Annual Review of CyberTherapy and Telemedicine

Transforming Healthcare Through Technology

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About the journal
ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. The mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of CyberTherapy and Telemedicine through original investigations in the telemedicine and cybertherapy areas, novel experimental clinical studies, and critical authoritative reviews.

It is directed to healthcare providers and researchers who are interested in the applications of advanced media for improving the delivery and efficacy of mental healthcare and rehabilitative services.

Manuscript Proposal and Submission
Because Annual Review papers examine either novel therapeutic methods and trials or a specific clinical application in depth, they are written by experienced researchers upon invitation from our Editorial Board. The editors nevertheless welcome suggestions from our readers. Questions or comments about editorial content or policies should be directed to the editors only.

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Manuscripts should be submitted in electronic format on CD-Rom or floppy disks as well as on 8½ x 11-in. paper (three copies), double-spaced format. Authors should prepare manuscripts according to the *Publication Manual of the American Psychological Association* (5th Ed.).

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Table of Contents
Volume 5

ORIGINAL RESEARCH

CLINICAL OBSERVATIONS

Editorial

I am honored to welcome you to the fifth volume of *Annual Review of CyberTherapy and Telemedicine*. This year's theme, “Transforming Healthcare Through Technology,” acknowledges the significant impact that technology has had and will have on modern healthcare. The theme also highlights the importance of the CyberTherapy conference and others like it. CyberTherapy acts as a meeting place for many in the field, a place where we share our triumphs, exchange ideas, and work together to shape the future of behavioral healthcare. Together, we can use technology to help those in need, improving existing protocols and disseminating care to a wider segment of the population.

Much has changed over the past twelve years since the inception of the conference. An exciting body of research regarding the utilization of advanced technologies in behavioral healthcare has emerged over the last decade, revealing the continuous advances and discoveries made by over 450 investigators to help patients with both mental and physical disorders. I am proud to report that as VR’s use in Behavioral Healthcare has grown, so has the CyberTherapy Conference. For the first seven years, CyberTherapy was a specialized symposium at the Medicine Meets Virtual Reality (MMVR) Conference featuring presentations that dealt primarily with conceptual matters and future possibilities. Over the years, the symposium continued to grow in both size and scientific evidence. In 2003, the symposium spun off into a separate three-day conference. The 11th Annual CyberTherapy Conference, held in Canada in June 2006, highlighted the largest program ever presented on controlled clinical trials of VR and other cutting-edge technologies in the areas of mental health, rehabilitation, disabilities, training, and education. It involved representatives from 22 countries, reflecting its truly international character.

I would like to take this opportunity to publicly thank all who have helped make this year’s volume a reality. First, my gratitude goes to Dr. Stephane Bouchard and Geneviève Robillard from the Cyberpsychology Lab of the University of Quebec in Outaouais for going beyond the call of duty to help collect and coordinate reviews of this year’s volume. I would also like to thank this year’s Editorial Assistants, Ruth Kogen, MFA and Jamie Sung who worked to edit and produce this volume. I am also indebted to all of the peer reviewers who worked tirelessly to ensure the scientific rigor of the papers in this volume: Nathan Appel, PhD, Stephane Bouchard, PhD, Tony Brooks, PhD, Connie Dresser, RDPH, LN, RM, Furio Gramatica, PhD, Andrea Gaggioli, PhD, Kay Howell, MBA, Robert S. Kennedy, Ph.D., CPE, Evelyne Klinger, PhD, Fabrizia Mantovani, PhD, Sarah Miyahira, PhD, Thomas D. Parsons, PhD, Giuseppe Riva, PhD, Albert Rizzo, PhD, Jaime Sanchez, PhD, Melba Stetz, PhD, Ioannis Tarnanas, PhD, Tamar Weiss, PhD, and Christine Youngblut, PhD.

I sincerely hope that you will find this year’s volume to be an interesting and intellectually stimulating read. I continue to believe that together we can change the future of healthcare.

Sincerely,

Brenda K. Wiederhold, Ph.D., MBA, BCIA
Editor-in-Chief

Editorial

My first thoughts for this year's edition of the Annual Review of CyberTherapy and Telemedicine (ARCTT) go to the reviewers who took the time to review each and every submission. This is a significant contribution to the field that is too rapidly forgotten. I also want to thank Brenda Wiederhold, who organized this year's conference, Geneviève Robillard, who helped us with managing the website and the database, and to Ruth Kogen, our onsite and main coordinator. Papers presented in ARCTT illustrate the rapid and diversified progression of cybertherapy. It evolved from mere ideas and proofs of concepts to pilot studies and theoretical papers based on very little, and almost anecdotal data, and now into a more mature and respected research field. We are still witnessing new developments, and I hope there will always be new applications. As our field matures, we must keep in mind two driving forces that will enable our findings to be recognized and used by clinicians, the scientific rigour of our studies and documenting with empirical data the advantages of using VR and other technologies.

Sincerely,

Stéphane Bouchard, Ph.D.
Co-Editor –in-Chief
Chairholder, Canada Research Chair in Clinical Cynerpsychology
Université du Québec en Outaouais

Editorial

For a long time cognitive science considered action, perception, and interpretation to be separate activities. A recent trend in cognitive science is instead seeing cognition as *embodied.* This is a rethinking of the idea that cognition is primarily a matter of performing formal operations on abstract symbols and has little or nothing to do with the sensorimotor activity and environment in which it occurs.

The *Embodied Cognition* paradigm takes as its starting point the idea that cognition occurs in specific environments, and for specific ends. Moreover, the *Embodied Cognition* approach underlines the central role of body in shaping the mind. Specifically, the mind has to be understood in the context of its relationship to a physical body that interacts with the world. Hence human cognition, rather than being centralized, abstract, and sharply distinct from peripheral input and output modules, has instead deep roots in sensorimotor processing.

In this picture, what is the role of "Virtual Reality" (VR)? The idea behind VR is that a computer can synthesize a three-dimensional (3D) graphical environment from numerical data. Using visual, aural or haptic devices, the human operator can experience the environment as if it were a part of the world. Because of these features, VR is described as an "*embodied technology*" with, and within which, people can interact. In summary, VR provides a new human-computer interaction paradigm in which users are no longer simply external observers of images on a computer screen but are active participants within a computer-generated three-dimensional virtual world.

If concepts are embodied simulations, and VR is a simulation technology, it should be possible to use VR simulations both for teaching concepts and for modifying them. In particular, as suggested by Tart more than 15 years ago, VR offers "intriguing possibilities for developing diagnostic, inductive, psychotherapeutic, and training techniques that can extend and supplement current ones."

Within this framework, the potential of VR is wider than the simple reproduction of real worlds. By designing meaningful embodied activities, VR may be used to facilitate cognitive modeling and change. More specifically, introducing embodiment in CyberTherapy will provide significant advantages:

- VR-based embodiment treatment differs from traditional therapy in that computer graphics and various display and input/output technologies are integrated *to provide the patient with a sense of presence or immersion*. More specifically, VR-based embodiment provides a new human-computer interaction paradigm in which users are no longer simply external observers of images on a computer screen but are active participants within a computer-generated three-dimensional synthetic world. In this world the patient has the opportunity to learn to manage a problematic situation
- VR-based embodiment opens the input channel to the full range of human expressions: in rehabilitation it is possible to monitor movements or actions from any body part or many body parts at the same time. On the other hand, with disabled patients feedback and prompts can be translated into alternate and/or multiple senses.

Sincerely,

Giuseppe Riva, Ph.D., M.S., M.A.
Co-Editor-in-Chief

Critical Reviews

Key elements of social presence for a psychosocial approach to VR based CBT: an interaction analysis

Gloria Belloni, MA, Matteo Cantamesse, Ph.D. candidate, Carlo Galimberti, Ph.D.

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Abstract: *An effective VR based CBT (Cognitive Behavioural Therapy) requires an explicit knowledge of presence and social presence dynamics fired by virtual reality immersion. Most of the literature suggests that CMC does not have the capacity to support social and affective interaction, however, recent reviews of the social presence literature question the extent to which this literature can be generalised to every communication medium and to every application of these media. In the present contribution, we propose a qualitative method based on a psychosocial approach to investigate different dimensions of the therapeutic experience and interaction. The final objective of the study is the improvement of the VR based therapy system designed by our research unit both from an ergonomic and, consequently, clinical point of view according to a perspective that is strongly 'context driven'.*

Social Presence and VR based therapy

The genealogy of the social presence construct can be traced back to Mehrabian's (1969) concept of *immediacy:* "Immediacy is the directness and intensity of interaction between two entities*".* Short et al. (1976) introduced and defined the term *social presence* as "the salience of the other in a mediated communication and the consequent salience of their interpersonal interactions". According to Riva (2004) this principle has significant outcomes on design process and ergonomic issues. The VR system used in our study based on the ECT (Experiential Cognitive Therapy) protocol for the treatment of anxiety disorders, recognises in 'other' presence an important therapeutic and functional element thus deserving, in our opinion, a careful investigation in order to allow interventions on two fronts:

- Ergonomic: the design of technical functionalities as they are implemented will have to support, and if necessary reinforce, the perception of the highest levels of social presence with specific reference to intentionality and 'sense attribution' that implies the ability to understand the other's intentions.
- Clinical-therapeutic: reflections emerging from the study can be at the same time considered relevant aspects from the clinical point of view and consequently lead to a further improvement of the clinical protocol currently in use, stressing other distinctive elements in comparison with non VR based CBT.

