about learning in Second Life using game-based learning and e-modules (Q8:  $P = 0.004$ ). Therefore, when building game-based learning in MUVEs continual reinforcement and support should be given.

#### **PERCEIVED USEFULNESS**

This involves behavioral arising from beliefs about the advantages of learning in Second Life or via e-modules. Regarding the therapeutic effect of learning via a specific platform, all participants in both groups disagreed that learning in Second Life or via e-modules relaxes them so that they could learn better. The Second Life group had never accessed Second Life before, and although a 20 min introductory session was provided at the beginning of the pilot, it was not enough for them to familiarize themselves with the environment. In relation to the e-module group, again this is something worth exploring further since interactive e-modules are normally very well received by the students. However, this is a linear virtual patient delivered as an e-module.

The Second Life group was more sceptical than the e-module group about the instructional potential of learning in Second Life, considering that other means (Q13:  $P = 0.049$ ) provide what can be learned from game-based learning in Second Life. The Second Life group perceived learning in MUVEs not as a unique learning and entertaining experience, but just as another way to learn.

It is interesting to note that both groups considered learning either in Second Life or via e-module as a way to enhance the learning experience to a degree that justifies the extra effort (Q6:  $P = 0.492$ ). Such disposition should be exploited. Neither group agreed that learning either in Second Life or via e-module provides more interesting and imaginative ways for learning (Q17:  $P < 0.0001$ ). During the focus group, the Second Life group discussed the fact that the delivery of virtual patients via a MUVE may replace contact with real patients, a situation that they found uncomfortable.

Regarding productivity (Q21:  $P < 0.0001$ ), the Second Life group regarded learning in Second Life as a less efficient and less effective learning experience.

#### **PERCEIVED CONTROL**

Perceived control refers to one's feelings and reactive behavioral while manipulating technological tools. This includes the ability to self-teach task-related skills, acquiring control over Second Life, and the degree of reliance on others' help to execute requested tasks.

The e-module group claimed more competence (Q15:  $P = 0.002$ ). Activities for the Second Life group can be provided offering more guidance and support when facing problems. Regarding the sense of control when learning in Second Life (Q7:  $P = 0.012$ ), the Second Life group felt much more in control of the virtual environment, (15/23, 65.22%) and thus more

capable of performing the demanded actions. However, more feedback and guidance should be provided to make sure learners accessing game-based learning activities feel in control at all times.

### **BEHAVIORAL COMPONENT**

Positive behavioral are manifested as willingness to use Second Life for learning. Negative behavioral involve avoidance tendencies. Both groups declared that they do not avoid using Second Life or e-modules for learning (Q4:  $P = 0.613$ ), therefore showing their disposition to engage in learning using both environments. A group difference was obtained in relation to avoiding learning if it involves using Second Life or e-modules (Q14:  $P = 0.075$ ). Interestingly, the e-module group was less in favor of avoiding using e-modules to learn about virtual patients (17/19, 89.47%) than the Second Life group (14/23, 60.87%). This shows a more favorable reaction towards using Second Life for learning.

Regarding their willingness to use Second Life or e-modules for learning if they are told to, both groups completely disagreed. When asked if they will continue to use Second Life or e-modules in the future (Q18:  $P = 0.358$ ), both groups declared that they would not access virtual patients either in Second Life or via e-module regularly for learning. This could be explained again by the feedback received during the focus group in which the students were not in favor of accessing virtual patients and preferred direct contact with real patients when possible.

### **IS THERE ANY RELATION BETWEEN GAMING COMPETENCE AND ATTITUDE TO LEARNING IN SECOND LIFE?**

There is some evidence of an association between gaming competence and gender for Second Life. ( $P = 0.03$ ): 5/11 (45.5%) of females are high gamers, while the proportion of males who are high gamers is higher (11/12, 91.7%). There is no evidence of an association between gaming competence and gender for e-module ( $P = 1.00$ ).

In subsequent research papers this project will further explore any gender-related differences and social propensities that might exist between high gamers and low gamers in their approaches to game-based learning in Second Life.

### **DISCUSSION**

Learning in immersive worlds is beginning to have a wider range of uses and applications (De Freitas 2006). Second Life provides a space in which games can be created, and the infrastructure for the design of open-ended, game-based immersive 3D experiences.

The literature demonstrates that game-based learning shows some initial evidence of accelerating learning and of supporting the development of higher-order cognitive and thinking skills (De Freitas and Jarvis 2007). The survey 'attitude to learning in Second Life and via e-module' is a useful instrument from a pedagogical perspective because it addresses attitudinal components. The survey findings have helped to identify key elements that should be looked at more carefully during the design of game-based learning for virtual patients in Second Life. These findings have driven the implementation of a series of changes in the original design, aiming to support learners under the different categorical values identified in the survey (affective component, perceived control, perceived usefulness and behavioural component).

Based on the evaluation and findings, the following caveats encountered in this study are highlighted and general recommendations are made when implementing game-based learning for the delivery of virtual patients in Second Life:

- General feedback and guidance for cyclical content should be provided at all times for students accessing game-based activities for virtual patients in Second Life. It is suggested that a 'badge' be provided for learners at the beginning of the activity, which they can wear and by which they can receive feedback from the system. Feedback will be delivered to the student

if they have not carried out any activity for the last 5 minutes. The feedback will inform the students about the patient they last treated and the last activity carried out on that patient.

- ‘Demanded feedback’ for cyclical content should also be provided by the patient’s area. The student should be able to click on a ‘Check status’ sign and receive feedback on where they were the last time they accessed the patient.
- Regarding control over the activity, it would be useful to provide a ‘Reset’ button which the students could access to reset the virtual patient activity in case they wanted to start all over again and therefore have more control over the activity.
- Some limitations in terms of space were found when the students were all trying to access the same virtual patient in the virtual hospital. It is important to take into account the number of potential users expected to interact within a specific environment in Second Life and therefore design the environment accordingly.
- It is suggested that the virtual patient area be designed to be as spacious as possible in order to accommodate several avatars accessing the virtual patient at the same time.
- It is suggested individual feedback be restricted to notecards or individual text messages in order to avoid congestion of the general chat text window and thus reduce confusion among the students.
- More guidance should be provided within the messages delivered when learners are not doing the right thing.
- It is worth pointing out that although a high percentage of the students in the Second Life group were high gamers, they still found problems navigating in Second Life. It is important to keep in mind that the interface offered in Second Life is unique. The traditional navigational functions offered in current web browsers are very different from the ones available in Second Life.
- It is recommended that the study ensure that the students are exposed to Second Life for at least 4 hours before engaging in any learning activity in this environment.

It is important to highlight the fact that following the four-dimensional framework and development process discussed in this paper has helped with the implementation of the learning outcomes originally proposed for the delivery of game-based learning for a virtual patient in the area of respiratory medicine. The pilot study carried out has been extremely important in the evaluation of students’ attitudes towards learning using this delivery mode. The feedback received has informed the development of Phase II, which incorporates a multi-patient approach. Five virtual patients suffering from different respiratory problems, such as Asthma and COPD, have been implemented. The same narrative and activity model is applied for all these patients including different modes of representation.

It is worth pointing out that after implementing the changes driven by the feedback received from this evaluation, further analysis has to be carried out in order to continue evaluating attitudes towards game-based learning for the delivery of the potential next generation of virtual patients.

This research is still ongoing and the findings highlighted above form part of a larger research project.

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# COMBAT SCENARIOS AND RELAXATION TRAINING TO HARDEN MEDICS AGAINST STRESS

Melba C. Stetz<sup>1</sup>, Chris P. Long<sup>1</sup>, Brenda K. Wiederhold<sup>2</sup> and David D. Turner<sup>1</sup>

Virtual Reality-Stress Inoculation Training (VR-SIT) is a technique designed to mitigate the negative effects of psychological stressors. This study was designed to examine the usefulness of VR-SIT to increase levels of stress in medical military personnel. We examined the psychological stress levels in 63 participants that were either in a group to practice combat medical skills with virtual scenarios only, or practicing relaxation techniques only, both, or neither. We observed higher levels of hostility in the VR group than in the rest. Also, those practicing relaxation techniques while exposed to the VR games showed higher levels of sensation-seeking. Interestingly, further analyses showed higher levels of both anxiety and dysphoria in those previously deployed that participated either in the VR or the relaxation group. Our results suggest that exposure to VR scenarios where to practice medical skills is a promising way to prepare warfighters for combat stress.

## INTRODUCTION

Warfighters face stressors such as uncertainty, long work hours, sleep deprivation, information overload, risk of death or disease, etc. (Campbell, Ritzer, Valentine, & Gifford 1998; Lukey, Stetz, & Romano, 2005). Stetz et al. (2005) found that in 2003 ( $n = 5,671$ ), stress and depression were the main reasons why 7% of warfighters during Operation Enduring Freedom (OEF) and 6% during Operation Iraqi Freedom (OIF) were medically evacuated from theater. Hoge, Castro, Messer, McGurk, Cotting, and Koffman (2004) reported that approximately 18 percent of warfighters returning from Iraq and 11 percent returning from Afghanistan screened positive on stress-related measures. Hoge, Auchterloni, and Milliken (2006) also suggested that 1 in 10 U.S. Iraq veterans suffer from some type of stress disorder. This increased stress to soldiers has led to an increased rate of suicide among the soldiers. According to the Army Suicide Event Report that was published in 2007, the rate of suicides in 2006 (16.91 per 100,000) was the highest since 1991, while the historical average for suicides has been around 12 per 100,000 soldiers (Yosick 2008). The Soldier suicide rates have varied since the operations in Iraq initiated in 2003, the suicide rates per 100,000 in 2003 (18.8), 2005 (19.9), and 2006 (17.3,  $p < .05$ ) were higher than the 10-year average of the U.S. Army (11.6 per 100,000), while in 2004 (9.6) the rate was lower than the average (Castro 2008).

While Stetz (main author) was deployed to Iraq in 2008, she observed that the military continues to face significant challenges in its efforts to prevent and heal combat stress casualties. Some potential reasons being: warfighters and their organizations ("units") either fail to recognize or deny combat stress as a readiness problem; lack of enough deployed resources to help prevent and treat combat stress; lack of rapid access to combat stress help; etc.

### Corresponding Author:

MAJ Melba Stetz, Ph.D., Research Director, Psychology Department, Tripler Army Medical Center, Hawaii  
Tel: +1/ 808-433-1651  
Melba.Stetz@us.army.mil

<sup>1</sup>United States Army Aeromedical Research Laboratory, Fort Rucker, Alabama

<sup>2</sup>Virtual Reality Medical Center, San Diego, California

The views expressed in this article are those of the authors and do not necessarily represent the official policy or position of the Department of Defense. This project was funded through the Army Medical Department Advanced Medical Technology Initiative, Telemedicine and Advanced Technology Research Center (TATRC), US Army Medical Research and Materiel Command, Fort Detrick, MD. TATRC has been involved in many partnerships with universities and federal agencies supporting well over 500 research projects.

An example of a tool widely used to treat combat stress is the Critical Incident Stress Debriefing (CISD). The CISD is typically used after warfighters have been exposed to a traumatic event (e.g., death of a comrade). It is designed to diffuse or prevent the later development of acute and chronic stress reactions to traumatic stressors. However, CISD's effectiveness for remediating combat stress injuries has received mixed and limited empirical support (Kavanagh, 2006). Also, only 44 percent of those individuals who undergo and complete psychotherapy will be ever classified as "improved" (Bradley, Greene, Russ, Dutra, and Westen, 2005). On the other hand, there are other techniques to cope with combat stress including the use of mobile phones and other mobile technologies. In an article by Riva et al., the use of mobile narratives may be used to improve the mood and the state of the soldier when a specific therapeutic protocol is combined with the treatment (Riva et al., 2008). Similarly, psychotropic medications such as selective serotonin reuptake inhibitors rarely yield better than a 40 percent reduction in the Clinician-Administered PTSD Scale scores. That is, most patients who use these medications continue to meet the criteria for PTSD at the end of their treatment trial (Hamner, Robert, & Frueh, 2004).

Due to both the increasing incidence of combat stress injuries and the limited effectiveness of current post-stress exposure treatments, the Department of Defense (DOD) is seeking methods that can be applied to mitigate the negative psychological reactions that warfighters have to the stressors of combat. Therefore, the present study was designed to answer DOD's call for viable prevention strategies by examining the efficacy of virtual reality (VR) stress inoculation training (VR-SIT) as a method to harden soldiers against the stressors they will encounter on the battlefield.

#### ***VIRTUAL REALITY STRESS INOCULATION***

The foundation of SIT dates back to Wolpe, Brady, Serber, Agras, and Liberman (1973) work on cognitive/behavioral stress-coping training. The main premise is that a controlled pre-exposure to a particular stressor can be applied in ways that will reduce a potential negative psychological impact. Over time, a repetitive exposure to a particular stressor would harden or psychologically "inoculate" an individual to that particular stress stimulus. That is, in order for exposure to a particular stressor to produce an inoculation effect, stressors must first produce a negative psychological reaction such as an increase in perceived psychological stress or negative affect. SIT can be accomplished through gradual, controlled and repeated exposure to a stressor with the goal of desensitizing or "inoculating" an individual against a stimuli that normally causes panic or a "fight or flight" response from the individual (Wiederhold & Wiederhold 2008).