The research framework: an analysis respectful of the ecological process

The study reported is part of the NeuroTIV project "Immersive Virtual Telepresence Managed Care for the Assessment and Rehabilitation in Neuropsychology and Clinical Psychology" (Italian National Research Project 2004-2007, funded by the Italian Ministry of University and Research). The objective of the project is to prove the technical and clinical viability of integrating TIV (Immersive Virtual Telepresence) systems into a managed care platform for neuro-psychological assessment and rehabilitation. Updated treatment protocols and VR based modules to be applied in assessment, therapy and follow up based on controlled clinical trials will be the main outcome of the research.

The intervention of the ergonomic research unit, to which the present study refers, consists in the elaboration of ergonomic analysis and in the production and fine-tuning of VR environments for clinical applications. The evolution of

the research perspective and of the software design has been marked by a fundamental step compared to previous studies conducted by the same unit. While in the past design and clinical practice were kept separate to a certain extent, in the current project great efforts have been made to overcome this limit by keeping the design phases and the fine-tuning of the environments strictly connected to the clinical applications and requirements' gathering process.

THEORETICAL APPROACH

As stated above, first definitions of 'social presence' can be dated back to 1976. More recently, Biocca et al. (2001) propose a clarification of the concept classifying different definitions into three themes respectively centred on co-presence and mutual awareness; on the experience of psychological involvement; on the behavioural interaction through which social presence is realised. Nevertheless the concept is still unclear and mainly used in different ways without specific distinction: with reference both to the medium in mediated communication and to perceptions, behaviours or attitudes of the participants (Rettie, 2003). Related to social presence are the concepts of 'awareness', defined as "an understanding of the activities of others, which provides a context for your own activity" (Dourish and Bly, 1992), and more recently the one of "connectedness" (Adler's 1998) referring to an individual's attitude and relationship to society and considered as one of the main principles motivating social behaviour (Smith and Mackie, 2000). Schumie et al. (2001), Insko (2003), Riva (2004) propose exhaustive reviews of main methods applied to study the concepts of presence and social presence on the basis of the different theoretical approaches related to the nature of these constructs. This kind of research is generally based on questionnaires or psycho-physiological measures useful to investigate the level of presence and social presence but that aren't enough to understand what is happening and how interactive context can help the therapist to keep the patient's "sense of being there" and the patient's sense of the "other perception" in control. We agree with the approach presented by Spagnolli et al. (2003) that "recognizes that presence is an ambitious concept referring to the user experience in the VE, which is complex, contextualized and dynamic. It stresses the reciprocal contribution of both environment and its inhabitants in configuring each other and the central role of local action in shaping presence". The authors identify some focuses which must be considered in presence research: the process through which presence is constituted and changed, the problems of the virtual body, of the VE boundaries and of the objects recognised in the simulation, the denial to consider a single perspective on the concept of social presence as the only possibility rather than allowing the coexistence of different configurations. The qualitative methods applied in the study presented are strongly based on perspectives that consider the action as the focus of analysis. In particular, Situated Action Theory (SAT) is an approach developed within the context of socio-cognitive research known as "cognition in practice" and introduces a change of perspective: the action is not considered as the execution of a ready-conceived plan, but as a process of adaptation to the context. Suchman underlines that "instead of separating actions from the circumstances in which occurs as the execution of a carefully thought out plan… [SAT] tries to study how people use circumstances to develop an intelligent course of action" (Galimberti, Riva, 2001, p.167). We think that such a perspective can be generally applied to presence research and to social presence research more specifically.

METHODOLOGY

The study, aimed at discovering some key concepts related to social presence, is based on the interaction analysis (Suchman and Trigg, 1991, Goodwin, 2000). This is a qualitative method that has its focus on the 'action', at the same time observable as an object, and produced in a local and specific context. Within a dialogical approach, VR-based therapy sessions could be studied as a social co-construction of meanings, where therapist and patient negotiate what is going on, how it is going and who is present. From this point of view, both patient and therapist are interacting *within* a medium, *with* a medium and *with* the other in the medium. The last is an emergent actor that therapist and patient co-define within their interaction and conversation; its emergence allows us to study the VR-session as a social context where a new, more flexible way of producing and interpreting data is needed, since it is originating separately from therapist, patient and

their interaction with/within the virtual environments. Within the framework of qualitative approaches it would be of central interest to develop the aspects of interpretation, the categories, as near as possible to the material, to formulate them in terms of the material. For that scope, qualitative content analysis has developed procedures of inductive and deductive category development, which are oriented to the reductive processes formulated within the psychology of text processing (Ballstaedt, Mandl, Schnotz & Tergan 1981; van Dijk 1980). Deductive category application works with prior formulated theoretical derived aspects of analysis, bringing them in connection with the text. The qualitative step of analysis consists in a methodological controlled assignment of the category to a passage of text.

PROCEDURE

The specific object of the study is to verify some key aspects connected to social presence and their relevance for therapy. The study includes a first analysis of occurrences in quantitative terms and the consequent *in context* evaluation that is the analysis of the specific situation in which a verbal exchange occurs, a thought is expressed, or an action done. The reference context for the coding definition is represented by the specific aims and therapeutic actions foreseen in the VR based ECT protocol for each one of the sessions. Main therapeutic actions have been coded through the identification of an ideal interactional sequence constituted by: therapist act/request, patient act/answer, therapist act/resumption. Both therapist and patient have then defined a series of therapeutic acts/ requests and possible reactions/answers. These last ones are specifically based on the social presence level determination proposed by Riva (2004). Special codes called modulators have then been added: they allow further qualitative specifications (*positive/negative* evaluation; answer *coherent/non coherent* to the specific request). Therapeutic interventions not strictly connected to the VR phase of the session aimed, for example, at the rational understanding of the cognitive restructuring process have not been deeply considered because they are not necessarily connected to the VR use.

Categories used for the analysis are exhaustively described in a parallel study conducted in the framework of the same project (Cantamesse & Galimberti 2007) and are synthetically described in Table 1 on the following page.

In order to evaluate the reliability and the validity of the coded data, 12 sessions were randomly assigned to two judges. Each judge received brief training as well as a codebook, with a definition and an example for each node. Cohen's Kappa statistics were also computed for each node. Kappa coefficients ranged from .69 to .82.

The analysis procedure is based on 'content analysis' carried out on transcriptions of interactions between therapists and patients within the VR based Experiential-Cognitive Therapy (ECT) treatment protocol for Panic Disorder and Agoraphobia. The present version (Vincelli et al., 2000) is based on the classic CBT protocol developed by Clark (1986). For VR based ECT, our research unit developed the Virtual Environments for Panic Disorders with agoraphobia (VEPDA) virtual reality system (Belloni, Cantamesse, Galimberti, & Gatti, 2006). VEPDA is a 4-zone virtual environment developed using the GameStudio A6® engine toolkit. The four zones reproduce different potentially fearful situations - an elevator, a supermarket, a subway ride, and a large square. In each zone the therapist can set up the characteristics of the anxiety-related experience. In particular the therapist can define the duration of the virtual experience, its end, possible exploration paths and the number of avatars to be included.

Figure 1. Screenshot of the 'town square'

Table 1. Categories' description

Categories' description	
Category	**Description**
Action	Actions performed by the actors
Request	The actor (usually the therapist) asks the patient to do something or to speak about something
Description	A reply given by the interlocutor (usually the patient): he can describe an environment, an action, a sensation
Scaffolding action	The therapist can confirm and support the description provided by the patient enhancing his impressions or interpretations
Locus	"Where" the action is performed and "where" the actor is perceived
Inside VE	Action performed in or description referred to the VE
Outside VE	Action performed in or description referred to the real world
Focus	Element perceived, described or interacted with
Place	Actor describes an action or a sensation in a place referring to its physical, spatial or functional elements
Social	Actor describes an action or a sensation in a place referring to who is present
Other agnition	The speaker is focused on a specific "other"
Intention Attribution	An avatar is judged being driven by a purpose
Center	Actions or descriptions are centered on the speaker

Data corpus is derived from transcriptions of 54 VR based ECT sessions (3 patients for each of the 3 therapists involved in the project for a total of 9 patients). Subjects are consecutive patients, aged 18-55, seeking treatment in one of the institutions involved in the study. They met DSM IV criteria for panic disorders and agoraphobia for a minimum of 6 months as determined by an independent clinician on clinical interview, according to the SCID (Structured Clinical Interview for DSM IV) model (Spitzer et al, 1992; William et al., 1992). The VR based ECT protocol has been carried out by three independent therapists after an adequate training phase.

As to the type of data produced, the reference to the *ecology of process* (Galimberti, Belloni, Cantamesse et al. 2006) may be represented in Table 2 on the following page.

Key aspects and examples of results

In this work, categories suggesting that the VR can be considered as a psychosocial experience have been used to analyze and interpret therapeutic sessions with a special focus on social presence with the aim to find out possible solutions to improve VR environments and protocol. On the basis of the categories described in the previous paragraph, some further enriching elements have been identified. In particular: 1) the existence of *reality check* dynamics. This means that in specific situations the therapist invites the patient to compare what is happening in the virtual world with a possible, or simply imagined, real situation. This procedure seems to be connected to specific therapeutic phases and purposes and will be further investigated; 2) *Scaffolding actions*: the therapist can confirm or support descriptions provided by the patient, enhancing his impressions and comprehension of the situation. They are considered significant elements assuming what we defined *sense*

Table 2. Typology of data produced

Therapists	Observation of therapists' use of VEs Data concerning therapist-patient interactions during VE experience (transcriptions)	Personal experience of VE use Situated interaction between users (therapist-patient)	
Patients	Observation of the patients' use of VEs Data concerning patient-therapist interaction during VE experience (transcriptions)	Personal experience of VE use Situated interaction between users (therapist-patient)	

making function. Therapist and patient tend to give sense to the situation without using a narration in the proper sense. 3) *Social and centered descriptions* seem to be connected to the anxiety level reported by the patient. Some examples of results deriving from the content's analysis are now presented.

When does the patient focus on social environment?
One of the first emerging key points concerns the coherence between requests to describe the general VR environment made by the therapist ("*Tell me what you see"* or *"Try to describe the plaza")* and the patient's reply. According to the category previously defined, requests by the therapist and answers of the patient are usually of two types: related to general descriptions of the VE and mainly focused on objects, or related to descriptions focused on other persons ("*There are a lot of people. The lady is smiling").* Considering the following excerpt, we see that the focus of the patient's answer is on the description of other people present in the VE:

Therapist 81: "Ok ... What do you see around? Describe me all the objects you see around"
Patient 82: "Well, now...now you have the coach with the straps. It's not...very crowded...there are men and women, with classic and casual dresses and a...a woman"
T82: "Perfect."
[....]
T83: "Ok, stop for a while G., how are you feeling now?"
P84: "I'm not…I'm not at my ease"

From a preliminary quantitative analysis of the occurrences based on a frequency calculation, it seems to emerge that when the anxiety level increases, patients' answers and descriptions are more focused on social elements of the environment than on objects, even if the therapist request specifically refers to the description of the objects in the environment. This kind of answer has been marked as *non coherent* (to the specific request). The anxiety level can be defined and checked thanks to frequent feedback (an average of one every 3 minutes) solicited by the therapist from the patient about his or her sensations or feelings. It is evaluated on a subjective scale from 1 to 10.

On the contrary, when the anxiety level is lower, the patient answers the request of the therapist concerning a general description of the environment focusing on the objects around him in a more coherent way. This does not happen only when the anxiety symptoms are voluntarily provoked as foreseen by the clinical protocol (in this case the request to describe objects is usually connected to the distraction strategy the patient is expected to apply), but also if the frightening stimulus emerges while the patient is freely exploring the environment. A successful way to study this specific aspect is then to further investigate in which specific phases of the session this happens and to look for possible

(code defined as *description of social VE*), he is inclined to describe himself as effectively present in VR, for example referring other actions or intensions to himself (higher level), or simply including himself in the social space (lower level) more than when he describes inanimate objects or physical circumstances. This modality has been defined as *self in VR*.

T13: "Ok...have a look around, then concentrate on your sensations, on your thoughts, ok? How is it? The anxiety?
P13: "Mhh...fine"
T14: "From one to ten?"
P14: "Yes...three, four"
T15: "What are you thinking of?"
P16: "We are too many in a big space..."

This element can be connected to the activation level in the sense that when the patient is immersed and recognizes others' presence, her or she is inclined to consider and define himself as reference point.

Is it possible to identify a 'therapeutic style'? How to use VR stimuli
A third consideration concerns how different therapists use VR stimuli or reality elements to help the immersion. One key code to help identify behaviors and strategies connected to this aspect has been defined as *reality check.* It identifies all the passages in which the therapist invites the patient to compare his experience in the real world to the one in the virtual environment. This sort of 'strategy' can be used for different purposes: for example to force the immersive experience a bit or, on the contrary, to support the use of the imaginative technique.

P65: "For example, I was on the tube, in Paris..."
T67: "No we are on the tube, now"
P66: "On the tube in Paris I was saying"
T68: "No, we are on this tube, here, now. Let's try to have a look around for example"

In this case the therapist insists in order to keep the patient immersed in the VE. In other cases the therapist uses some cues of the VE to invite the patient to imagine "what would happen in the real world if...". The analysis of the interaction suggests that these different strategies are applied by different therapists or by a single therapist in the same session. It is possible to identify a proper 'style' when the number of occurrences of one type is considerably frequent for a specific therapist and independently by the patient. It is important to underline that this strategy, even when it can be defined as a style, could depend on the aims of the different therapeutic phases: the need to "bring" the patient in the VE, or, on the other side, the necessity to teach specific relaxing techniques to control the symptoms. Surely further research is needed on this topic.

Narration as "sense making"
Different from the initial hypothesis formulated by our researchers about the opportunity to use narrative elements in order to help the therapist to enrich the virtual experience, it seems that therapists rarely feel the need to create a story to facilitate the immersion. More often, detailed descriptions of the elements already existing in environment and support action towards the patient when he tries to do the same (code defined as *scaffolding action with reference to the immersion*) are enough to "give sense" to the situation and to the immersion in general. Narration and "sense making" can be considered two ideal levels set on a *continuum* that includes different ways to enrich the immersive experience through the co-creation of a credible, or at least possible, situation.

CONCLUSIONS

In this work we have illustrated a method for analyzing therapist-patient interaction with a VE and with the 'other' emerging in VE even when no interaction, for example with other avatars, is foreseen. VR-based sessions can be considered a social context that can be analyzed with psychosocial methods. Information gathered with this kind of analysis, after appropriate studies and further investigations, could help the researchers to become more aware of the dynamics emerging during the therapeutic interaction in a correct *process ecology* perspective. The focus of the research is on those elements more strictly connected to concept of *social presence*, to its multi-componential nature that includes both human and technological elements, literally emerging from the complexity of the interaction and the value it can assume from the therapy efficacy point of view.

Considerations deriving from the study will be used not only to improve VR environments, but also the clinical procedures by formalizing - if necessary - those interaction aspects which are not visible without an in-depth selective approach which takes into account all possible elements and levels of this special therapeutic relation. To mention some examples with reference to the VR environments: 1) *Focus on the social environment*. 'Social situations' will be improved and better characterized. The social dimension will have to be immediately perceived by the patient (queues at the supermarket, more people in front of shop-windows); 2) *Self-perception.* The presence of the patient must affect the environment and above all the social environment: for example the patient can have the possibility to push his way through the crowd and see the people change their place.

With reference to the therapeutic protocol: 3) *Therapeutic style.* Each VR environment can be better structured in different zones with different situations to facilitate the therapist in his narration purposes and according to personal styles. Possible narrative paths can be suggested and formally included in the protocol; 4) *Narration as sense-making*. Useful elements that the therapist can autonomously activate and use to focus patients' attention can be included in the VR environments such as, for example, sudden rumors, prototypical characters (a crying girl, a policeman, a person wearing a strange dress and so on). The therapist could use these cues to build short stories according to clinical purposes, but attention must be paid in order to create a correct balance of elements because they do not have to distract from the therapy. As for point 3, these new possibilities can be formalized in the protocol.

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The “emerging other”: an essay about the study of social ecology of VR-therapy

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Abstract: *VR-based psychological therapy is largely used in different clinical approaches and a variety of studies can be found in the literature about the experience of VR-therapy sessions. Usually, such studies are focused on a user's private experience. With this contribution, we present a perspective to improve VR-session definition towards a "co-defined reality", abandoning both artifact and user–artifact centered interaction in favour of a "situated and context sensible" interaction analysis. Theoretical background is based on an ethnometodological approach: this perspective gives evidence of how people, in specific social situations, produce shared meanings. Within such theoretical framework, an analysis has been conducted with reference to two different dimensions. From a strictly ergonomic point of view, main results are related to the improvement of VR training sessions and to patient integration in the framework of the therapeutic protocol, to avoid interruptions and breakdowns. With reference to the sense of presence, we investigated how therapist and patient can populate with “others” and “meanings” the co-defined environment and how a VE's level of interactivity influences the quality of the immersive experience. Main findings highlight the sequential and dialogical process of VR fruition and could help in VR technical design process.*

INTRODUCTION

Use of Virtual Reality (VR) technology in psychological therapy is largely documented in the literature: virtual environments (VE) have been used by therapists within different backgrounds, and within several theoretical approaches (Krijn et al., 2004; Rothbaum et al., 2001; Rothbaum et al., 2004). Besides such richness, it's not easy to find a common shared definition of Virtual Reality, as pointed out by Riva (2004).

We can identify three different approaches to defining VR: (a) definitions focused on technical elements, (b) definitions based on user perceptions and (c) definitions based on user experiences. Tech-focused definitions refer to hardware and software elements of VR, such as the head-mounted display (HMD) or head-tracker. According to Ellis (1994), VEs can be defined "...as interactive, virtual image displays enhanced by special processing and by nonvisual display modalities, such as auditory and haptic, to convince users that they are immersed in a synthetic space” (Ellis, 1994). In recent years, definitions evolved to considering design topics: for example, Brey defines VR as "a threedimensional interactive computer-generated environment that incorporates a first-person perspective” (Brey, 1999). As stated by Steuer (1993), a VR definition focused only on technological aspects is inadequate, and research needs to focus on the analysis of system factors (vividness and interactivity) that have an influence on human experience. User perception-based definition focuses on what the user can perceive of VEs while considering perceptual realism, spatial sounds and multi-sensorial perceptions: “We define a virtual environment as a set of data displayed in such a way as to create in users the impression of objects in a space” (Nunez & Blake, 2001). Recent works underline the importance of user experience, like immersion, presence and social presence: “defining characteristics of virtual reality systems is to create presence and fool the user into believing that one is, or is doing something in the synthetic environment” (Dongsik et al., 2003). This position is shared by Riva who defines the core element of VR as a mental experience, which makes the user believe that ‘he or she is there’, that he or she is present in the virtual world (Riva, 1999).