SIT has been studied extensively and appears to reduce negative reactions to stressors prior to and during performance (Stahl, 2005). For example, Saunders, Driskell, Johnston, and Salas, (1996) conducted a meta-analysis of SIT studies to determine the effect of such training on subjective (anxiety) and objective (performance) measures. They found a strong overall effect for SIT reducing performance anxiety resulting from engaging in a specific task. They also found a moderate effect for reducing state anxiety (anxiety that is not necessarily task-related) and increasing performance. Wiederhold, Bullinger and Wiederhold (2006) and others have also displayed how virtual reality technologies can be used to mitigate the negative effects of stress injuries and post-traumatic stress disorder (PTSD).

With recent advances in virtual reality (VR), specific stressors can be systematically added to virtual reality environments to increase the perceived realism or "vividness" of the experience.

Therefore, VR-SIT is a specific form of SIT that utilizes VR technologies to control individual's exposure to particular stressors. Many clinicians use VR-SIT to expose individuals to stressors in ways that enable them to adapt, learn how to cope, and become psychologically "hardened."

Military personnel can easily train in virtual environments (e.g., Iraqi village, a shoot house, or a ship) where simulations are viewed on a desktop computer, or laptop computer, through a head-mounted display, or as a 1- or 3-wall computer



automated virtual environment projection system (Wiederhold & Wiederhold 2008b). The training is eventually transferred to real-world exercises designed specifically for tactical training. While more traditional cognitive-behavioral training SIT has been implemented in military, medical, and others settings, VR-SIT offers potentially a potentially very effective way to prevent mental health problems, thereby saving warfighters and their families the pain of psychiatric illness and also saving the taxpayers the cost of psychiatric treatment.

### ***VR-SIT AND RELAXATION TECHNIQUES***

Relaxation techniques can help individuals cope with stress. Two of these techniques are: “Progressive Muscle Relaxation” (PMR) and Controlled Breathing (CB). PMR has been thoroughly researched and documented as an effective tool for a wide range of disorders. Much of the research and practice is based on the work of Dr. Edmund Jacobson beginning in the 1930s. It has been applied to help patients deal with numerous medical and psychological applications since it can help reduce generalized autonomic arousal and positively alter cognitive effects (e.g., distraction from pain). Some of these applications are: anxiety disorders (Ost & Westling, 1995), hypertension and coronary artery disease (Alexander et al., 1996), insomnia (Lacks & Morin, 1992), depression (Harte, Eifert, & Smith, 1995; Marcotte, 1997), and acute pain (Lang et al., 2000). The rationale behind PMR is that individuals must re-focus their experienced tension to their big muscle groups. Individuals are typically asked to tense their muscles starting at their toes and proceeding all the way to their faces. At each muscle group participants will spend a few seconds tightening and relaxing.

When individuals get anxious, they also tend to breathe shallowly, using their upper chest muscles instead of their diaphragms. Rhythm formulas that involve breathing at six breaths per minute induce favorable psychological and possibly physiological effects. CB is a relaxation technique that can take from seconds to minutes. Individuals are typically asked to inhale through their noses for a few seconds, hold momentarily, and then exhale slowly through their mouths. CB can help relieve anxiety as well as improve circulation, concentration and digestion. This technique can be easily incorporated to this process by asking individuals to tense muscles while inhaling and releasing the body tension while exhaling.

In our present study, we build from previous research and investigate whether VR-SIT may be used to inoculate medical service members against combat stress. We specifically examined whether individuals exposed to VR-SIT would exhibit increased levels of psychological stress.

## **METHOD**

### ***PARTICIPANTS***

Our sample was composed of 63 volunteers who were attending a combat medical class (e.g., Flight Medic, Joint En-route Care Course, Ranger First Responder) at either Fort Rucker, AL; Fort Drum, NY; or Fort Benning, GA.

### ***DESIGN - VR AND COPING TRAINING SESSIONS***

Our VR scenarios/games were created by the Virtual Reality Medical Center (VRMC). One of the scenarios was called “Combat Medic.” In this environment “medics” (used loosely throughout this manuscript to further group our whole sample composed of nurses, paramedics, physician assistants, etc.) had to decide when to shoot and when to treat. They only had about three minutes to triage, treat casualties on ground, administer intravenous fluids, morphine, chest seals, and call for MEDEVAC help. The other scenario, designed specifically for our study, was the “Flight Medic.” In this scenario, participants had to treat a similar casualty but inside a helicopter that was facing turbulence and on its way to the next level of care (e.g., medical facility). Our coping sessions consisted of a research staff asking selected participants (see design below) to either breathe or tense a body part per our PMR and CB techniques. Participants were inside a noise-proof

chamber, in the dark, and wearing a head mounted display while being guided and monitored externally (see Figure 1).

Since we depended on students' availability to participate in our study, we were only able to pseudo-randomly assign them to either the control or one of the experimental groups, as defined below.

1. VR Group- 18 medics participated only in either two or four VR sessions.
2. CT Group- 18 medics participated in either two or four CT sessions.
3. CT-VR Group- 18 medics participated in a combination of a CT and a VR session.
4. Control- 9 medics did not participate in any session.

### **MEASURES**

To help ensure that individuals who participated in this study were in good physical health, we measure the basal body temperature of all participants. Only those volunteers who showed normal oral temperature (e.g., temperature between 98.2 and 98.6 degrees Fahrenheit, see Shoemaker, 1996) were allowed to participate. Also ensure that individuals maintained a low level of baseline stress, we pre-screened participants using the "Post Traumatic Stress Disorder Checklist-Military" version (PCL-M) by (Weathers, Huska, & Keane, 1991). The PCL-M is a widely used, self-administered objective questionnaire with 17 questions assessing trauma-related stress. Response options range from 0 (not at all) to 5 (extremely) with the higher numbers indicating greater stress. Only the volunteers showing low stress symptoms on the PCL-M (scores less than 4 and 5 on each item) were allowed to participate in our study.

Furthermore, to ensure that individuals exposed to the virtual reality scenarios did not exhibit increased levels of stress due to physical problems related to their exposure to the virtual reality scenarios, we asked participants exposed VR-SIT to complete the "Simulator Sickness Questionnaire" (SSQ). The SSQ was developed by Kennedy, Lane, Berbaum, and Lilienthal (1993) to quantify the type and magnitude of symptoms specifically related to flight simulation. Currently, the SSQ is also sometimes used to measure symptoms of cybersickness. Cybersickness (see Wiederhold, Rizzo, & Wiederhold, 1999) can be described as a cluster of symptoms that are similar to motion sickness. These symptoms could result from exposure to virtual environments. Some of these symptoms are: disorientation, nausea, dizziness, headache, blurred vision and vection (feeling of moving through space). The SSQ analyzes simulator sickness by breaking it into three components: nausea, oculomotor, and disorientation. The questionnaire has 16 items measured on a 4-point scale of 1 (none), 2 (slight), 3 (moderate) and 4 (severe) that allowed participants to indicate the degree to which they experienced each symptom.

We examined their levels of psychological stress by using the "Multiple Affect Adjective Check List- Revised" (MAACL-R) (Zuckerman & Lubin, 1985). This checklist is designed to measure five components of subjective trait characteristics that affect changes in response to stressful situations. Specifically, it measures anxiety, depression, hostility, positive affect, sensation seeking, and dysphoria using a computerized composite scored system provided to the PI by the Army Research Laboratory. Participants in all groups had to choose from a set of 132 adjectives those that best described how they felt before and after each session.

Presence has been defined as the subjective experience of being in one place or environment mentally, even when one is physically situated in another place or environment (Witmer & Singer, 1994). As applied to a virtual environment, presence refers to experiencing the computer-generated environment rather than the actual physical locale. We measured the realism of our VR scenarios with the "Presence Questionnaire" (PQ). The PQ measures six presence factors: involved/control, natural, interface quality, auditory, haptic, and resolution. This survey was administered after each VR session.

## RESULTS

Most participants in our sample were Caucasian ( $n = 48$ , 76%) enlisted ( $n = 51$ , 85%) married ( $n = 34$ , 56%) males ( $n = 47$ , 75%) serving in the Regular Army ( $n = 41$ , 65%) and under the age of 30 ( $n = 35$ , 60%). They had been previously deployed ( $n = 36$ , 57%) and wanted to stay in the military ( $n = 46$ , 73%).

During our screening session, we found that their body temperature was within normal range. Also, none of them showed high rates of PTSD. In Figure 2 we can see that the three main PTSD symptoms reported as either “Moderately” to “Quite a bit” were in the following order “Repeated, disturbing dreams of a stressful military experience” (26%); “Repeated, disturbing memories, thoughts, or images of a stressful military experience?” (25%); and “Feeling as if your future will somehow be cut short.” About 10 to 20% of participants reported similar levels of stress across the remaining items. In regards to “presence,” participants rated our VR scenarios as moderately realistic (i.e., between 3 and 5) on most of the dimensions examined by the PQ.

We did not find any interesting finding from the small control group. However, we found the opposite when studying the experimental conditions/groups (e.g., VR) and previous deployment status with a two-way Multivariate Analysis of Variance (MANOVA). This MANOVA included the full complement of MAA CL-R measures (i.e., hostility, anxiety, depression, positive affect, sensation seeking, and dysphoria). Tests of the overall model only suggested a statistically significant effect for condition or group ( $F(12, 242) = 3.3$ ,  $p < .001$ ) on psychological stress levels. Additional post-hoc comparison tests showed that participants in the CT-VR condition, showed levels of sensation-seeking that were significantly higher than levels of sensation-seeking for participants in either the VR (mean difference = 5.9,  $p < .01$ ) or the CT (mean difference = 9.1,  $p < .001$ ) groups. Finally, comparison analyses also indicated that levels of hostility for participants in both the VR (mean difference = 6.1,  $p < .01$ ) and CT-VR (mean difference = 5.6,  $p < .01$ ) groups were higher than the levels of hostility for participants in the CT one. Figures 3 and 4 provide graphical representations of those results.

Tests of the overall model also revealed significant effects for the interaction of condition and previous deployment on both anxiety ( $F(2, 126) = 3.3$ ,  $p < .05$ ) and dysphoria ( $F(2, 126) = 4.9$ ,  $p < .05$ ). The post-hoc comparison tests that we conducted indicated that participants who were exposed to only the VR environment that had been previously deployed exhibited higher levels of anxiety (mean difference = 7.5,  $p < .05$ ) and dysphoria (mean difference = 10.4,  $p < .05$ ) than participants in the same condition who had not been previously deployed.

Post-hoc comparison tests also suggest that dysphoria in the CT group was higher for participants who had previously been deployed (mean difference = 7.6,  $p < .05$ ) when compared to the rest of the participants. In addition, dysphoria was lower for participants in the CT-VR condition who had previously been deployed (mean difference = 11.3,  $p < .05$ ) when compared to participants in that condition who had not been deployed. Figures 5 and 6 provide graphical representations of patterns of those effects.

Many VR organizations around the world are hoping that this type of training can be used for stress inoculation purposes along with enhancing the skills and techniques of military personnel in order to enhance their performance in stressful situations (Wiederhold & Wiederhold 2008b).

## DISCUSSION

With or without prompt and proper recognition, stress has always been one of the most pervasive and debilitating readiness factors on the battlefield. Nevertheless, the military medical system is still working on preventing the high turnover of warfighters out of combat due to stress.

The purpose of our study was to examine the effectiveness of using VR-SIT to inoculate medical warfighters against combat stress injuries. A total of 63 individuals participated in our study. Nine served as control, 18 engaged in VR combat medic games, 18 practiced relaxation, and 18 more practiced both the games and the relaxation.

We observed that hostility levels were higher in the VR group when compared with those in the CT group. Also, sensation-seeking levels were higher in the CT-VR group than either the CT or VR conditions. Thus, it appears that VR-SIT may be an effective tool for raising psychological stress levels. While further testing is needed, this is an important first step in examining how artificially induced stress can be produced in ways that may ultimately be used to create psychological inoculation effects against combat stress.

VR-SIT may be a particularly effective way to raise stress levels in individuals who have already experienced combat. We found higher levels of hostility in the VR group than in the rest. Also, those practicing relaxation techniques while exposed to the VR games showed higher levels of sensation-seeking. Finally, further analyses showed higher levels of both anxiety and dysphoria in those previously deployed that participated either in the VR or the relaxation group.

Some of the limitations that we faced were the following ones (1) the development of some of the virtual reality scenarios took longer than expected, (2) participants could only participate in our study after duty hours due to the fast-paced long training that they had to attend during the day, and (3) we lost a few participants every month when the course that they were attending would send them home due to academic standards.

We can draw two main suggestions for the usefulness of VR technologies in the prevention of combat stress. First, it may suggest that combat breathing and VR technologies may actually increase negative affect when administered independently to previously deployed service members. Thus, these techniques might be important tools to produce the reactions necessary to stimulate inoculation effects. Second, when these techniques are combined, they may produce a decrease in negative affect among individuals with previous deployment experience. Hence, the combination of these two techniques (medic training and relaxation) might be instrumental to producing the “hardening” effect against combat stress. That said, future research will be necessary to fully explain this observation.

In sum, having more deployable, and engaging (e.g., game-based) techniques to help manage or reduce stress levels can allow our service members and civilians to better focus on the mission at hand. VR-SIT seems to continue being a useful and promising tool to “harden” personnel for future operations in the always stressful war-zone.



**FIGURE 1.**  
Dr. Stetz Monitoring a Participant in the Research Laboratory.

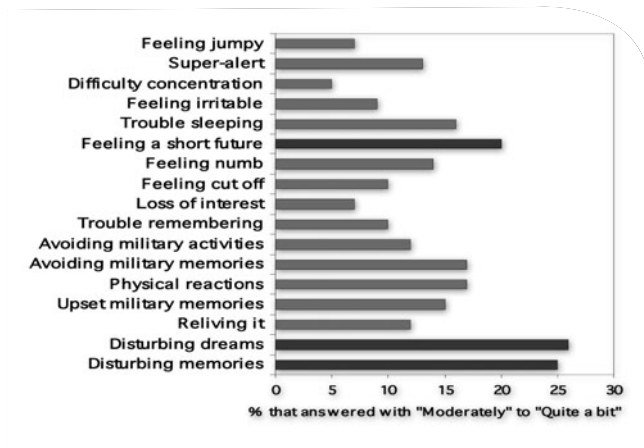


FIGURE 2. Reported PTSD Symptoms prior the First Session.

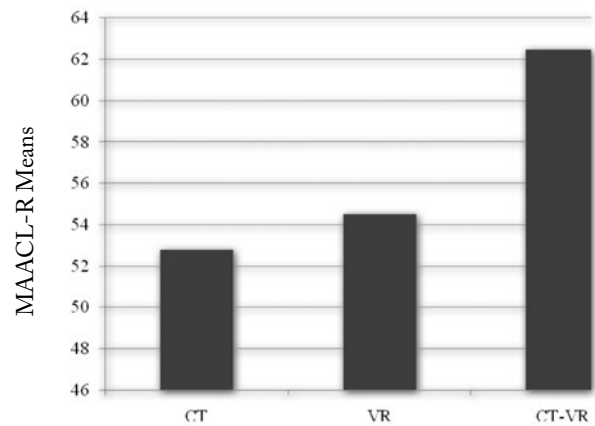


FIGURE 3. Sensation Seeking Scores for Each Group.

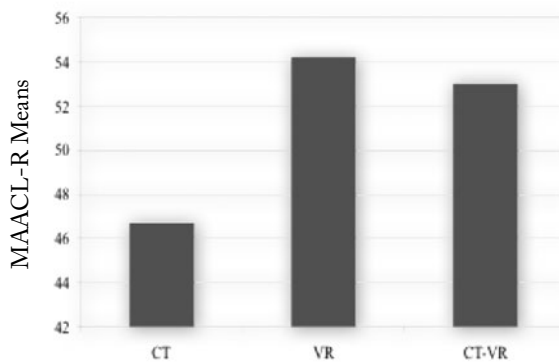


FIGURE 4. Hostility Scores for Each Group.

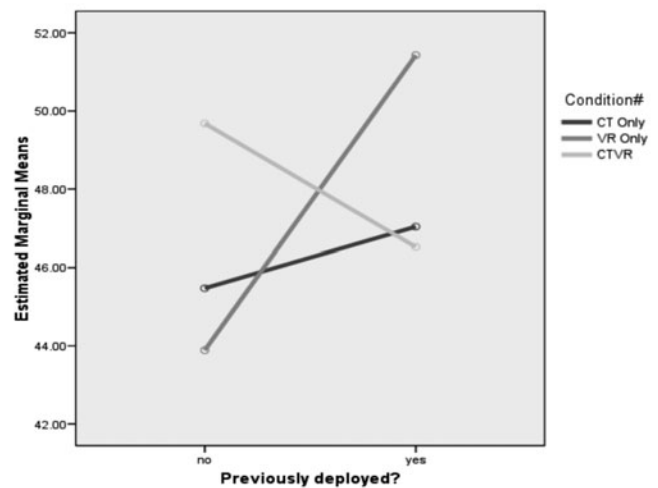


FIGURE 5. Anxiety Interaction of Condition and Previous Deployment

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# THERAPEUTIC PROCESSES IN VIRTUAL REALITY EXPOSURE THERAPY: THE ROLE OF COGNITIONS AND THE THERAPEUTIC ALLIANCE

Katharina Meyerbröker<sup>1</sup> and Paul M.G. Emmelkamp<sup>1</sup>

Little is known about the processes involved in Virtual Reality Exposure Therapy (VRET), including the role of the therapeutic alliance and the patients' cognitions. This study was designed to investigate VRET processes in patients with specific phobias. We analyzed the influence of VRET on self-efficacy and negative self-statements without addressing these cognitions directly through treatment. In addition, we examined whether the quality of the therapeutic alliance as assessed with the Working Alliance Inventory (WAI) predicted successful outcome in VRET in terms of anxiety reduction. As expected, results showed that anxiety was reduced through treatment and an increase in self-efficacy, and a decrease in negative self-statements was observed. The quality of the therapeutic alliance was only positively related to outcome in fear of flying patients, but not in patients with acrophobia.

## INTRODUCTION

The essential feature of a specific phobia is the intense fear that the stimulus provokes in the individuals that suffers from phobias (DSM-IV-TR, APA, 1994). People with specific phobias tend to avoid the feared stimulus and this avoidance will reinforce anxiety because leaving the feared object or situation will reduce the experienced fear.

The 'golden standard' for the treatment of specific phobias is exposure in vivo (Emmelkamp, 2004). Over the last decade, technical innovations made it possible to simulate anxiety-provoking situations in the therapist's office via computer generated virtual environments. The effectiveness of Virtual Reality Exposure Therapy (VRET) for the treatment of specific phobias has been demonstrated in several studies (for an overview see Wiederhold & Wiederhold, 2005). Today, computer generated virtual environments simulate anxiety provoking situations in even more complex anxiety disorders such as panic disorder (e.g. Botella et al., 2007; Peñate et al., 2008). However, not all studies meet high methodological criteria and validity (Cote & Bouchard, 2008). Recent meta-analyses have shown that exposure therapy given in virtual reality is at least as effective in anxiety reduction as the state-of-the-art exposure in vivo (e.g. Powers & Emmelkamp, 2008; Parsons & Rizzo, 2008).

As of yet, little is known about the processes involved in VRET, such as the role of the therapeutic relationship and of cognitions during the therapy. Hardly any information about cognitive restructuring or coping as a result of VRET is available. In the context of therapy, self-efficacy can be described as someone's assumptions about his or her own capacities to finish certain tasks and actions successfully and his belief in his own skills or abilities (Bandura, 1980). To date, only one study has investigated the effects of VRET on self-efficacy (Krijn et al., 2007b) on individuals with a fear of flying. VRET has led to a linear increase in self-efficacy.

Corresponding Author:  
Katharina Meyerbröker, University of Amsterdam, Department of Clinical Psychology,  
Roetersstraat 15, 1018 WB Amsterdam, Tel: +31(0)525 7084.  
K.Meyerbroeker@uva.nl

<sup>1</sup> University of Amsterdam

While self-efficacy refers to a more global belief in someone's own capacities to generate effects (Smith et al., 2006), self-statements as investigated by Krijn et al. (2007a) refer to the positive or negative thoughts somebody has about him or herself. Positive self-statements can also be interpreted in a sense of coping mastery while negative self-statements may promote avoidance behavior (van Hout et al., 2001). Krijn et al. (2007a), using a cross-over design, investigated the effect of cognitive restructuring in phobic subjects. Subjects were randomly assigned to either two sessions of VRET followed by two sessions of VRET with coping self-statements, or they were assigned to two sessions of VRET with coping self-statements followed by two sessions of VRET. Results indicated that the addition of coping self-statements did not influence the effectiveness of treatment. Given the cross-over design used, no conclusion can be drawn on the change of cognitions during VRET as stand alone treatment.

Another important aspect concerning therapy outcome and process is the therapeutic alliance between therapist and patients. Since Freud's (1912) emphasis on the role of the client-therapist relationship, the importance of the relationship between client and therapist is increasingly being recognized in nearly all schools of psychotherapy. In contrast to the more general term 'therapeutic relationship,' which denotes the overall relationship between therapist and client, 'therapeutic alliance' (Greenson, 1966) characterizes a particular phenomenon within the therapeutic relationship: a sense of collaborative bond. Psychotherapy researchers use the term treatment alliance today, this term refers to a variety of interpersonal processes in psychotherapy that are considered to be independent from specific treatment techniques (Green, 2006).

Over the past decade, a substantial number of studies have consistently linked the quality of the alliance between the therapist and client with therapy outcome (e.g. Horvath & Symonds, 1991; Orlinsky, Rønnestad & Willutzki, 2004). The strength of the alliance, defined by Bordin (1979) as the degree to which the client and therapist agree on the goals and tasks of treatment and share a mutual, positive affective bond, predicted premature termination (drop-out), global ratings of satisfaction and improvement. A consistent finding is that the stronger the therapeutic alliance, the chance of client drop-out decreases, more satisfaction will be reported by the client, and the therapeutic change achieved will increase (Horvath & Bedi 2002; Martin, Garske & Davis, 2000; Orlinsky et al., 2004). In the most recent meta-analysis of the therapeutic alliance (Horvath and Bedi, 2002) small to moderate effect sizes of .22 and .15 were found for the prediction of outcome of psychotherapy for client and therapist alliance ratings, respectively. The magnitude of the relationship between the therapeutic alliance and therapy outcome is unrelated to the type of therapy practiced. There has been an increase in evidence that the therapeutic relationship plays an equal important part in cognitive-behavior therapy as it does in more verbal psychotherapies such as psychodynamic and experiential psychotherapy. There is some evidence that the clients' ratings of the alliance early in therapy are the best predictors of therapy outcome.

Because of its consistent, although modest, ability to predict treatment outcome, the therapeutic alliance has become the most studied process variable in psychotherapy research (Shelef & Diamond, 2008). Although the therapeutic alliance is an established predictor of psychotherapy outcome, alliance research in technology-based psychological treatment has been neglected (Emmelkamp, 2005). Research into the importance of the therapeutic relationship in non technology-based psychotherapies may not apply to treatments using virtual reality methodology. The specific requirements of treatment using virtual reality technique (e.g. using Head Mounted Device) may affect the quality of the therapeutic relationship, since there is no face-to-face contact during treatment.

The present study was designed to investigate processes involved in VRET in patients with specific phobias: acrophobia and fear of flying. One of the aims of the study was to analyze the influence of VRET on cognitions without addressing these cognitions directly through treatment. We expected not only a reduction in anxiety, but an increase in self-efficacy and a decrease in negative self-statements as well.



The second aim of this study was to examine whether the quality of the therapeutic alliance as assessed with the Working Alliance Inventory (WAI) predicted successful outcome in virtual reality exposure therapy (VRET) in terms of anxiety reduction. In addition, we investigated whether or not the experience of presence during VRET was related to the quality of the therapeutic alliance.

## METHOD

### *DESIGN*

After an intake session, a pre-test followed with suitable subjects. Subjects received four sessions of VRET. Sessions were scheduled once a week. After the last session, a post-test was held, and 12 months after treatment a follow-up test was held (not reported here). A within-subject design was used to evaluate treatment effects.

### *PARTICIPANTS*

The consecutive referral of a patient to our department with fear of flying and acrophobia had to meet current Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (DSM-IV) criteria for a specific phobia. The specific phobia had to be the main problem. Subjects were excluded if they met criteria of posttraumatic stress disorder or acute stress disorder, panic disorder, and/or severe agoraphobia. Furthermore, subjects with co-morbid Axis-I disorders (DSM-IV-TR, 2000) were excluded. Subjects were also excluded if they had suicidal tendencies, did not want to stabilize their antidepressant medication during the course of treatment, or were unable to discontinue the use of benzodiazepines. Other reasons for exclusion included whether or not the subjects were undergoing treatment elsewhere or if they were younger than 18 years. For technical reasons related to the use of VR equipment, subjects with glasses who wore eyeglasses stronger than 3.5, had epilepsy, or pacemakers were also excluded.

### *TREATMENT*

To give patients a gradual and optimal exposure treatment, both acrophobic and flying phobic participants had to rate their anxiety regularly during the virtual reality exposure therapy (VRET) by means of Subjective Units of Discomfort (SUDS), from 0 to 10. Patients were exposed during VRET to the anxiety-provoking situations in a gradual manner. After extinction, as evidenced by a relatively low SUD, patients were encouraged to take a next step (for instance, move up one floor); there was more variability in the acrophobic worlds as compared to the fear of flying worlds. In order to study the effects of pure VRET, patients did not receive any homework instruction.

### *COMPUTER EQUIPMENT AND VIRTUAL ENVIRONMENTS*

The VRET was conducted in a basement laboratory room at the Department of Clinical Psychology of the University of Amsterdam. The virtual worlds for therapy were generated by a Pentium-II 450 MHz computer with 128 Mb RAM, 4 Gb hard disk, and a 3D-Labs Oxygen GVX-420 graphics card with a 128 Mb video memory and dual monitor support. The software used was Sense 8 WorldUp R4. The system was able to generate the display at a rate of about 15 to 20 frames per second. The worlds were displayed using the Cybermind Visette Pro glasses. The projection of the worlds into the glasses was stereographic. The field of view was 70.5 degrees diagonally. The tracking was done with Ascension Flock of Birds.

Two virtual environments were used for fear of flying therapy and three for the fear of heights therapy. For fear of flying, the first environment was Amsterdam's Schiphol Airport; subjects could walk freely (within one square meter) from the entrance to the boarding hall, passing all the main points (check-in, luggage control, duty free shop etc) that are normally passed on the way to the aircraft. The second environment was an aircraft where subjects could take seat in different positions in the aircraft (See figures 1). This environment was supported by two real aircraft-seats and part of an airplane-wall,

with windows. The aircraft-chair vibrated during take-off, landing and during turbulences.