In this essay, we want to stress how these three aspects (technical elements, user perceptions, user experiences) could be compared to situated-action theory elements: object, subject and process (Galimberti & Riva, 2001). Within this metaphor, virtual reality, like any other artifact, could be studied looking at its objective characteristics (performance, functionality, hardware and software, for example), at users and actors that use it, and finally looking at dynamic processes fired by VR use, as communication, im-

mersion, presence and mediated communication. Therefore it could be defined as a social artifact: users can interact with other users, processes and living experiences, using artifact elements (Galimberti et al., 2006).

This consideration requires analyzing VR social dimensions of interactional data. Allport defines social psychology as “an attempt to understand and explain how the thought, feeling, and behaviour of individuals are influenced by the actual, imagined, or implied presence of others” (Allport, 1985). A question we want to raise is: how is the “other” in VR? How can a user imagine, imply or interact with an actual “other” during VR sessions? Theoretical background is based on an ethnometodological approach: this perspective gives evidence of how people, in specific social situations, produce shared meanings. From an *ecology of state*-oriented perspective we expanded the focus to the concept of *ecology of process*. *Ecology of state* includes both an *ecology of context*, which has been exhaustively defined and conceptualized by different research streams, and an *ecology of situation*. The wider *ecology of process* concept introduces the value of dialogical perspective, extending the social dimension of the studied context. Within the dialogical approach, VR-based therapy sessions could be studied as a social co-construction of meanings, where therapist and patient negotiate what is going on, how it's going and who is present. From this point of view, both patient and therapist are interacting *within* a medium, *with* a medium and *with* the other in the medium. The last is an emergent actor that therapist and patient co-define within their interaction and conversation; its emergence allows us to study the VR-session as a social context where a new, more flexible way of producing and interpreting data is needed, since it is originating separately from therapist, patient and their interaction with/within virtual environments.

METHOD

In order to explore social dimensions of VR experience, we analyzed 54 session transcriptions, collected during the MIUR-FIRB NeuroTIV project, with 9 patients and 3 therapists. The protocol used was the ECT (Experiential Cognitive Therapy), which integrates VR experiences with the traditional CBT (Vincelli et al., 2002). Virtual environments used were the Panic Disorders and Agoraphobia VR modules developed in the framework of the project: an underground station, a town square, a supermarket and a lift (Belloni et al., 2006). All environments contained static avatars, represented with 3D models (see Figure 1) and 2D sprites. We used a qualitative software analysis called NVivo 2, developed by Qualitative

Figure 1: 3D avatars

We used a qualitative content analysis approach to underline how therapist and patient interact within virtual reality, and how they co-define the existence of the “other”. Content analysis is “the use of replicable and valid method for making specific inferences from text to other states or properties of its source" (Krippendorff, 1969), and it has two major approaches: inductive category development and deductive category application. The main idea of the inductive procedure is to formulate a criterion of definition, derived from theoretical background and research questions. Following this criterion, data is analyzed and categories are considered tentative and deduced step by step. Within a feedback loop those categories are revised, eventually reduced to main categories and checked in respect to their reliability. If the research question suggests quantitative aspects (e.g. frequencies of coded categories) it can be analyzed (Mayring, 2000). Such a decision implies that data is approached with the goal of allowing the categories (nodes) to emerge from the reading of the qualitative data (Gibbs, 2002).

Solutions and Research (QSR) International in 2002, to compile and analyse the data.

In order to document the process of category development, we present a "documentational table" (Constas, 1992), representing the three procedural elements of categorization (origination, verification and nomination) and the temporal aspects of the process. According to Constas (1992), origination identifies the locus of category construction, verification details the strategies used to support the creation and application of categories, and nomination is concerned with the naming of categories; while temporal designation addresses the temporal characteristics of such a process.

Categories generated during this study are related to the 1) type of conversational *action* (1.1 *Request*, 1.2 *Description* and 1.3 *Scaffolding* action and attributes of action: 2) *Locus* (*Inside VE* and *Outside VE*); 3) *Focus* (*Place*, *Other Agnition*, *Intention Attribution*) and 4) *Center*, as defined below.

Table 1 shows the components of categorization domain on the vertical axis and the temporal designation domain on the horizontal axis. Categories are represented by numbers located according to the components and temporal characteristics associated with a given category.

The **origination** component is based on three sources for generating the categories. The *Scaffolding* action category is based on both literature and investigative perspective: Steiner introduce the idea to use VEs in order to “scaffold the students' pre-existing knowledge of story structures” (Steiner, 1994) and in a psychosocial approach, we decided “a priori” to investigate how the scaffolding function could be related to therapist’s actions. In this perspective, the therapist could support the patient’s description of VE and

Table 1

Categories development process

Components of categorization	**Temporal designation**		
	A priori	***A posteriori***	***Iterative***
Origination: **Where does the authority for creating categories reside**			
Participants			
Programs			
Investigative			
Literature	1.3		
Interpretative			1.1, 1.2 , 2 , 3 , 4
Verification: **On what grounds can one justify a given category?**			
Rational			
Referential			1.3
External			
Empirical			
Technical		1.1, 1.2, 1.3, 2 , 3 , 4	
Participative			
Nomination: **What is the source of the name used to describe a category**			
Participants			
Programs			
Investigative			
Literature	1.3		
Interpretative		1.1, 1.2 , 2 , 3 , 4	

its experience. Others categories are based on an interpretative position, and they emerged during data analysis and have been designated in an iterative confrontation by the investigators.

The **verification** component was applied both interactively and at the end of the coding process in a technical way: once a draft of categories definition was prepared, the next step was to check that different coders could replicate each other's work. To pretest categories, we randomly selected 11 sessions (representing 20% of data) and two coders independently coded the selected sessions. To quantify the degree of agreement during the preliminary pretest and final intercoder reliability, we used Cohen's kappa method as suggested by Dewey (1983). As reliability levels in the pilot test ranged from .65 to .72, we proceeded to code the full sample: according to the exploratory nature of this study and to considerations presented by Rietveld and van Hout (1993), we judged this range acceptable.

The **nomination** component was accomplished in an "a priori" literature-based way for Scaffolding category (Steiner, 1994), and "a posteriori" for other categories, with labels based on a interpretative position.

RESULTS

We'll briefly explain each category, providing an example.

Type of conversational action: patient and therapist could perform three types of actions. They can do a *Request*, a *Description*, and a *Scaffolding Action*. A *Request* action means that the actor (usually the therapist) asks the other to do something (to describe something, to perform a movement, to speak about something):

T117: "Can you describe what you see?"

T8: "Could you go upstairs?"

A *Description* is usually a reply done by the interlocutor, while describing an environment, an action, or a sensation.

P116: "There is a map on the wall … It's colourful"

More interesting is the *Scaffolding* action, done mainly by the therapist: he could confirm and support the description provided by the patient, enhancing his impressions.

T118: "Could you tell me more about that map?"

***Locus*:** the analysis of the qualitative data suggests that each action, besides the therapeutic process, could refer to two different "loci": *Inside VE* and *Outside VE*. This node refers to "where" the action is performed, and "where" the actor is perceived; the patient can describe an action done inside the VE, for example:

P12: "I'm going downstairs"

Performed during an exploration of the Subway VE. Or an action done in the real world:

P34: "I'm pulling the joystick, now"

Focus: this attribute refers to the element perceived, described or interacted with. An actor can describe a place referring to its physical, spatial or functional elements (*Place*), or he can speak about who is present (*Social*), and what they are doing. The *Social* node could be deeply divided into: *Other agnition,* when speaker focuses on a specific "other" and *Intention Attribution*, performed when an avatar is being driven by a purpose.

Center: this node codes an action centered on the speaker. We can find many descriptions:

P73: "I'm in the middle of a large square"

or, more often, descriptions of social environment:

P54: "There are a lot of people around me"

This node is usually related during post-hyperventilation phase (as requested by the protocol), or while the patient is describing the VE without any previous request to do it.

Such dimensions could be found mixed in a wide range of actions: therapist could ask to perform an action inside the VE, and the patient describe an action done outside it; or therapist could describe a corrective (while solving an hardware issues) action outside the VE, and patient would speak about an external sensation (for example, speaking about a previous experience). We present in Table 2 the frequency of different nodes.

Table 2

Category frequency

Category	Freq.
Action	1860
Request	864
Description	672
Scaffolding action	324
Locus	
Inside VE	339
Outside VE	103
Focus	
Place	281
Social	391
Other agnition	295
Intention Attribution	96
Center	442

DISCUSSION

Analyzing conversation during VR-based sessions with a psychosocial approach, researchers can underline some elements: each action could refer to an in-world or out-of-world target, and could be performed inside or outside the VE; places and actions could be described by their "physical" dimensions, or actors can choose to focus on their social meanings; therapist and patient can reciprocally support or detract their shared representation of the VE.

From a preliminary analysis, we can notice that users describe social elements of VE more frequently than physical (space, objects, colors and light, for example): 391 descriptions are based on social features while 281 on physical elements. *Social description* could be focused on general characteristics, or on a specific "other": 295 social descriptions referred to an avatar, its appearance, its position or its imagined actions (as stated above, in our VEs avatars where mere 3D static models). Moreover, 96 of these descriptions are about intentions, expectations, feelings of such avatars; an important element of the *Intention Attribution* code is that we can find it more frequently after a *Scaffolding* action by the therapist: actors co-define the existence of others inside the VE.