Three Virtual Environments (VE's) were created for treatment of fear of heights and were used in a gradual order. The first was a six-story fire escape, on which subjects could move freely within one square meter (See figures 2). The second was a



**FIGURE 1.** Virtual Environment For The Fear of Flying



**FIGURE 2:** Virtual Environment For Acrophobia (Fire Escape)

roof garden on the eighth floor of a building of the University of Amsterdam, where subjects could walk freely along the railing. The third environment was a construction-site; an unfinished four story building with stairs which subjects could see through and where, from the third floor up, the virtual railing was missing.

#### **INTAKE**

The section of anxiety disorders of the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I) was used in the intake session (First, Spitzer, Gibbon & Williams, 1996). The SCID-I is designed to diagnose axis-I disorders of the DSM-IV (Diagnostic Statistic Manual, 1994). It consists of a number of open questions to inspect the personal situation and sufferings of the patient. Furthermore, it also consists of a number of screening questions to give a survey of whether the patient is suffering of any psychopathology. If patients give one or more positive answers, the interviewer can go to the respective section to question the patient about the symptoms he or she is experiencing, in order to examine if the criteria for a current diagnosis are met.

#### **MEASURES**

A number of questionnaires were used during the pre-test and post-test to evaluate the effectiveness of treatment and cognitive processes related to it:

##### **ACROPHOBIA QUESTIONNAIRES (AQ)**

The Acrophobia Questionnaire-Anxiety Scale measures anxiety in height situations (Acrophobia Questionnaire, Cohen, 1977). Therefore, 20 items were used where the subject could express his or her fears on a scale ranging from 0-6, whereby 0 stands for "no fear at all" and 6 for "almost panic" (ranging from 0-120).

##### **THE FLIGHT ANXIETY SITUATIONS QUESTIONNAIRE (FAS, VAN GERWEN ET AL, 1999)**

The FAS measures the quantity of fears experienced in different situations concerning a fear of flying. The question-

naire is a 32-item self report inventory with a 5-point Likert scale (ranging from 'no anxiety' to 'overwhelming anxiety'). The questionnaire consists of three subscales: 1) Anticipatory Flight Anxiety Scale, measuring anxiety when anticipating an aircraft flight (14 items), 2) In-flight Anxiety Scale, measuring anxiety experienced during a flight (11 items) and 3) Generalized-Flight Anxiety Scale, measuring anxiety experienced for aircrafts in general, regardless of personal involvement in a flight situation (7 items). In this study the total score was used (ranging from: minimum: 32, maximum: 160).

Within VRET sessions the following questionnaires were used to measure changes within each treatment session:

#### ***COGNITIVE QUESTIONNAIRE (CQ)***

A cognition questionnaire was developed (Krijn et al., 2007a/b) for fear of heights and fear of flying respectively, based on the cognition questionnaire of agoraphobia (van Hout, Emmelkamp, Koopmans, Bögels & Bouman, 2001). This questionnaire was filled in after every treatment session. The questionnaire consisted of 24 items for fear of heights and 30 items for fear of flying (e.g. for acrophobia: 'I have the feeling that I will jump off'. E.g. for fear of flying: 'I cannot leave as soon as I want to'). Each item was scored on a five-point Likert-type scale ranging from "not at all" to "permanently". Range for fear of flying is from 0 – 120; range for acrophobia is 0 – 96.

#### ***SELF-EFFICACY QUESTIONNAIRE***

A Self-efficacy Questionnaire was constructed to measure the degree of self-efficacy subjects experienced with respect to the phobic situation (Krijn et al., 2007b). The questionnaire consisted of five items on self-efficacy in a real phobic situation (standing on a fire-escape on the sixth floor for acrophobia or being in an aircraft on a flight to Rome for fear of flying). The items represented five different themes: 1) the capability to reduce the experienced fear, 2) to think clearly, 3) to control one's own actions, 4) to control anxious thoughts and feelings and 5) to stay in the situation while experiencing intense fear. Patients were instructed to rate their own capability by giving a percentage. This was recoded on a 0-10 scale, resulting in scores ranging from 0-50.

#### **OTHER MEASURES INCLUDED:**

##### ***WORKING ALLIANCE INVENTORY (WAI; HORWATH & GREENBERG, 1989)***

The WAI was developed to measure the working alliance as defined by Bordin (1979). It was created to assess the working alliance independent of a therapist's theoretical orientation. It is a self-report instrument consisting of 36 items. The questionnaire was completed at two different phases of therapy (at sessions 2 and 4) to register possible changes. Parallel forms exist for clients' and therapists' ratings of the working alliance. There are three scales that reflect congruence on goals, tasks, and the emotional bond between client and therapist. Each item is rated on a 5-point scale (1-never, 5-always). The total score ranges from 36 to 180, with higher scores reflecting a stronger working alliance. The WAI has been extensively validated for use in psychotherapy. The WAI was completed after the second and the last sessions. In line with research into the therapeutic alliance, only the WAI scores after the second session were used in the analyses.

##### ***IGROUP PRESENCE QUESTIONNAIRE***

To measure presence during VRET, the Igroup Presence Questionnaire (IPQ, Schubert, Friedmann and Regenbrecht, 1999) was used. Presence is the feeling of being in the VE (i.e., a height situation or flying situation) instead of the real environment (the therapist office, wearing VR glasses). The questionnaire consisted of 14 items concerning three factors belonging to the physical sense of presence. The three factors refer to 1) the spatial presence: which is the sense of really being in the virtual environments; 2) involvement: the attention which is paid to the real world and to the virtual environments; and 3) to

the realness of the virtual world: the reality judgment of the virtual environment. The subject could give an indication of how real the virtual world was on a scale ranging from -3 to +3, respectively “completely disagree” and “completely agree”.

## RESULTS:

### PARTICIPANTS' CHARACTERISTICS

In total, 72 subjects registered for participation, of which 25 subjects were rejected, because of a variety of reasons: eye problems ( $n = 2$ ), a diagnosis of panic disorder with agoraphobia ( $n = 4$ ), and unstable antidepressant medication ( $n = 7$ ). Other reasons included being elsewhere in treatment ( $n = 8$ ), or personal problems, which made it impossible to come regularly to treatment ( $n = 4$ ). A total of 3 eligible participants were not in state to start therapy due to personal reasons.

During therapy 10 patients dropped out for various reasons ( $n = 5$  acrophobia and  $n = 5$  fear of flying). Four patients dropped out because VRET did not arouse anxiety, and 2 dropped out because of simulation sickness during VRET. Other reasons included health and personal problems ( $n = 4$ ). Fear of flying patients who dropped out did not differ significantly from completers on the FAS ( $t(17) = -1.4$ ;  $p = .17$ ), but there was a trend that the drop-outs with acrophobia were more severe at the pretest compared to completers on the AQ-anxiety score ( $t(23) = -1.8$ ;  $p = .08$ ). A total of 34 subjects completed treatment: 14 in the fear of flying group and 20 in the acrophobia group. The mean age of participants was 47.5 years ( $SD = 10.24$ ). The gender ratio was 67.6% female and 30.4% male.

### ANALYSES

Paired T-tests were used to compare baseline (pre-test) and post-treatment assessment (post-test); bivariate correlations were used to analyze the strength and the direction of the relationship between the WAI and a number of dependent variables.

### EFFECT OF TREATMENT UPON ANXIETY REDUCTION AND COGNITIONS

To examine the overall treatment effect on anxiety reduction, self-efficacy and negative self-statements, a series of paired sampled t-tests were performed on both treatment groups. To investigate whether anxiety significantly improved with time, a paired samples t-test was used to compare pre- and post assessment of anxiety scores. In agreement with the hypothesis, testing 1-tailed a significant improvement on the FAS was found:  $t(13) = 5.51$ ,  $p = .00$ .

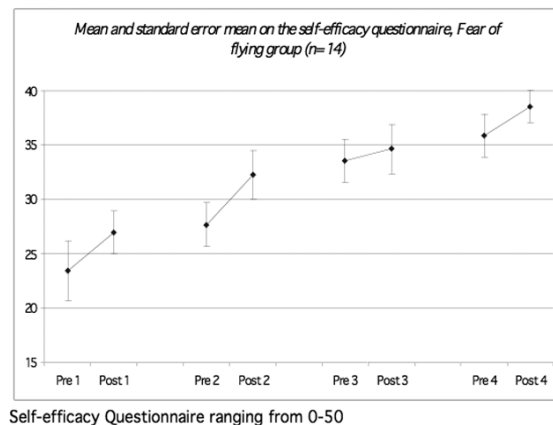
Also, supporting the hypothesis, a significant increase in self-efficacy was found for the fear of flying group testing 1-tailed:  $t(13) = -4.9$ ,  $p = .00$ .

Further, in line with expectations negative self-statements decreased significantly in the fear of flying group, testing 1-tailed:  $t(13) = 8.74$ ,  $p = .00$  (See table 1 for means and standard deviations).

TABLE 1: Fear Of Flying, Self-Efficacy And Self-Statement Scores (N=14)

	$\bar{x}_{pre}$	SD	$\bar{x}_{post}$	SD	t	df	p
FAS	106.21	17.02	67.57	23.44	5.51	13	.000
Self-efficacy	26.35	8.46	36.03	9.44	-4.91	13	.000
Self-statements	29.28	8.87	4.50	4.01	8.74	13	.000

FIGURE 3



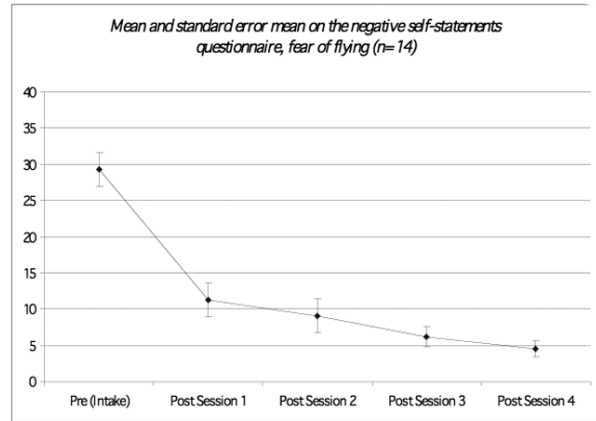
**TABLE 2:** Acrophobia, Self-Efficacy And Self-Statement Scores (N=20)

	$\bar{x}$ pre	SD	$\bar{x}$ post	SD	t	df	p
AQ Anxiety	59.30	17.46	40.65	15.39	4.98	19	.000
Self- efficacy	15.29	10.55	36.03	9.44	-6.17	19	.000
Self- statements	34.20	7.05	11.00	6.38	11.14	19	.000

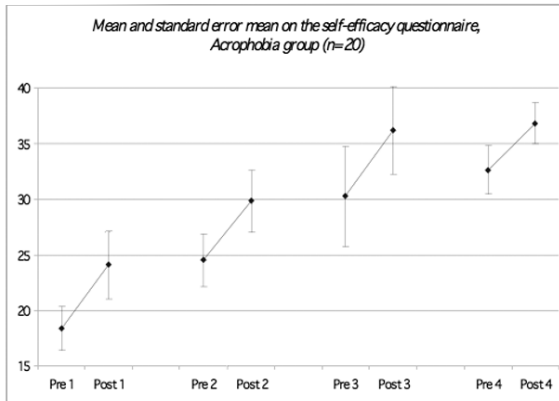
To investigate whether anxiety in the acrophobia group significantly improved over time, a paired samples t-test was used to compare pre- and post assessment of anxiety scores. In agreement with the hypothesis, testing 1-tailed a significant improvement on the AQ was found:  $t(19) = 4.99$ ,  $p = .00$ .

Also in accordance with the hypothesis a significant increase in self-efficacy was found for this group testing 1-tailed:  $t(19) = -4.9$ ,  $p = .00$ .

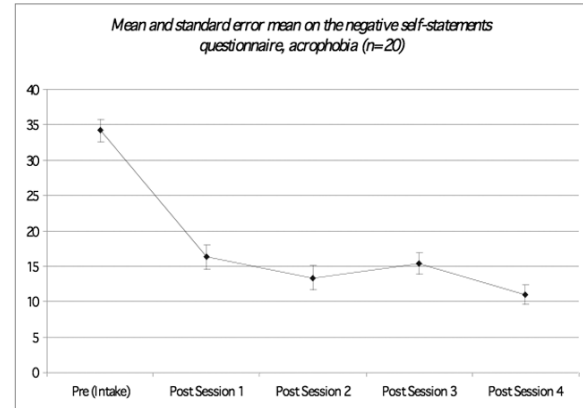
Furthermore, negative self-statements decreased significantly in the acrophobia group, testing 1-tailed:  $t(19) = 11.14$ ,  $p = .00$  (See table 2 for means and standard deviations).

**FIGURE 4**

Negative self-statements questionnaire: ranging from 0-120

**FIGURE 5**

Self-efficacy Questionnaire ranging from 0-50

**FIGURE 6**

Negative self-statements questionnaire: ranging from 0-96

#### RELATIONSHIP BETWEEN THERAPEUTIC ALLIANCE AND TREATMENT OUTCOME

To account for potential differences in the quality of the therapeutic alliance between groups, an independent t-test was conducted. No significant difference between the quality of the therapeutic relationship in both groups was found (WAI-total Fear of flying  $X = 158.86$ ;  $SD = 12.33$ ; acrophobia  $X = 158.60$   $SD = 13.39$ ;  $t(32) = .057$ ,  $p = .95$ ). For the whole group, mean and standard deviations were as follows: Total:  $X = 158.7$ ;  $SD = 12.77$ ; Task:  $X = 53.32$ ;  $SD = 4.56$ ; Bond:  $X = 52.58$ ;  $SD = 4.31$ ; Aim:  $X = 52.79$ ;  $SD = 5.55$ .

Another aim of this study was to examine whether the quality of the therapeutic alliance assessed with the WAI predicted successful outcome in virtual reality exposure therapy (VRET) in terms of anxiety reduction. A Pearson correlation was used to analyze the strength and the direction of the relationship between the subject's perception of the therapeutic alliance as assessed at the end of session two and the reduction in anxiety at the post-test. Separate analyses were run for fear of flying subjects and acrophobic subjects since different measures were used to assess the outcome. For the fear of flying group the total score and the three subscales of the WAI were correlated with pre-post changes on the FAS. Pre-post changes on the FAS correlated significantly with the total score of the WAI, the subscale Task, the subscale Aim, and borderline significant with the factor bond (1-tailed).

Also for the acrophobia group, a Pearson correlation was used to analyze the strength and the direction of the relationship between the subject's perception of the therapeutic alliance as assessed in session two and the reduction in acrophobia at the post-test. Our prediction proved to be wrong, as none of the factors correlated significantly with the subscale Anxiety of the Acrophobia Questionnaire (See table 3).

#### **THERAPEUTIC ALLIANCE AND THE EXPERIENCE OF PRESENCE**

In addition, we conducted an explorative investigation to see whether the experience of presence during VRET was related to the quality of the therapeutic alliance. Therefore, the WAI-total and the 3 subscales of the WAI were correlated with the score on the Igroup Presence Questionnaire as assessed at the end of session two. No significant correlations were found: WAI total:  $r = .27$ ,  $p = .12$ ; Task:  $r = .25$ ,  $p = .15$ ; Bond:  $r = .23$ ,  $p = .19$ , and Aim:  $r = .24$ ,  $p = .17$ .

#### **DISCUSSION**

This study was designed to analyze cognitive and related processes involved in VRET. Four sessions of VRET led to a significant reduction in fear of flying and in fear of height and corroborate earlier findings (e.g. Emmelkamp et al., 2002; Krijn et al., 2004; 2007a; 2007b; Rothbaum et al., 2006; Mühlberger, Weik, Pauli, & Wiedemann, 2006). Although cognitions were not directly addressed during VRET, our hypothesis that self-statements change during VRET was confirmed. Results demonstrated that four sessions of VRET not only led to significant reduction in anxiety but also to enhanced self-efficacy and decreased negative self-statements. The steady increase in self-efficacy over the course of the four VRET sessions is in line with research done by Krijn et al. (2007b) who found that VRET led to a linear increase in self-efficacy in subjects with fear of flying. Our results extend the earlier findings to individuals with acrophobia, indicating that the increase in self-efficacy is not limited to a specific patient group, nor is it limited to specific virtual environments. Further, in line with our hypothesis, reduction of negative self-statements occurred in both groups. In an earlier study (Krijn et al., 2007a), it was found that the addition of coping self-statements did not enhance the effectiveness of VRET in the treatment of acrophobia. Our results extend these findings in that negative cognitions reduced 'automatically' through VRET without offering alternative coping statements by the therapist. Similar reduction in negative self-statements has been found in patients treated with exposure in vivo without any cognitive restructuring (Emmelkamp, 2004).

**TABLE 3:** Correlation (Pearson R) Between Pre-Post Changes Anxiety And The Working Alliance Inventory For Both Groups<sup>1</sup>

		WAI Total (Client)	WAI Task (Client)	WAI Bond (Client)	WAI Aim (Client)
Pre-Post change FAS	$r$	.68	.68	.45	.70
	Significance	.004	.004	.055	.003
Pre-Post change AQ Anxiety	$r$	-.09	-.10	.10	-.20
	Significance	n.s.	n.s.	n.s.	n.s.

\*\* Correlation is significant at the 0.01 level (1-tailed).

<sup>1</sup> Acrophobia group  $n = 20$ , Fear of Flying group  $n = 14$

Our hypothesis that the quality of the therapeutic alliance as judged by patients is positively related to anxiety reduction as a consequence of VRET could only be confirmed for the fear of flying group, meaning that at least for the fear of flying group the therapeutic alliance plays a role in the outcome of VRET. For the fear of heights none of the three factors concerning the therapeutic alliance predicted reduction in fear of heights as assessed with the AQ-Anxiety. The discrepant results with respect to the predictive value of the therapeutic relationship between the fear of flying group and the acrophobia group are puzzling. This discrepancy may be related to the more demanding challenges concerning exposure in the fear of heights group. While in the fear of flying treatment the demands were not continuously increasing in every treatment session, the demands for the fear of heights group were continuously increased in every single session. As soon as the SUDS declined a more demanding VR world was introduced by the therapist, which might have affected the experienced therapeutic relationship and might have accounted for the differences between treatment groups. On the other hand, the quality of the therapeutic alliance was quite high in both groups with relatively small standard deviations. In fact, there was no significant difference between the quality of the therapeutic relationship in both groups. Further, the same therapists treated both type of patients, so it is highly unlikely that other unknown therapist differences explain the differences found. Furthermore, we investigated whether the quality of the therapeutic alliance is related to the level of presence subjects experienced during VRET. Experienced presence was unrelated to the therapeutic alliance; this holds for the total score and for the scores on the subscales of the WAI.

It should be noted that the WAI is an instrument developed for verbal psychotherapy. The WAI has not been adapted for VRET, and some questions may be irrelevant in context with this directive form of treatment (e.g. question 20: "I feel that the therapist is not honest to me concerning his feelings about me"). Under these circumstances, some statements from the WAI might have been confusing for patients because their meaning might have been difficult to adapt to the specific therapeutic situation. A possible solution to this problem might be to adapt some items of the WAI for VRET in future studies. It might also be interesting to include items concerning the experience about being guided through the virtual environment by the therapist. This may give a more detailed view of important aspects concerning the therapeutic alliance in a virtual reality exposure setting. However, it should be noted that reliability analysis confirmed the good psychometric properties of the WAI in the present study (Cronbach alpha: WAI total score:  $\alpha = .89$ , Task:  $\alpha = .75$ , Bond:  $\alpha = .72$ , Aim:  $\alpha = .78$ ).

The question of causality (is the therapeutic alliance better rated because the patient felt already somewhat better – or does the patient improve because of a good alliance) cannot be answered with this design. To minimize the effects of VRET on the evaluation of the therapeutic alliance, however, we used the first assessment of the therapeutic alliance (after the second session) for analyzing its relationship with the outcome of VRET after four sessions.

Considering limitations of this study, it is difficult to draw hard conclusion about a time-effect since no control condition was included in this study. Since the main aim of this study concerned process variables rather than outcome in terms of anxiety reduction, no control condition was included, given that there is now robust evidence that VRET is more effective than control conditions (e.g. Powers & Emmelkamp, 2008; Parsons & Rizzo, 2008).

Nevertheless, there are indications that at least some parts of the efficacy of VRET can be attributed to an increased sense of competence managing difficult situations. Furthermore, the reduction in negative cognitions in the process of treatment although these cognitions were not directly addressed could be an indication that the experience of successful managing an anxiety provoking situation has a positive impact on the amount of negative cognitions about oneself.

In future research it would be interesting to analyze more detailed cognitive processes and to establish temporal precedence for cognitive and emotional variables changes during VRET. This might be especially helpful in determining differences in

mechanisms of change and to understand the intervention process in exposure based treatment. More specifically, no study has examined the full mediation criteria (Baron & Kenny, 1986) including temporal precedence in VRET. This would also promote the methodological validity concerning VRET research as demanded by Cote and Bouchard (2008). So not only further outcome studies about the comparative efficacy of VRET are needed, but studies investigating the emotional and cognitive processes that are involved in virtual reality exposure therapy are also needed.

Overall, it can be concluded that self-efficacy and negative self-statements change during the process of VRET. Results with respect to therapeutic alliance as judged by the patient are inconclusive: in fear of flying the quality of the therapeutic alliance predicted successful outcome, but not in acrophobia. There is a clear need of further studies investigating the processes involved in VRET.

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## Physiological Assessment During VR PTSD Treatment of a Motor Vehicle Accident Patient

Pedro Gamito<sup>1</sup>, Tomaz Saraiva<sup>1</sup>, Jorge Oliveira<sup>1</sup>, Diogo Morais<sup>1</sup>, Pedro Rosa<sup>1</sup>,  
 Miguel Pombal<sup>1</sup>, Luiz Gamito<sup>2</sup> and Alberto Leal<sup>2</sup>

Besides physical injuries, motor vehicle accidents (MVAs) are responsible for serious mental disorders, up to 40% of the victims of MVAs can develop posttraumatic stress disorder (PTSD). A 42-year old patient was exposed to a virtual highway with an increasing anxiety triggering events (traffic intensity; horns; proximity of the surrounding buildings; tunnels; crossovers). The results indicate that the patient had a decrease in PTSD symptoms, namely in the IES (Intrusion and Avoidance dimensions) and in the HADS (Anxiety and Depression dimensions). As far as the psychophysiological activation concerns, the distribution GSR and ECG values during the 12 sessions followed the expected pattern, being reduced during the final session with statistically significant differences between sessions for ECG ( $F(11) = 2.842$ ;  $p < .05$ ). However, the most relevant fact is that this decrease led to the patient being able to drive again.

### STUDY

Motor vehicle accidents (MVA), besides death and physical injuries, are also responsible for anxiety disorders such as acute stress disorder or Posttraumatic Stress Disorder (PTSD). Albuquerque et al. (2003), found that 5.6% of the individuals exposed to serious MVA presented symptoms of PTSD. A higher figure was found by Blanchard & Hickling (1997). They estimated that 8 to 40% of MVA victims suffered from PTSD; furthermore, Pires & Maia (2006) presented results in which they suggest that in the first evaluation after the accident (3/4 days), 55% of the 42 subjects presented PTSD symptoms. Four months after the accident, the percentage was reduced to 31%, even though 7.1% of the subjects presented more symptoms than on first evaluation. A follow-up longitudinal study also showed a prevalence of 11% 3 years after the MVA (Mayou, Ehlers & Bryant, 2002).

The most common therapy for the treatment of PTSD is exposure therapy, as suggested by the International Society for Traumatic Stress Studies (Foa et al., 2000). Traditionally, imagination exposure, in the impossibility of in vivo exposure such as in the MVA cases, is usually psychotherapists' first choice. However, more often than not, patients with severe anxiety disorders are not willing to cooperate with the therapist when asked to imagine the situation that induced the trauma. The avoidance of recalling the traumatic experience is a PTSD symptom itself. On the other hand, some of them are not able or not willing to engage emotionally, which may reduce therapy success (Jaycox, Foa & Morral, 1998).

This brings about a new challenge to psychotherapists, as traditional techniques may not deliver the expected results. An alternative to in vivo and to imagination exposure may be Virtual Reality Exposure (VRE). The use VRE, despite being a

Corresponding Author:

Pedro Gamito, PhD, Associate Professor, Department of Psychology, University Lusófona de Humanidades e Tecnologias, Campo Grande, 376, 1749-024 Lisboa, Portugal, Pedro.gamito@gmail.com

<sup>1</sup> University Lusófona of Humanities and Technologies

<sup>2</sup> Hospital Júlio de Matos

relatively new procedure, is not a novel technique within the anxiety disorder therapies. In fact, for more than a decade, Virtual Reality (VR) has been used to treat patients with acrophobia (Emmelkamp et al., 2001), arachnophobia (Carlin et al., 2002), claustrophobia (Botella et al., 2000) and fear of flying (Rothbaum et al., 2000), among other pathologies. There are several PTSD studies published as well. Difede, Hoffman and Jay singhe (2002) studied patients with PTSD from World Trade Center attacks, Josman et al. (2005), patients with PTSD from suicide bomb attacks in Israel, and Rizzo et al. (2006), soldiers that had returned from Iraq. In all studies a reduction on PTSD symptomatology was found.

VRE has also proven itself to be an option to treat anxiety disorders derived from MVA. When it comes to driving phobia, Wald and Taylor (2000) found a decrease on anxiety and avoidance ratings from pre to post VRE treatment. A similar trend was reported on a 2003 study, where 3 out of 5 patients shown a decrease on driving phobia after being exposed to a virtual reality world (Wald & Taylor, 2003). Concerning PTSD from MVA, Beck, Palyo, Winer, Schwagler and Ang (2007) found a significant reduction in posttrauma symptoms (such as, reexperiencing, avoidance, and emotional numbing) on a sample of six participants after 10 sessions of Virtual Reality Exposure Therapy (VRET). In this way, these studies point towards the possibility of choosing VRET as an alternative procedure to treat anxiety disorders.

This outcome is enhanced by data from physiological assessment. Several studies were conducted where physiological measures were adopted to assess the effectiveness of VRET for victims who have developed PTSD as a result of a MVA. To evaluate physiological responsiveness among survivors of MVA with PTSD, Veazey et al. (2004) compared patients with chronic PTSD, patients with sub-syndromal PTSD and a control group without PTSD. The results showed physiological differences for heart rate activity between these groups.