A typical sequence points out, from a social perspective, that there is an "emergent other", acting in the VE: to a request done by the therapist to describe the spatial VE, the patient can reply by describing a social element of it; on the next turn, if the therapist performs a scaffolding action, supporting such social description, patient focuses on the *Other Agnition*, and then attributes an intention to the avatar. After that, the patient will speak directly to the avatar:

P143: "Hello, miss... Could you let me pass, please?"

while trying to go around an avatar blocking his way to the subway train.

This sequence has some rules: (a) the therapist could easily stop this sequence describing an action performed outside the VE, or asking to describe a previous experience; (b) after such a sequence, the patient would usually perform descriptions of the social VE; (c) following description will be focused on the self in VR. In the same way, therapists could modulate the sense of being in the VE by performing specific actions: by using (or avoiding) a scaffold act; supporting (or not) patient descriptions; diverting the focus of an action from inside the VE towards outside; by introducing external elements, for example a request to think about a previous, real-world experience; or request to describe the VE "around you", positioning the patient inside the VE.

Regarding presence and social presence concepts, this framework could help the understanding of a user's experience of being inside the VE. Users often (442 on a total of 672 description) speak about events and elements as related to their position ("around me", "near", "I'm on a train" and so on), and 339 times they described elements inside the VE. We can therefore trace a continuum based on the co-defined position of the patient and the existence of others: from "I'm here, in the research room, alone, moving around a picture on my HMD using a joystick" to "I'm here, in a mall, trying to find a way out avoiding the crowd". We argue that it's possible to attribute a presence level regarding dialogical position assumed by the actors on this continuum.

CONCLUSION

We opened this essay with a question: are VR-based sessions a social context that can be analyzed with psychosocial tools and methods?

In order to find an answer we analyzed 54 sessions and defined some characteristics of conversational actions performed. By conversing, patient and therapist co-define and negotiate a shared world. This shared world is not a social vacuum, but it's inhabited by a plurality of actors: the patient and therapist themselves but also the other they are speaking about and the other they are speaking to them.

This consideration could help researchers to understand dynamics, interactions and experiences within Virtual Environments: by studying the conversational negotiation of the sense of being there, we can find clues about presence, social presence; as well ideas to design and implement better VE for therapy. Further studies should compare the sense of presence attribution based on conversational actions to some other presence measurement methods, such as behavioural elements or standardized questionnaire.

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A Second Life for Telehealth?

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INTRODUCTION

In recent years, the emergence of the Internet and related tools such as chat and email has opened new possibilities of communication between therapists and patients. As a consequence, a number of research studies have begun to investigate the potential benefit of e-therapy.

E-therapy, also known as "cybertherapy" or "net-therapy", is defined as the provision of psychological therapy and consultation over the Internet. Although e-therapy provides several advantages for both the therapists and patients, such as the possibility to deliver health information and services across geographical distance for an underserved population, this approach poses new challenges with respect to the anomalies of being present, and able to meet other presences, in virtual space with no physical body (Castelnuovo et al., 2003). A further limit of conventional e-therapy applications is that they do not allow multiple users to share the same mediated communication environment.

The emergence of Multiplayer Online Games (MOGS) may provide a useful approach towards the implementation of multi-user applications in e-therapy. MOGS are collaborative virtual environments characterized by the simultaneous presence of multiple users within the same simulated space, who can communicate using local chat, voice, instant messaging, and in some cases, gestures and movements. Over the last few years the number of MOGs has increased dramatically: as recently as in 2005, there were 101 MOGs in commercial service, 69 in development/beta, and 22 being actively localized for the U.S. and other English-language markets (PersistentWorldz, 2005). Also, there has been a tremendous growth in MOGs users: according to recent market estimates, combined global memberships in subscription and non-subscription games exceeded 15 million in 2006, with market value for MOGs hitting $1bn in Western countries alone. The aim of the present article is to describe the potential role that MOGS can play in e-therapy applications, by addressing the potential advantages and the issues related to the use of this emerging medium in the clinical setting.

From e-therapy to immersive virtual telepresence

According to Glueckauf et al. (2003) online therapy provides four key advantages: a) the potential to deliver health information and services across geographical distance for underserved population; b) the potential to enhance the quality of health information and services in particular areas or for specific populations; c) the potential to ensure continuous medical and psychological service overall for chronic disabilities reducing the cost of an extended traditional assistance; and d) the growing trend of patients' preferring to use home-based computer systems for psychotherapy.

These advantages have led an increasing number of mental health professionals worldwide to provide psychotherapy services over the Web. The two main applications of e-therapy are individual therapy and online self-help groups. The first refers to the provision of individual therapy and consultation over the Internet. This approach presents risks related to clinician-patient relationships, but it also allows patients more time for communication with their clinicians through asynchronous e-mail communication, allowing the depth of disclosure to be improved by patients who feel inhibited in a face-to-face situation (Maheu & Gordon, 2000).

On-line self-help groups, on the other hand, refer to bulletin boards, chat rooms, news and discussion groups operated within health-related web pages, listservs, i.e., groups in which each individual message is copied and e-mailed to all subscribers, and other electronic forums focused on the sharing and solving of

psychological disturbances (Humphreys, Winzelberg, & Klaw, 2000). These may be unstructured discussion groups or led by an individual, usually a non-professional, who shares the problem that the group addresses. The principle at the core of this approach is the sharing of experiences, strengths and hopes between members in order to solve their common problem (Castelnuovo et al., 2003).

Internet-assisted therapy and counselling has many advantages for both the psychotherapist and for the patient, but it poses new challenges too. One such issue is related to the impossibility of being physically present, and able to meet other presences, in virtual space. Indeed, a key element of the success of psychotherapy is related to the ability of a therapist to access the non-verbal communications of their patients. This skill is often essential for making accurate diagnoses and in formulating effective treatments for patients. Without non-verbal cues, it is more difficult to feel and be able to convey empathy toward their geographically remote patients (Bauer, 2001). Physical separation may also involve emotional separation between patients and therapists. This concern is particularly critical for those patients who already suffer from depression and feelings of alienation.
To address these challenges, Riva has recently introduced the concept of Immersive Virtual Telepresence (Riva, 2004). In this vision, telepresence-based health is a shared immersive e-therapy in which the presence, simulation, and experience components are key factors of therapeutic success. From the technological viewpoint, the goal of this approach is to combine the use of Internet and Virtual Reality (VR) to create distributed virtual environments that are used to enhance the remote communication between therapists and patients. The concept of presence clarifies the possible role of virtual reality in e-therapy: a communication interface based on interactive 3D visualization, able to collect and integrate different inputs and data sets in a single realistic experience. The two principle ways in which IVT can be applied are: a) as an interface, which enables a more intuitive manner of interacting with information, and b) as an extended communicative environment that enhances the feeling of presence during the interaction. Within this perspective, it is up to the health care provider to decide if the VR application will be more focused on the integration of different data sets or on the realism of the virtual experience.

However, the IVT approach is also faced with practical and technological challenges. A first issue is related to bandwidth requirements, as virtual environments must be downloaded from the remote server on the patient's PC. Further, in current IVT applications the virtual simulation is limited to a single user. For example, in remote virtual reality exposure therapy, the patient explores the virtual environment under remote supervision, but the therapist is not included in the virtual scenario. Some virtual environments include virtual characters, but they are mostly autonomous virtual humans whose behaviours are driven by artificial intelligence programs. In the following paragraph, we explain how the emergence of MOGs may provide a useful technological framework to address these issues.

The rationale of using MOGS in immersive virtual telepresence

MOGs: definition and technological features

According to the Squire and Steinkuehler definition, MOGs are "highly graphical 3-D videogames played online, allowing individuals, through their self-created digital characters or avatars, to interact not only with the gaming software (the designed environment of the game and the computer-controlled characters within it) but with other players' avatars as well. These cyberworlds are persistent social and material worlds, loosely structured by open-ended (fantasy) narratives, where players are largely free to do as they please – slay overgrown butterflies, siege cities, barter goods in town, or scalp raw materials off the local flora and fauna" (Squire & Steinkuehler, 2006). Most MOGs are implemented by using a client/server architecture. The front-end on the player's side acts as a terminal that receives the player's input and forwards it to the server where the game world is hosted. Processing of the game state is performed on the server-side and changes are fed back to clients, which show an audio-visual representation of the game world. The majority of MOGs have proprietary content, but some independent MMORPG projects have

been proposed as completely open source platforms. For example, the WorldForge project and the Multiverse Network have formed a community of independent developers who are working on creating a framework for a number of open-source MOGs.

Psychological features in avatar-based interaction

As we have seen, the IVT vision suggests that providing the remote patient with a feeling of shared presence is a key for improving therapeutic effectiveness. From this perspective, MOGs can be useful since they may be able to convey high feelings of presence and social presence, where social presence is defined as a feeling of togetherness of remote persons who are connected through some form of telecommunication medium. Embodiment by means of avatars has the potential to facilitate the clinical communication process, to positively influence group processes and cohesiveness in group-based therapies, and to create higher levels of interpersonal trust, which is a fundamental requirement for establishing a successful therapeutic alliance.

Results of recent studies in avatar-based social interaction provide support for this hypothesis. In one such study, Bente and colleagues (2004) measured social presence and interpersonal trust in avatar-based collaborative net communications, and compared this condition to face-to-face-communication as well as audio-based (phone) and text-based net-communication. Findings of this experiment, which involved 48 participants, showed that the level of co-presence was higher in avatar-based interactions than in phone or chat interactions. However, authors suggest taking this observation carefully, since the co-presence values for the avatar-based encounters were close to zero and therefore data can hardly be interpreted as a positive effect in itself.

In a subsequent study, Bente and colleagues (2005) have investigated the experience of "social presence" as a relevant effect dimension of avatar mediated net-communication. In this study, 142 participants were randomly assigned to one of five possible communication settings: (1) text only, (2) audio only, (3) audio and video, (4) audio and low fidelity avatar (LFA), (5) audio and high fidelity avatar. Results revealed a significant difference between text and all other communication modes, indicating that audio, video and avatar systems worked similarly well in creating an experience of social presence. However, according to these authors, avatar platforms offer new possibilities to overcome many of restrictions related to audio and video communication modes. In particular, they suggest that “Virtual worlds and avatars could thus be seen more as a means to contextualize social interaction and to foster the salience of non-verbal information, rather than just to provide high fidelity transmission channels for visual cues. They are in this sense not just virtual equivalents of a video conferencing system but a possibility for active filtering and contingency management systems” (p. 102).

Other studies have suggested that even avatars with rather primitive expressive abilities may elicit strong emotional responses in users of a collaborative virtual environment. Experiments have shown that the avatar can readily take on a personal role, thereby increasing the sense of community feeling, and becoming a genuine representation of the underlying individual, not only visually, but also within a social context (Fabri et al. 1999).

Yee and colleagues (2006) have investigated whether norms about social space in the real world map onto how avatars act in relation to each other in virtual space. In an observational study of Second Life, a virtual community, the authors collected data from avatars in order to explore whether social norms of gender, interpersonal distance (IPD), and eye gaze transfer into virtual environments even though the modality of movement is entirely different. Their findings were that, similar to the real world, male-male dyads tend to stand further from each other and look at each other much less than female-female dyads: 1) Male dyads have larger IPDs than female-female dyads, 2) male-male dyads maintain less eye contact than female-female dyads, and 3) decreases in IPD are compensated with gaze avoidance.

In summary, these preliminary research findings suggest that avatar-based interaction in virtual worlds may have the potential to provide a means to enrich the level of emotional con-

nections and social presence conveyed by conventional e-therapy tools; from this perspective, MOGs may at least provide opportunities to build strong partnerships between patients and clinicians by giving patients more contextual information and nonverbal information.

MOGS in e-therapy: two application scenarios

MOGS in virtual reality exposure therapy

In recent years, a number of studies have suggested the efficacy of virtual reality exposure in the diagnosis and treatment in various psychological disorders. In the field of psychotherapy, most studies have addressed specific phobias, in particular on fear of flying, acrophobia, fear of driving, claustrophobia and fear of spiders. In addition, several studies have been published on the use of this approach for eating disorders, social anxiety disorders, sexual disorders, post-traumatic stress disorder and panic disorder with or without agoraphobia. In VR exposure, the patient is immersed in a VE containing the feared stimulus. This procedure has been shown to be at least as effective as these traditional techniques in reducing phobic symptoms (Pull, 2005). The added-value of this approach exists in the practical advantages offered by the use of VR technology. As stimuli are generated by the computer, the therapist has full control over their intensity, and the risk of unpredictable effects is significantly lower than in vivo exposure. Further, virtual exposure allows the therapist to present the patient with realistic three-dimensional visualization of the feared situation. This feature can be very useful when the patient is unable to recreate the scenarios because of pathological avoidance of problematic memories, as is often the case in post-traumatic stress disorder (Rizzo et al., 2005).

In our view, MOGs represent the next logical step in virtual reality exposure. As in conventional VR-based exposure, MOGs provide a virtual scenario that reproduces the feared situation, but with the possibility of having the therapist supervision directly in the virtual environment, thereby providing the patient with more feelings of safety and control. Another potential use of MOGs exposure therapy could be in social phobia applications. Clinical research has shown that VR exposure can be used to reproduce situations that social phobics feel are the most threatening, such as performance, intimacy, scrutiny and assertiveness. In most VR applications for social phobia, animation-based character, videos or autonomous virtual humans are used as anxiety-provoking stimuli. The use of MOGs could provide the therapist with the possibility of using avatar-based exposure, thereby enhancing the realism of the social interaction while at the same time maintaining full control over the simulated social environment.

MOGs for creating virtual patient communities

This scenario draws on previous work of Winkelman and Wey Choo (2003). They started from the assumption that patients with chronic disease possess tacit knowledge gained from their personal experience. This knowledge is closely equivalent to a worker's tacit knowledge in that it is "used by organizational members…to make sense of their worlds". However, different from work-related tacit knowledge, which is mainly based on procedural, action-based skills, a patient's knowledge is acquired experientially by the necessity to match the daily challenges and needs of a chronic disease. These needs include information on their disease, treatment side-effects, treatment plans, professional contacts, as well as supportive information for family and friends. In addition, access to the highest quality evidence is important when patients participate in decisions about their care choices, and patients with diseases in which medication therapy is the primary treatment option may have greater and more in-depth informational needs. According to Winkelman and Wey Choo, if this tacit knowledge can be shared or socialized through a program, tool or medium, a patient's sense of self-efficacy can improve, thereby positively affecting health outcomes as well as social functioning.

Winkelman and Wey Choo's approach argues a shift in role of chronic disease patients from external consumers of healthcare services to a "community of practice" of internal customers. Introduced by Wenger (1998), community of practice is a social construct that bring learning into lived experience of participation in the world. They are defined as self-organizing, informal groups whose members work together

towards common goals, face common needs, share best practices, and have a common identity. Drawing on these concepts, Winkelman and Wey Choo (2003) suggest that with the implicit support of a healthcare organization, patients can benefit from accessing to the expertise of peers, by integrating the knowledge gained from the experiences of living with chronic disease in their self-management. In particular, they claim that virtual patient communities can become effective tools of communication if a) members have common interests, needs, goals, as well as an aspiration for mutual communication and the furthering of relationships, and b) if they are able to supplement already existing face-to-face communication opportunities. Documented examples of web-based communities are *Zora* (Bers, Gonzalez-Heydrich et al., 2001), an animated virtual community for paediatric haemodialysis patients that help children and families cope with their disease, and *WebMD* (Emdeon, 2005), which includes experience-sharing tools such as Message Boards, Newsletters, and Live Events.

Starting from this model, we argue that MOGs have the potential to bring about several innovative features to virtual patient communities. In fact, not only can MOGs provide mediated environments with appropriate social, non-verbal and contextual information that current communication technologies are unable to convey, but they can also bring together people who are experiencing similar problems - people who are geographically distant and/or who experience problems that might be rare. A number of support groups of all shapes and sizes have been already developed in MOGs like Second Life and Entropia, which may serve as valuable adjuncts to clients in individual therapy. Considering the type of the client's chronic disease, the therapist might suggest a particular community or specific behavioural assignments within a virtual patient community. The patient's experience with the community can then provide an opportunity for creating self-insight and for developing new interpersonal skills.

Existing therapeutical applications of MOGs

Specific games and virtual communities are now being designed for the purpose of therapy, and a number of support groups of all shapes and sizes have been already developed in MOGs like Second Life and Entropia, which may serve as valuable adjuncts to clients in individual therapy. A British organization called ARCI, for example, has developed a virtual environment in Second Life to help abused children learn important life skills. They enter the virtual world to learn to socialize, work as a team, and learn essential computer skills (Terdiman, 2005). Brain Talk Industries is another organization that is paving the way in this field by creating a variety of on-line communities and forums which provide support and information for specific groups suffering from physical and mental disabilities. John Lester, the president of BrainTalk, has created the private island Brigadoon in Second Life in order to attempt to enhance the lives of people dealing with a form of autism called Asperger's Syndrome. This island is reserved specifically for people diagnosed with this disorder. Because the disorder can make normal social interaction very difficult in real life, these people are often unable to feel a sense of belonging in the real world. However, this virtual world provides an ideal place for them to communicate and interact with other people dealing with the same problems (Lester, 2005). Live2Give is another one of BrainTalk's projects within Second Life. It provides an on-line world for people dealing with cerebral palsy and other physical disabilities. It was created by John Lester and June-Marie Mahay to give these people opportunities in a virtual world that they do not have in the real world. Like Brigadoon, this virtual world brings people together who can relate and help each other in their similar struggles. According to Mahay, this seems to be a quite empowering experience, and has "revolutionized how they feel about themselves and their part to play in the world" (Lester, 2005).

Some important caveat in the use of MOGs in therapy

Although the therapeutic possibilities of online games are quite promising, we must not overlook the problems that could arise with such therapy. If it is true that people can explore threatening aspects of reality in a "safe" environment, it also true that if the use of MOGs becomes excessive it risks preventing people from forming meaningful real world relation-

ships. As observed by Allison (2006) an "Increased substitution of cyberspace-based personas and relationships at the expense of face-to-face interaction may create a developmental double-edged sword. The Internet may provide a socially anxious patient the opportunity for modified peer group interactions, yet it does little to foster the development of genuine intimacy". Therapists should take care to prevent game addiction. Besides and after "safe exposure", the patients should be encouraged to participate in real life social interaction as much as possible.