On the other hand, Walshe et al. (2005), investigated the use of computer generated environments in exposure therapy for driving phobia. Eleven patients that were diagnosed according to the DSM-IV criteria for Specific Phobia (i.e. driving) were exposed to a computer-generated driving environment using computer driving games. Results were assessed by self-report measures for emotional distress, presence, immersion, and physiological data for heart rate activation. The authors mention that VR enables the patient to pay attention in the virtual driving situation; therefore exposure therapy might be an effective alternative for driving phobia following a MVA.

In fact, physiology assessment and analysis seems to provide reliable clues to evaluate posttraumatic behaviors. One of the key PTSD diagnosis criteria, according to the DSM-IV (APA, 2002), is the hyperactivation before the exhibition to the traumatic events. Psychophysiological studies carried out in patients with PTSD, have demonstrated a physiologic peripheral hyperactivation at the level of the cardiac beat, blood pressure, muscular tension and skin conductance (Blanchard, Kolb, and Prins, 1991).

In the same way, Blanchard et al. (1991) carried out a study that was intended to distinguish two groups of veterans of war (with and without PTSD), on the basis of their cardiac frequency before sounds of war. The results obtained through a discriminating analysis allowed to identify correctly 84 % of the cases of PTSD.

Pitman et al. (1987) found in a study with a war veterans' sample that the skin conductance is a measure with bigger discriminating power of the PTSD (73 %) than the electrodermiography (67 %) as well as the cardiac frequency (63 %). The same authors reported that there was an increase of the sympathetic activation before traumatic images and that hyperactivation is positively associated with the frequency of intrusive thoughts.

Walshe et al. (2003) developed a study to investigate the effectiveness of computer generated environments involving driving games and virtual reality driving environment in exposure therapy for accident phobia. The sample consisted of fourteen subjects with DSM-IV (APA, 2002) criteria with a simple driving phobia. Self-report measures, as well as physiological activa-

tion (heart rate) showed significant post-treatment reductions on all measures analyzed. According to Walshe et al. (2003) these virtual worlds may play a useful role in the treatment of driving phobia post-accident even when co-morbid conditions such as PTSD and depression are present.

Accordingly to previous studies, this work was designed to assess the effectiveness of Virtual Reality Exposure to a patient who was involved in a Motor Vehicle Accidents and the subsequent influence on their symptoms of PTSD. In this way, it is expected that anxiety, depression, PTSD symptoms, as well as physiological activation, are lower in a post-treatment stage when compared to an initial and during treatment stages.

## METHOD

### ***PARTICIPANTS***

The participant was a 42 years Old Portuguese woman who met DSM-IV (APA, 2002) criteria for PTSD and depressive disorder (Clinical Administered PTSD Scale; Blake et al., 1990). Prior to the trial, the participant was in psychotherapy and was medicated with Fluoxetine, Clonazepam and Lorazepam. The medication was stable during the 3 months before VR (virtual reality) exposure.

### ***MATERIALS***

Emotional adjustment through anxiety and depression levels was evaluated using the Hospital Anxiety and Depression Scale – HADS (Zigmond & Snaith, 1983).

PTSD's intrusion and avoidance criteria were assessed through the Impact of Events Scale – IES (Horowitz, Wilner, & Alvarez, 1979). Psychophysiological data such as EEG (Electroencephalography), GSR (Galvanic Skin Response) and ECG (Electrocardiography) was recorded, respectively, through Neuroscan 32 channels cap (Compumedics LimitedTM) and a Profusion PSG system (Compumedics LimitedTM).

### ***PROCEDURE***

The participant was exposed through a 295 X 225 cm Translucid Screen installed on the Neurophysiology Service of the Hospital of Júlio de Matos, Lisbon, Portugal. A wide lens XGA VPLPX 41 Sony projector and a Creative 5.1 surrounding sound system plugged to a P4 3.4 GHz with a 7800 GT graphic board were in use. The patient was sitting on a chair positioned over a platform coupled with Aura twin bass shakers.

The VR world was developed using the Valve Source 3D graphic editor Hammer simulating a driving environment where the subject was driven through a highway scenario. Throughout 11 treatment sessions, participant was presented to increasing anxiety triggering events such as horns, an increasing proximity to surrounding buildings, and increasing traffic and highway singularities (i.e. driving through tunnel) (Figure 1). Prior to each treatment session, a VR training session occurred.

Besides EEG, GSR and ECG recordings, video imagery was also registered. Psychoeducation and hierarchy development were completed prior to beginning of exposure sessions.

Patient clinical and self-report evaluations occurred at three different moments. Data was collected (1) before treatment, (2) during treatment and (3) follow-up assessment 6 months after treatment, Psychophysiological data was recorded during VR sessions. EEG records were used only for monitoring purposes.

Statistical analysis was carried out using the Statistical Package for Social Sciences (v.14.0).

## RESULTS

Regarding self report assessment, evaluation occurred at three different moments: (1) before treatment, (2) after treatment and (3) follow-up assessment.

Descriptive analysis, as can be seen in the table 1, showed that scores on self-reports measures decreased from the before treatment to follow-up assessments. Accordingly, reported anxiety and depression scores (HADS), evidenced a decrease in these dimensions between the initial and final assessment.

**Table 1:** Total scores for Anxiety and Depression (HADS)

	Before treatment (1)	During treatment (2)	Follow-up (3)	Reduction (1 to 3)
<b>Anxiety</b>	13.00	11.00	11.00	15%
<b>Depression</b>	17.00	16.00	13.00	24%

The same pattern was observed for PTSD related symptoms (IES). Before treatment, the patient presented a score of 31 for Intrusion and a score of 31 for Avoidance behaviours with a total score of 62 corresponding to a severe condition. After treatment, scores showed a decrease in these symptoms, with 27 for Intrusion and 21 for Avoidance for a total score of 48, which still corresponds to a severe PTSD condition. In the follow-up assessment, scores in the Avoidance (19) and total score (47) were lower than previous phases, nevertheless for Intrusion (28), this score was higher than the previous 6 months.

Besides self-report assessment, psychophysiology, namely the HR (heart rate) and GSR (galvanic skin response), records were registered, as well as video imagery for observational methods.

Within sessions, psychophysiological scores were calculated at specific times during each session: (a) Baseline, corresponding to 1 minute after VR exposure (VRE); (b) Start, in the first minute of VRE; (c) 10 minutes after the beginning; and (d) 20 minutes after beginning of VRE.

From the first to last session, a decreasing pattern was observed for Heart Rate (HR) scores (Figure 2). In the last VRE session, the participant's heart rate was lower than in the previous sessions. This activity was always higher during VRE session than in the baseline, with the exception of the last session, where heart rate was similar between assessments.

As for HR, GSR scores were also lower at the end of VRE (Figure 3); however, the same decreasing trend was not observed. Between the 4th, 7th and the 10th session, higher skin responses were recorded than on initial sessions and at the end session. During the last session, the skin response before VRE (baseline) was higher during the session than was before session start.

Through observational methods, a decreasing pattern in emotional reaction to virtual environment, for example, crying was evident. Particularly, in first two sessions, the patient showed extreme anticipatory anxiety reactions, which decreased during treatment sessions, even during the sessions where GSR scores were higher, where the patient did not showed signs of psychomotor agitation.

According to Hierarchical Cluster Analysis for sessions with centroid clustering method, psychophysiological data was organized in three clusters (Figure 4). Moreover, subsequent K-Means cluster analysis arranged the diverse characteristics of each cluster, where higher scores of ECG and GSR were found in the first cluster corresponding only to treatment session 1 (1st session group). Mild psychophysiological scores were observed in the second cluster corresponding to all the other sessions (2nd to 10th session group), with the exception of the last session that was considered as being the less reactive session (11th session group). According to this Cluster Analysis, three independent groups were created from psychophysiological data, the 1st session group, 2nd to 11th session group and 11th session group. Therefore, comparative analyses were performed between these three different groups for each psychophysiological data provided through within session assessments (baseline, initial phase, 10 minutes after and 20 minutes after the beginning) for HR and GSR.

The Repeated Measures ANOVA revealed a statistically significant effect only for HR for within session factor, Wilks  $\lambda(3,10) = .221$ ;  $F = 7.482$ ;  $p < .05$ , with higher physiological activation for 10 minutes after beginning the assessment.

ANOVA also showed a significant interaction effect in HR for within session factor with between sessions factor Wilks  $\lambda(6,10) = .31$ ;  $F = 9.422$   $p < .01$ . Psychophysiological activation, measured within sessions at the baseline, the initial phase, 10 and 20 minutes after beginning, was significantly different between session assessments (Figure 5).

For GSR data, no statistically significant results were observed (Figure 6).

### DISCUSSION

The results of this case study indicate a decrease of anxiety (15.4%) and depression (23.5%) symptoms after the treatment protocol of 11 sessions. Furthermore, the observational methods derived from the video recording analysis were highly consistent with self-report measures of anxiety and depression. This data might suggest less emotional distress and a better behavioural adjustment to the PTSD condition.

Non-verbal behavior by the patient showed a clear reduction in agitation and avoidance behavior as the sessions progressed. In the fourth session, the patient mentioned a predisposition towards driving. The predisposition is at least a relevant sign, even though the results from the IES indicate only a small decrease in the PTSD symptoms, since the participant was still in the severe PTSD cohort.

The psychophysiological data, concerning the patient's heart rate, showed a decrease in the activation of the autonomic nervous system during treatment. More specifically, it was observed that heart rate differed between sessions from initial to final treatment assessments. In the initial stage results from heart rate showed that autonomic activation was lower in baseline condition and was higher after 10 minutes of VRE (virtual reality exposure). However, in the final stage (last sessions) this pattern was different and activation in baseline condition was higher than other conditions. These results showed that overall heart rate activation was lower for a post-treatment stage when compared to a previous phase of treatment. In fact, reduction of heart rate also corroborates the self-report measures for emotional adjustment. This evidence was confirmed by other authors as well (Foa & Kozac, 1986; Wilhelm et al, 2005).

Moreover, the fact that overall physiological activation has increased from the first to the second session, and how it then proceeded to progress downwards, is congruent with the results of a therapeutic process. In particular, the analysis for heart rate data within sessions showed a higher activation at 10 minutes after virtual exposure that decreased throughout the session. These data are in agreement with cognitive and behavioral therapy and is considered as an element of a successful exposure.

The overall results are in agreement with results from other studies that use VR exposure techniques to treat PTSD. Concerning war veterans, a decrease of 34 % and of between 15% and 67% on PTSD symptoms, was found in two studies with American Vietnam combatants that were exposed to VR worlds (Rothbaum et al., 1999; Rothbaum et al., 2001).

Although these conclusions are drawn from a single subject study, results are in line with previous studies and supports VR as exposure technique on a Cognitive and Behavioral Approach. Nevertheless, more studies with clinical samples are needed to confirm the effectiveness of VRE on cognitive and behavioural treatment protocols.

**Table 1:** Total scores for Anxiety and Depression (HADS)

	Before treatment (1)	During treatment (2)	Follow-up (3)	Reduction (1 to 3)
Anxiety	13.00	11.00	11.00	15%
Depression	17.00	16.00	13.00	24%

**Table 2:** Total scores for Intrusion and Avoidance (IES)

	Before treatment (1)	During treatment (2)	Follow-up (3)	Reduction (1 to 3)
Intrusion	31.00	27.00	28.00	11%
Avoidance	31.00	21.00	19.00	39%
Total score	62.00	48.00	47.00	24%

**Table 3:** K-Means Cluster Analysis

	Cluster 1 (Initial)	Cluster 2 (During)	Cluster 3 (Final)
ECG Baseline	76,00	78,00	66,00
ECG Initial VRE	82,00	82,00	60,00
ECG 10' after VRE	98,00	86,00	62,00
ECG 20' after VRE	88,00	84,00	64,00
GSR Baseline	2,00	3,50	2,00
GSR Initial VRE	2,50	3,50	1,50
GSR 10' after VRE	3,50	3,50	1,50
GSR 20' after VRE	3,00	4,00	1,50

**Table 4:** Repeated Measures ANOVA for main and interaction effects

	<i>F within sessions</i>	<i>F within session * between sessions</i>
ECG	9.644**	3.783*
GSR	1.983	1.120

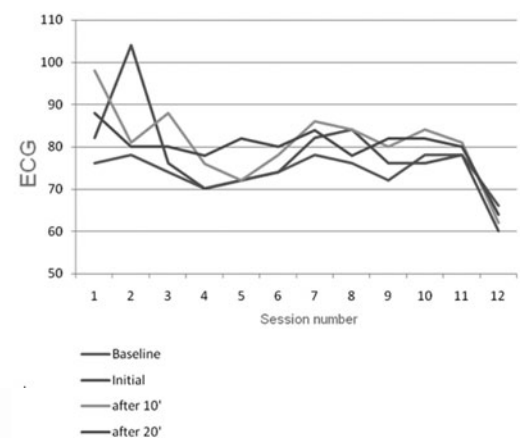
\* $p < .05$ ; \*\* $p < .01$

**Figure 1:** Virtual Reality World Highway

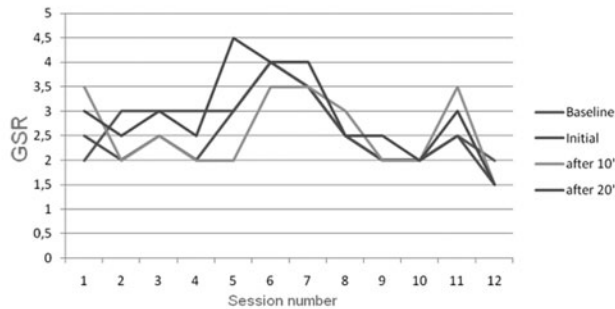


**Figure 2:**

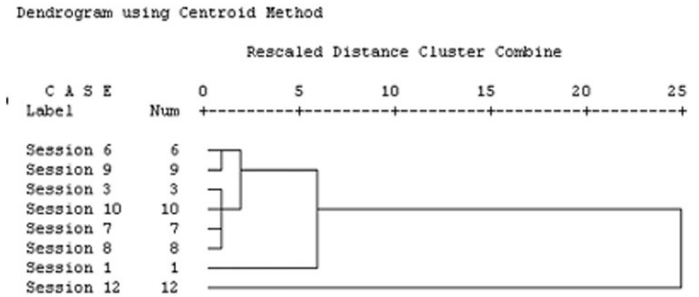
ECG data for Baseline, Initial phase of VRE, 10 minutes and 20 minutes after VRE during treatment protocol



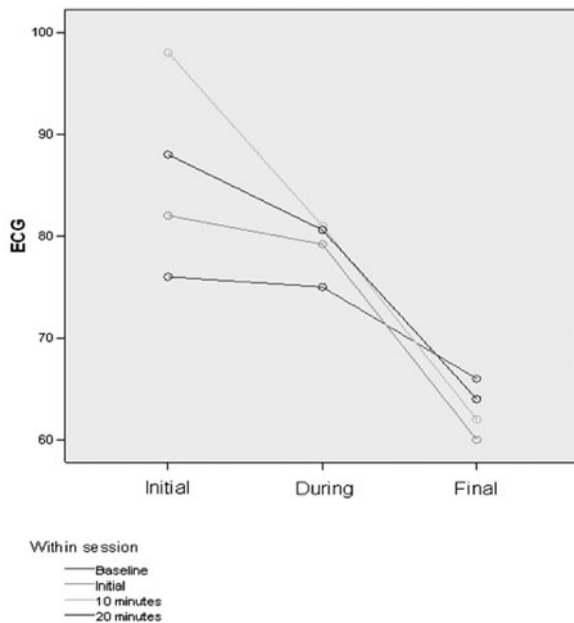
**Figure 3:**  
GSR data for Baseline, Initial phase of VRE, 10 minutes and 20 minutes after VRE during treatment protocol



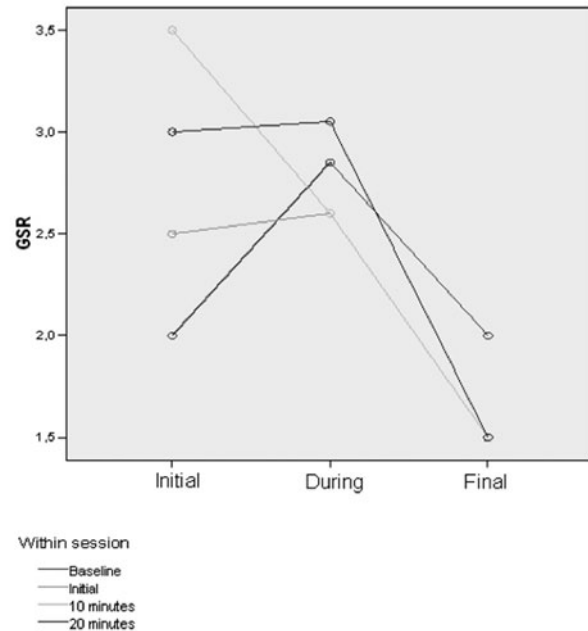
**Figure 4:**  
Hierarchical Cluster Analysis Dendrogram



**Figure 5:**  
Repeated Measures ANOVA for ECG between session assessment (pre, during and post treatment) by within session (baseline, initial, 10 minutes and 20 minutes after VRE)



**Figure 6:**  
Repeated Measures ANOVA for GSR between session assessment (pre, during and post treatment) by within session (baseline, initial, 10 minutes and 20 minutes after VRE)





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## ADDENDUM

Due to technical errors we would like to reprint the last half of the article by Manon Bertrand and Stephane Bouchard, "Applying the Technology Acceptance Model to VR With People Who Are Favorable to its Use", which originally appeared in the Summer 2008 issue of the JCR. We would like to express our sincere apologies for these errors. Below are the corrected pages from this article; in addition the full article is on our website <http://www.imi-europe.eu>.

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 $\chi^2$ ). 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 $\chi^2$ ) 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.

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  $\chi^2(176, N = 141) = 226.8$ ,  $p < 0.01$ , robust CFI (0.9, 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  $\chi^2(177, N = 141) = 227.4$ ,  $p < 0.01$ ; Robust CFI = 0.98; RMSEA = 0.45; NNFI = 0.96; SRMR = 0.06]. This model allows predicting 85% of the variance of the intention to use virtual reality for clinical purposes.

Figure 1

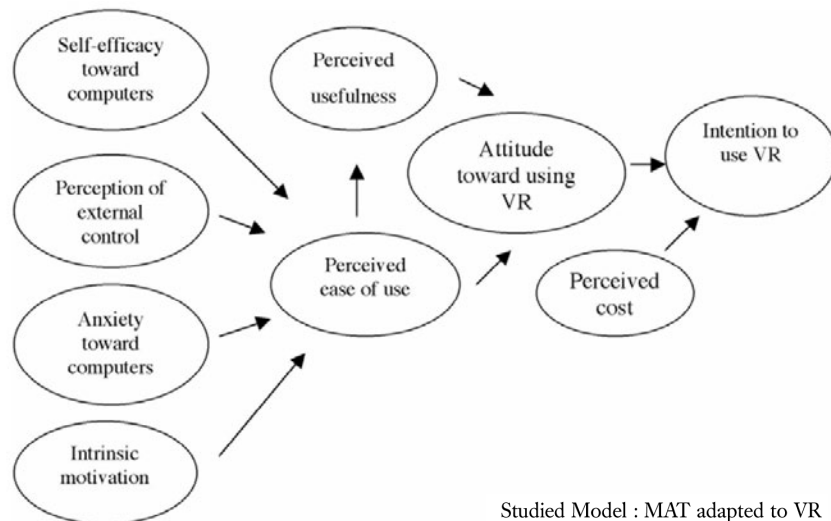


Figure 2

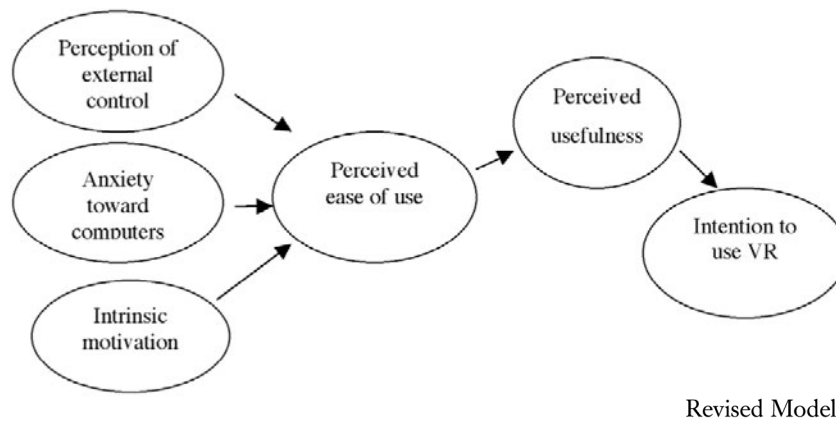
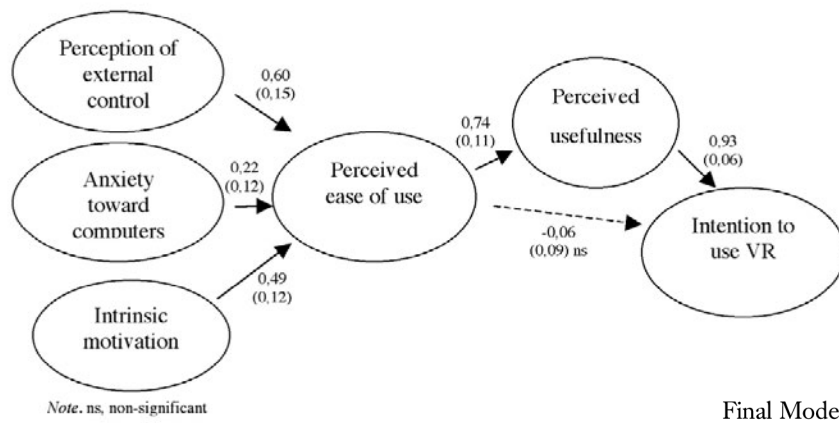
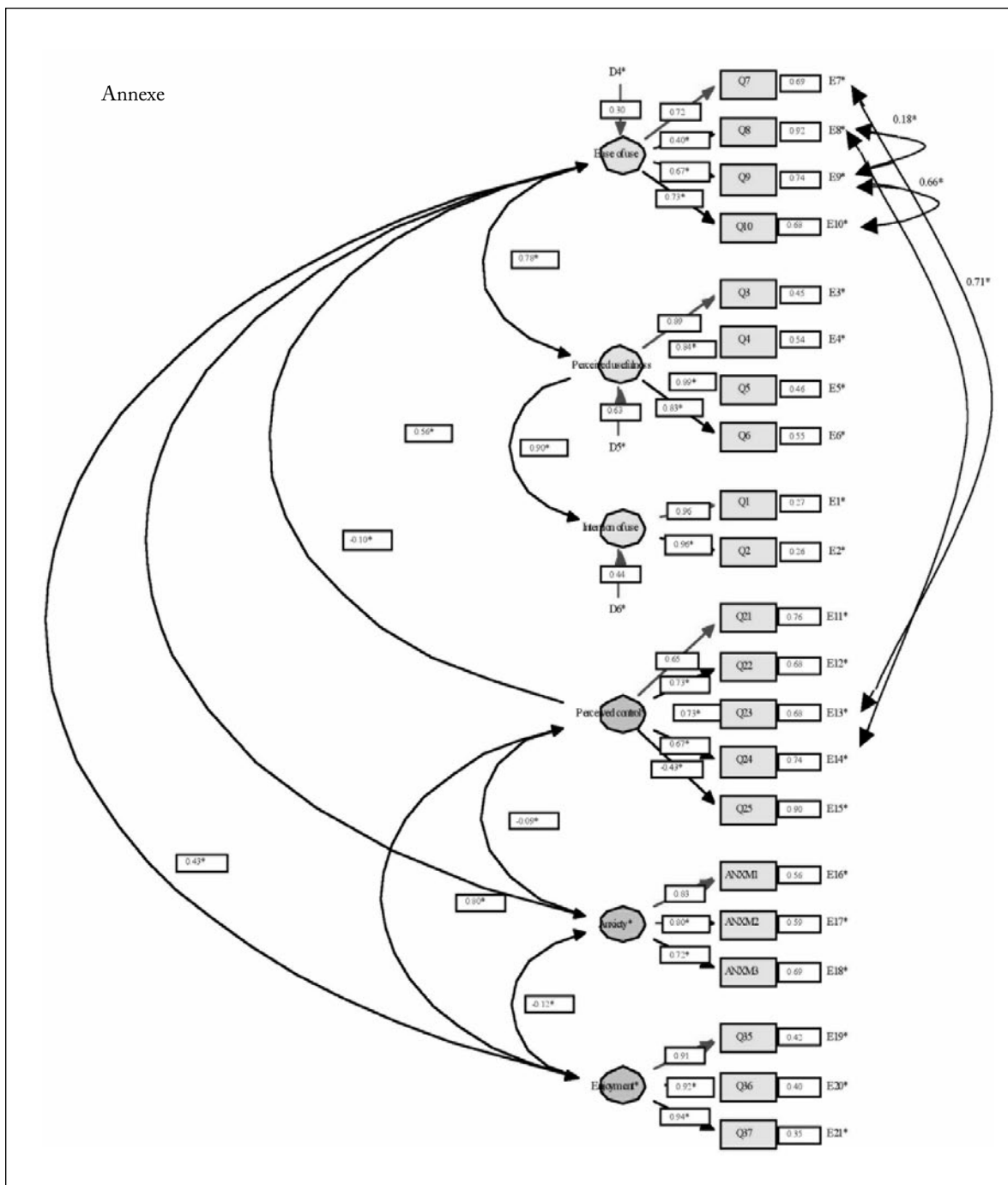


Figure 3



Annexe



## 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 from fall 2008 through summer 2009, 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](mailto:office@vrphobia.eu).

### **CyberTherapy 14 & CyberPsychology**

June 21–June 23, 2009

Lago Maggiore, Verbania, Italy

<http://www.interactivemediainstitute.com>

The Journal of CyberTherapy & Rehabilitation (JCR) is the official journal of the CyberTherapy Conference. The 14th Annual International CyberTherapy & CyberPsychology Conference (CT14) brings together researchers, clinicians, policy makers and funding agencies to share and discuss advancements in the growing discipline of cybertherapy and rehabilitation. The conference includes pre-conference workshops and two full days of symposia. The focus of this conference is on the increasing use of interactive media in training, education, rehabilitation, and therapeutic interventions. Technologies featured at the conference include virtual reality simulations, videogames, wearables, telehealth, videoconferencing, the Internet, robotics, brain-computer interfaces, and non-invasive physiological monitoring devices. The symposia also include discussions of societal & behavioral implications of advanced technologies as well as research issues such as cyber-sickness, presence, and human factors. Conference attendees have the opportunity to play a role in designing the future of healthcare. Interactive exhibits at the Cyberarium allow participants to experience the technologies firsthand.