On-line games provide anonymity to their players, thus offering a less intimidating opportunity for social interaction and psychological reflection. The important factor of anonymity within this kind of therapy would allow more people to discreetly seek help on their own. Although the anonymity that exists within such games provides a sense of freedom that could allow patients to open up, explore, and grow, it can also present some negative aspects. Other people can enter the virtual environment and interact with patients producing negative effects on their experience and introducing uncontrollable and disturbing variables into the environment. To prevent this, a private server could be made into a controlled environment specifically designed and dedicated to therapy.
Privacy and the identity of both the patient and the therapist must be also taken into account. The computer-based interface does not guarantee that the person on the other side of the screen is really who we expect it to be. This aspect can be overcome, for example, with the use of protection codes given by the therapist.

The possibilities of MOGs use for therapy are quite promising as long as its limitations and dangers are taken into consideration as well. These considerations suggest that further research should examine better ways to create a form of therapy in MOGs and consider in depth these and other limitations and dangers linked to the use of MOGs in therapy in order to understand if they really represent a risk for patients.

CONCLUSIONS

In this paper, we have proposed an approach for application of MOGs to the field of e-therapy. Although this emerging medium has an interesting potential for improving existing e-health applications, there are several challenges that need to be addressed. First, more basic psychological research is needed in order to get a clearer understanding of the psychological, communication and interpersonal aspects of avatar-based interaction, and differences between this type of communication and all other communication modes. Further, it is important to define guidelines for the development of MOG-based clinical applications, to reduce to minimum the risk of abuses. Actually, most MOGs have open access, meaning that it may be difficult to create safe therapeutic environments in which patients can interact with a therapist without external interferences and with privacy protection. Also, cost issues should not be overlooked. The vast majority of MOGs are characterized by high subscription costs, which may be too expensive for therapists who work in private practice. Finally, most MOGs provide users with building tools (editors) that are not easy to use for non-experts, as they often require the user to learn script-based programming languages. Despite technical, ethical and economic issues, we suggest that MOGs may represent a valuable opportunity for the future development of e-therapy. Our hope is that the present article will stimulate a discussion within the research community about the potential, the limits and the risks that this emerging medium offers for cybertherapy applications.

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A Free Virtual Reality Platform for Clinical Psychology and Behavioral Neurosciences: The NeuroVR Project

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Abstract: *Virtual reality (VR) can be considered an embodied technology whose potential is wider than the simple reproduction of real worlds. By designing meaningful embodied activities, VR may be used to facilitate cognitive modelling and change. However, the diffusion of this approach is still limited by three main issues: poor usability, lack of technical expertise among clinical professionals, and high costs. To address these challenges, we introduce NeuroVR (http://www.neurovr.org – http://www.neurotiv.org), a cost-free virtual reality platform based on open-source software, that allows non-expert users to adapt the content of a pre-designed virtual environment to meet the specific needs of the clinical or experimental setting. Using the NeuroVR Editor, the user can choose the appropriate psychological stimuli/stressors from a database of objects (both 2D and 3D) and videos, and easily place them into the virtual environment. The edited scene can then be visualized in the NeuroVR Player using either immersive or non-immersive displays. Currently, the NeuroVR library includes different virtual scenes (apartment, office, square, supermarket, park, classroom, etc.), covering two of the most studied clinical applications of VR: specific phobias and eating disorders. The NeuroVR Editor is based on Blender (http://www.blender.org), the open source, cross-platform suite of tools for 3D creation, and is available as a completely free resource. An interesting feature of the NeuroVR Editor is the possibility to add new objects to the database. This feature allows the therapist to enhance the patient's feeling of familiarity and intimacy with the virtual scene, i.e., by using photos or movies of objects/people that are part of the patient's daily life, thereby improving the efficacy of the exposure. The NeuroVR platform runs on standard personal computers with Microsoft Windows; the only requirement for the hardware is related to the graphics card, which must support OpenGL.*

INTRODUCTION

The basis of virtual reality (VR) is that a computer can synthesize a three-dimensional *(3D)* graphical environment from numerical data. Using visual, aural or haptic devices, the human operator can experience the environment as if it were a part of the world. This computer generated world may be either a model of a real-world object, such as a house; or an abstract world that does not exist in a real sense but is understood by humans, such as a chemical molecule or a representation of a set of data; or it might be a completely imaginary science fiction world.

A VR system is the combination of the hardware and software that enables developers to create VR applications. The hardware components receive input from user-controlled devices and convey multi-sensory output to create the illusion of a virtual world. The software component of a VR system manages the hardware that makes up the VR system. This software is not necessarily responsible for actually creating the virtual world. Instead, a separate piece of software (the VR application) creates the virtual world by making use of the VR software system.

Typically, a VR system is composed of (Brooks, 1999; Burdea & Coiffet, 2003) the *output tools* (visual, aural and haptic) that immerse the user in the virtual environment;

-the *input tools* (trackers, gloves or mice) that continually report the position and movements of the users;

-the *graphic rendering system* that generates, at 20-30 frames per second, the virtual environment;

-the *database construction and virtual object modeling software* for building and maintaining detailed and realistic models of the virtual world. In particular, the software handles the geometry, texture, intelligent behavior, and physical modeling of hardness, inertia, or surface plasticity, of any object included in the virtual world.

According to the hardware and software included in a VR system it is possible to distinguish between:

-*Fully Immersive VR*: With this type of solution the user appears to be fully inserted in the computer generated environment. This illusion is produced by providing immersive output devices (head mounted display, force feedback robotic arms, etc.) and a system of head/body tracking to guarantee the exact correspondence and co-ordination of a user's movements with the feedback of the environment.

-*Desktop VR*: Uses subjective immersion. The feeling of immersion can be improved through stereoscopic vision. Interaction with the virtual world can be made via mouse, joystick or typical VR peripherals such as a Dataglove

-*CAVE*. A CAVE is a small room where a computer-generated world is projected on the walls. The projection is made on both front and side walls. This solution is particularly suitable for collective VR experiences because it allows different people to share the same experience at the same time.

-*Telepresence*. Users can influence and operate in a world that is real but in a different location. The users can observe the current situation with remote cameras and achieve actions via robotic and electronic arms.

-*Augmented*. The user's view of the world is supplemented with virtual objects, usually to provide information about the real environment. For instance, in military applications vision performance is enhanced by pictograms that anticipate the presence of other entities out of sight.

VR in medicine and behavioral neurosciences

The use of virtual reality (VR) in medicine and behavioral neurosciences has become widespread (Riva & Wiederhold, 2006). According to a recent market analysis, in 2003 the medical sector contributed $8.7 billion to worldwide visual simulation/virtual reality systems; in the same year, psychotherapy and medical research were rated among the top ten applications of VR. The growing interest in medical applications of VR is also highlighted by the increasing number of scientific articles published each year on this topic; searching Medline with the keyword “virtual reality”, we found that the total number of publications has increased from 45 in 1995 to 246 in 2005, showing an average annual growth rate of nearly 14 percent (see Figure 1).

One of the leading applications of VR in the medical field is psychotherapy, where it is mainly used to carry out exposure treatment for specific phobias (VR exposure therapy – VRE), i.e., fear of heights, fear of flying, and fear of public speaking (Wiederhold & Rizzo, 2005; Wiederhold & Wiederhold, 2003). In VR exposure therapy, the patient is gradually confronted with the virtual simulation of feared stimuli while allowing the anxiety to attenuate. Avoiding a dreaded situation reinforces a phobia, and each successive exposure to it reduces the anxiety through the processes of habituation and extinction. VRE offers a number of advantages over in vivo or imaginal exposure (Wiederhold *et al.*, 2002). First, VRE can be administered in traditional therapeutic settings. This makes VRE more convenient, controlled, and cost-effective than in vivo exposure. Second, it can also isolate fear components more efficiently than in vivo exposure (Choi *et al.*, 2005). For instance, in treating fear of flying, if landing is the most fearful part of the experience, landing can be repeated as often as necessary without having to wait for the airplane to take-off. Finally, the immersive nature of VRE provides a realistic experience that may be more emotionally engaging than imaginal exposure.

In VR exposure therapy, the patient is gradually confronted with the virtual simulation of feared stimuli while allowing the anxiety to attenuate. The main advantage of VR exposure over conventional “in vivo” exposure is that using VR, the therapist can control and grade the feared situations with a high degree of safety for the patient (Wiederhold & Rizzo, 2005).

Riva and his group (Riva *et al.*, 2006a) have recently conducted the largest randomised controlled trial to date with 211 morbidly obese patients. This trial compared Experiential Cognitive

Therapy (CT) - a VR-based treatment for obesity - with nutritional and cognitive-behavioral approaches along with waiting list controls. At the 6 month follow up, experiential CT, in contrast to the other approaches, resulted in improvements in both the level of body image, satisfaction and self-efficacy; and in the maintenance of weight loss. Riva and colleagues' experiential CT has also been used in the treatment of Anorexia, Bulimia and Binge Eating (Riva *et al.*, 2002; Riva *et al.*, 1999; Riva *et al.*, 2003). A similar approach was presented and tested by Perpiña and colleagues (Perpiña *et al.*, 2003) in the treatment of eating disorders.

Further applications of VR in psychotherapy include, posttraumatic stress disorder (Josman *et al.*, 2006; Rothbaum *et al.*, 2001), sexual disorders (Optale, 2003; Optale *et al.*, 1998), and pain management (Hoffman, 2004; Hoffman *et al.*, 2003).