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### **eChallenges e-2008**

October 22 - October 23

Stockholm, Sweden

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

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### **2nd International Conference: "Telemedicine: Myths and Reality"**

October 23-24

Lviv, Ukraine

<http://www.telemed.net.ua/>

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### **Advances in eHealth and Telemedicine International**

October 23-26

Warsaw, Poland

<http://www.aehti.eu/>

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**The 3rd International Conference on Virtual Learning**

October 31-November 2

Constanta, Romania

<http://www.icvl.eu/2008/>

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**The World of Health IT Conference & Exhibition**

November 4-6

Copenhagen, Denmark

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

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**DGTelemed Congress 2008**

November 6-7

Berlin, Germany

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

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**4th National Conference of the Telemedicine Society of India**

November 14-16

Chandigarh, India

<http://www.telemedicon2008.com/>

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**Association for Behavioural and Cognitive Therapies 2008**

November 13 - November 16

Orlando, Florida

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

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**Beyond Combat Conference**

November 27

Hull, Great Britain

<http://www.humber.nhs.uk/templates/Page.aspx?id=4492>

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**Fundatel: First International Conference on Telemedicine**

November 27-29

Paraná, Argentina

<http://www.fundatel.org.ar/fundatel2008/funda2008en.html>

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**ICAT 2008: Artificial Reality and Telexistence**

December 3 - December

Singapore

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

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**2009 Conferences at a Glance**

Medicine Meets Virtual Reality 17 (MMVR)

January 19-22

Long Beach, California

<http://www.nextmed.com/>

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**Technology 09**

January 30- February 1

Huntsville, Alabama

<http://t09.cgpublisher.com/>

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**eTELEMED 2009**

February 1-6

Cancun, Mexico

<http://www.iaria.org/conferences2009/eTELEMED09.html>

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**International Conference on Computer Graphics Theory and Applications**

February 5-8

Lisboa, Portugal

<http://www.grapp.org/cfp.htm>

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**SPIE: Medical Imaging 2009**

February 7 - February 12

Orlando, Florida

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

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**IASTED International Conference on Artificial Intelligence and Applications**

February 16-18

Innsbruck, Austria

<http://www.iasted.org/conferences/home-639.html>

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**Innovations for Health- eHealth for individuals, society and the economy**

February 19-20

Prague, Czech Republic

<http://www.eu2009.cz>

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**World Conference on Innovative VR 2009**

(WIN VR 09)

February 25-26

Chalon-sur-Saône, France

<http://www.asmeconferences.org/winvr09/>

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**IEEE VR 2009**

March 14-18

Lafayette, Louisiana

<http://conferences.computer.org/vr/2009/>

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**SPIE: Defense and Security Symposium**

March 16 - March 21

Orlando, Florida

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

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**Therapies for Generalized Anxiety Disorder**

March 18-19

Herzliya, Israel

<http://isas.co.il/gad09/index.php>

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**Med-e-Tel 2009**

April 1 – April 3

Luxembourg, Luxembourg

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

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**Applied Psychophysiology & Biofeedback 2009**

April 1 – April 14

Albuquerque, New Mexico

<http://www.aapb.org>

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**The 6th Annual World Health Care Congress**

April 14 – April 16

Washington, D.C.

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

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**18th International World Wide Web Conference: WWW2009**

April 20-24

Madrid, Spain

<http://www2009.org/>

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**IMCL:2009 The 4th International Conference on Interactive Mobile and Computer Aided Learning**

April 22-24

Amman, Jordan

<http://www.imcl-conference.org>

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**Laval Virtual 2009: 11th Virtual Reality International Conference**

April 22-23

Laval, France

[http://www.laval-virtual.org/index.php?option=com\\_content&task=view&id=32&Itemid=110](http://www.laval-virtual.org/index.php?option=com_content&task=view&id=32&Itemid=110)

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**Society of Behavioral Medicine: 2008**

April 22 - April 25

Montreal, Quebec

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

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**American Telemedicine Association 2009: 14th Annual International Meeting and Exposition**

April 26 - April 28

Las Vegas, Nevada

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

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**12th World of Health Conference on Public Health**

April 27- May 1

Istanbul, Turkey

<http://www.worldpublichealth2009.org/>

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**NIHR Mental Health Research Network National Scientific Conference**

May 20-22

Nottingham, United Kingdom

<http://www.mhrn.info/index/about/annual-conference/>

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**Health Professions Education: Setting Standards for Best Practice in Simulation**

May 21-23

Toronto, Canada

<http://www.nursing.utoronto.ca/academic/ciene/conference2009.htm>

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**New Pathways to Trauma Treatment II**

May 24-29

Montepulciano, Italy

<http://www.laitaliavera.com/>

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**SIMTECT 2009**

June 15-18

Adelaide, Australia

<http://www.siaa.asn.au/simtect/2009/papers.htm>

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**11th European Conference on Traumatic Stress**

June 15-18

Oslo, Norway

<http://www.ecots2009.com/home.cfm>

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**17th Industrial Virtual Reality Expo**

June 24-26

Tokyo, Japan

<http://www.ivr.jp/english/>

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**XXII Interamerican Congress of Psychology**

June 28- July 2

Guatemala, Guatemala

<http://www.sip2009.org/>

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**11th European Congress of Psychology**

July 7 - July 10

Oslo, Norway

<http://www.ecp2009.no>

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**American Psychological Association**

August 6 - August 9

Toronto, Canada

<http://www.apa.org>

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**XIVth European Conference on Developmental Psychology**

August 18-22

Vilnius, Lithuania

<http://www.ecdp2009.com/>

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**39th European Association for Behavioural and Cognitive Therapies Annual Conference**

September 16-18

Dubrovnik, Croatia

<http://eabct2009.org/>

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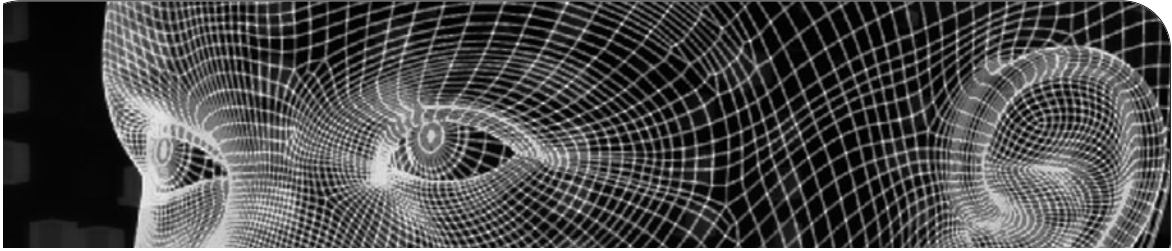
**Association for Behavioural and Cognitive Therapies 2009**

November 19 - November 22

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

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 ISSN: 1784-9934  
 GTIN-13 (EAN): 9771784993017

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The International Association of CyberTherapy & Rehabilitation (IACR) is an international association to promote Virtual Reality and other advanced technologies as adjuncts to more traditional forms of therapy, training, education, prevention, and rehabilitation. IACR will address the urgent need to develop a “roadmap” for the future of this rapidly growing field.

### KEY ISSUES

- ▶ Need for shared operating standards/platforms
- ▶ Need for improved access to healthcare for all citizens
- ▶ Need for advanced interactive training and education for healthcare professionals
- ▶ Need to enhance existing healthcare treatments through the addition of advanced technologies
- ▶ Need to move healthcare and health promotion/disease prevention to the individual level, providing all citizens the opportunity to become active participants in their own healthcare

### MISSION

Our mission is to bring together top researchers, policymakers, funders, decision makers and clinicians, pooling collective knowledge to improve the quality, affordability, and availability of existing healthcare.

Ultimately, through international collaboration with the most eminent experts in the field, we are working to overcome obstacles and increase access to top-quality healthcare for all citizens. By enhancing public awareness of the possibilities that technology offers, we move toward changing and improving healthcare as it currently exists.

IACR is the official voice and resource for the international community using advanced technologies in therapy, training, education, prevention, and rehabilitation.

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- ▶ Share your knowledge with industry peers
- ▶ Learn industry best practices and standards
- ▶ Attend the CyberTherapy Conference and other special events at a member's-only rate
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- Interactive Method of Treatment
- Fun and Exciting
- Create Your Own Experience
- Instant Therapeutic Feedback



### Combat Medic Training

- Medical Skills Assessment
- Shallow Learning Curve
- Preparedness Enhancement
- Methodical Execution
- Instant Feedback



### PTSD Treatment

- Benefitting Results
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- Emotional Balance
- Sense of Clarity and Purpose

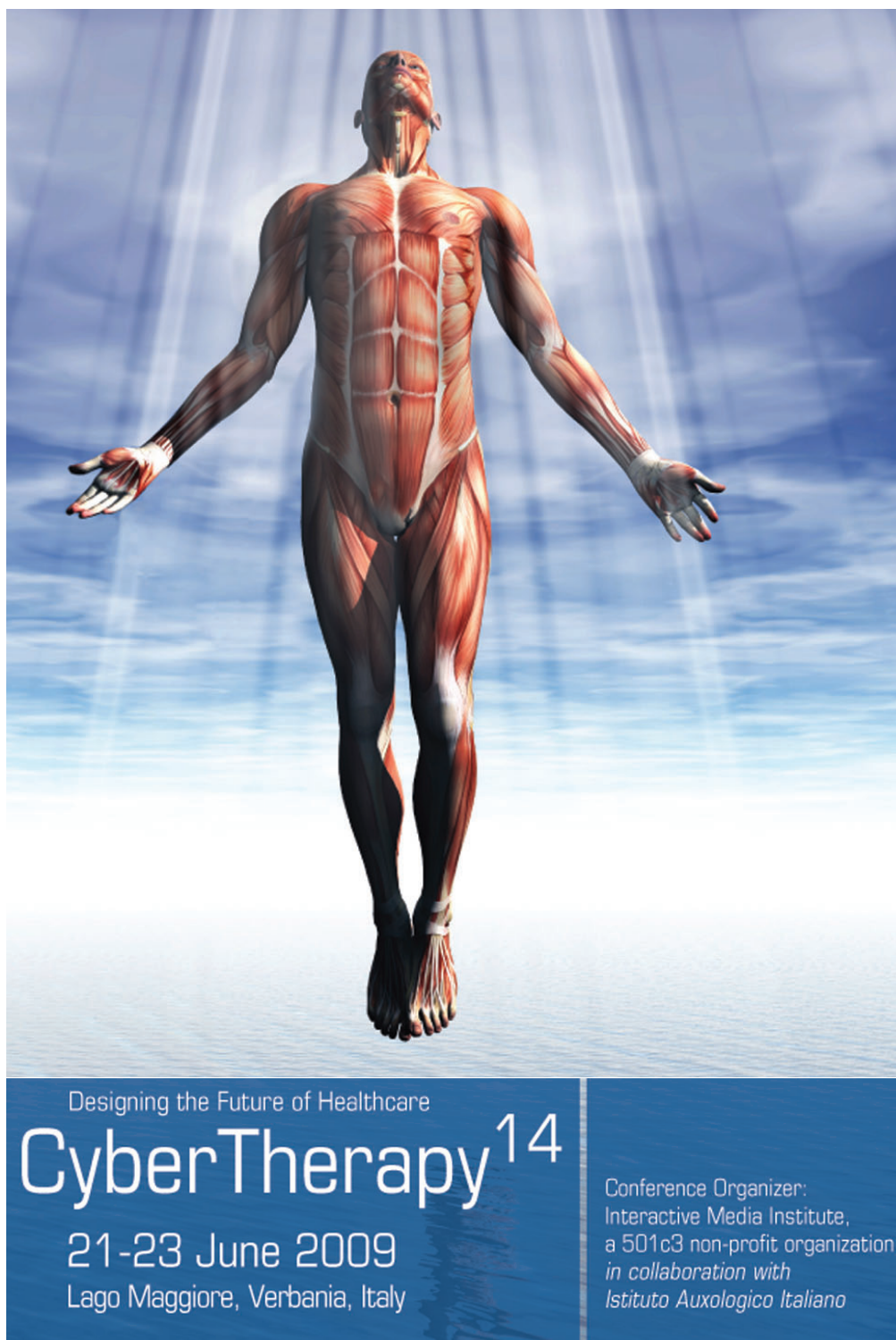


### Rehabilitation System

- Fun and Entertaining
- Cost Effective
- Rapid Recovery
- Real Life Practice







## CT14 Goes Green!

To be environmentally friendly, the use of paper at CT14 will be limited. Conference documents will be available in electronic format. Instead of the usual conference bag, participants will receive a free USB stick.

The focus of this conference is on the increasing use of interactive media in training, education, rehabilitation, and therapeutic interventions. Technologies include virtual reality simulations, video games, telehealth, videoconferencing, the Internet, robotics, and noninvasive physiological monitoring devices.

**Brenda K. Wiederhold, Ph.D., MBA, BCIA,**  
Conference Co-Chair

**Giuseppe Riva, Ph.D.,**  
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