Another medical field in which VR has been fruitfully applied is neuropsychological testing and rehabilitation. Here, the advantage of VR over traditional assessment and intervention is provided by three key features: the capacity to deliver interactive 3D stimuli within an immersive environment in a variety of forms and sensory modalities; the possibility of designing safe testing and training environments, and the provision of "cueing" stimuli or visualization strategies designed to help guide successful performance to support an error-free learning approach (Morganti, 2004; Riva *et al.*, 2006b; Schultheis & Rizzo, 2001).

Beyond clinical applications, VR has been revealed to be a powerful tool for behavioral neuroscience research. Using VR, researchers can carry out experiments in an ecologically valid situation, while still maintaining control over all potential intervening variables. Moreover, VR allows the measurement and monitoring of a wide variety of responses made by the subject (Tarr & Warren, 2002).

Although it is undisputable that VR has come of age for clinical and research applications, the majority of them are still in the laboratory or investigation stage (Wiederhold & Wiederhold, 2004). In a recent review, Riva identified four major issues that limit the use of VR in psychotherapy and behavioral neuroscience (Riva, 2005):

- the lack of standardization in VR hardware and software, and the limited possibility of tailoring the virtual environments (VEs) to the specific requirements of the clinical or the experimental setting;
- the low availability of standardized protocols that can be shared by the community of researchers;
- the high costs (up to $200,000 US) required for designing and testing a clinical VR application;

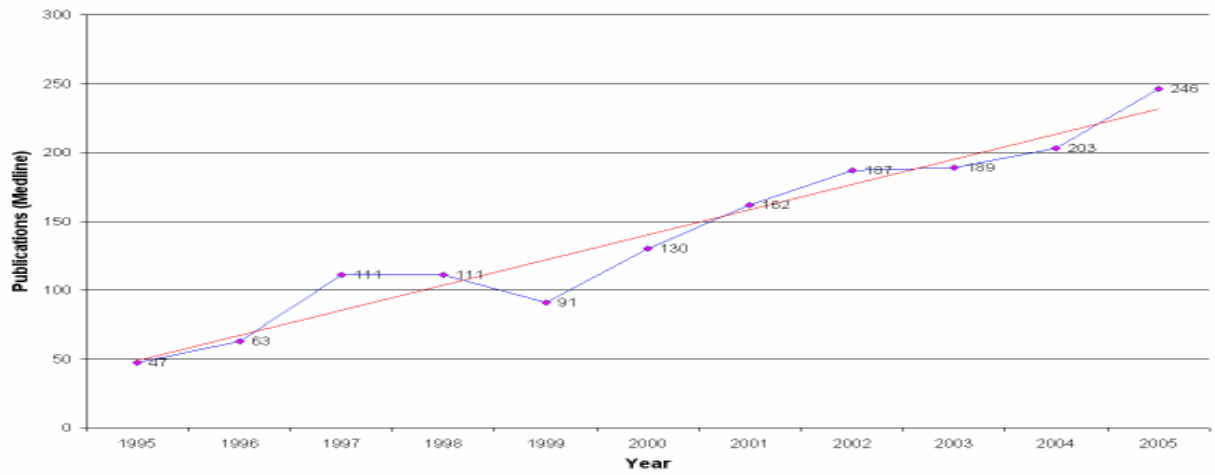

Figure 1. Trend in publications on VR in medicine (Source: Medline; keyword: "virtual reality"; accessed: June 30, 2006)

- most VEs in use today are not user-friendly; expensive technical support or continual maintenance are often required.

To address these challenges, we have designed and developed NeuroVR (http://www.neurovr.org), a cost-free virtual reality platform, based on open-source software, that allows non-expert users to easily modify a virtual environment (VE) and to visualize it using either an immersive or non-immersive system.

The NeuroVR platform is implemented using open-source components that provide advanced features; this includes an interactive rendering system based on OpenGL which allows for high quality images. The NeuroVR Editor is realized by customizing the User Interface of Blender, an integrated suite of 3D creation tools available on all major operating systems, under the GNU General Public License; this implies that the program can be distributed with the complete source code. Thanks to these features, clinicians and researchers have the freedom to run, copy, distribute, study, change and improve the NeuroVR Editor software so that the whole VR community benefits.

The NeuroVR Editor

The majority of existing VEs for psychotherapy are proprietary and closed source, meaning they cannot be tailored from the ground up to fit the specific needs of different clinical applications (Riva, 2005). NeuroVR addresses these issues by providing the clinical professional with a cost-free VE editor that allows non-expert users to easily modify a virtual scene to best suit the needs of the clinical setting.

Using the NeuroVR Editor (see Figure 2), the psychological stimuli/stressors appropriate for any given scenario can be chosen from a rich database of 2D and 3D objects, and easily placed into the pre-designed virtual scenario by using an icon-based interface (no programming skills are required). In addition to static objects, the NeuroVR Editor allows an overlay on the 3D scene video composited with a transparent alpha channel.

The editing of the scene is performed in real time, and effects of changes can be checked from different views (frontal, lateral and top).

The NeuroVR Editor is built using Python scripts that create a custom graphical user interface (GUI) for Blender. The Python-based GUI allows the clinician to hide all the richness and complexity of the Blender suite, exposing only the controls needed to customize existing scenes and to create the proper files to be viewed in the player.

Currently, the NeuroVR library includes different pre-designed virtual scenes, representing typical real-life situations, i.e., the supermarket, an apartment, the park.

These VEs have been designed, developed and assessed in the past ten years by a multidisciplinary research team in several clinical trials, which have involved over 400 patients (Riva *et al.*, 2004). On the basis of this experience, only the most effective VEs have been selected for inclusion in the NeuroVR library.

An interesting feature of the NeuroVR Editor is the ability to add new objects to the database. This feature allows the therapist to enhance the patient's feeling of familiarity and intimacy with the virtual scene, e.g., by using photos of objects/people that are part of the patient's daily life, thereby improving the efficacy of the exposure (Riva et al., 2004). Future releases of the NeuroVR Editor software may also include interactive 3D animations controlled at runtime. A VRML/X3D exporter and a player for PocketPC PDAs are planned Blender features, too.

The NeuroVR Player

The second main component of NeuroVR is the Player, which allows navigation and interaction with the VEs created using the NeuroVR Editor.

NeuroVR Player leverages two major open-source projects in the VR field: Delta3D (http://www.delta3d.org) and OpenSceneGraph (http://www.openscenegraph.org). Both are building components that the NeuroVR player integrates with ad-hoc code to handle the simulations.

The whole player is developed in C++ language, targeted for the Microsoft Windows platform but fully portable to other systems if needed. When running a simulation, the system offers a set of standard features that contribute to increasing the realism of the simulated

scene. These include collision detection to control movements in the environment, realistic walk-style motion, advanced lighting techniques for enhanced image quality, and streaming of video textures using the alpha channel for transparency.

The player can be configured for two basic visualization modalities: immersive and non-immersive. The immersive modality allows the scene to be visualized using a head-mounted display, either in stereoscopic or in mono-mode; compatibility with head-tracking sensor is also provided. In the non-immersive modality, the virtual environment can be displayed using a desktop monitor or a wall projector. The user can interact with the virtual environment using either keyboard commands, a mouse or a joypad, depending on the hardware configuration chosen.

Figure 2. A screenshot taken from the NeuroVR Editor

CONCLUSIONS

In this paper, we have introduced NeuroVR, an advanced platform designed for the creation and customization of highly flexible VEs for clinical psychology and behavioral neurosciences. Currently, the NeuroVR library includes a limited number of VEs addressing specific phobias (i.e. fear of public speaking, agoraphobia) and eating disorders. However, these pre-designed environments can be easily adapted for targeting other clinical applications. Moreover, it is envisioned that the 250,000 person worldwide Blender user community will contribute to extend the NeuroVR library, developing new VEs which can be tailored by the clinical professionals for a range of clinical and experimental needs.

A future goal is also to provide software compatibility with instruments that allow collection and analysis of behavioral data, such as eye-tracking devices and sensors for psychophysiological monitoring. Beyond clinical applications, NeuroVR provides the VR research community with a cost-free, open source “VR lab”, which allows the creation of highly-controlled experimental simulations for a variety of behavioral, clinical and neuroscience applications.

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Evaluation Studies

The Sims in Therapy: An Examination of Feasibility and Potential of the Use of Game-Based Learning in Clinical Practice

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Abstract: *Easily adaptable commercial computer game simulations may be of use to art and play therapists, providing a customizable venue for creating meaning and facilitating communication, and at the same time offering many of the established strengths of game based-learning (empowerment, motivation, insight, and engagement (Prensky, 2001)) to achieve healing and resolution. More specifically, Electronic Arts' game The Sims2, with its tools that allow users to create a character's appearance and personality attributes, and a game engine that runs character interactions based on these user-directed qualities, may be ideally suited for use in art and play therapy.*

This pilot study examines the possibility of using The Sims 2 and computer-based simulation games with similar tools in a therapeutic setting. While use of The Sims 2 at this point is for the most part casual and often user-directed for addressing and possibly mediating emotional issues, its more formalized use and adaptation by professionals is most likely imminent. However, before The Sims2 can be used by clinicians, it is necessary to assess some of the technological and conceptual issues that may impact its use as a treatment modality. This manuscript documents a pilot study involving interviews with and observation of art, play, and occupational therapists learning about and exploring The Sims2 for possible clinical use in the treatment of certain psychological disorders.

While all of those who participated in the study were interested in the possible use of digital simulation games like The Sims2 in their professional practice and recognized its probable implementation in the near future, many identified factors that would be necessary for its successful use. In particular, transference was the paramount concern of all of the therapists interviewed. The therapists maintain that while a computer-based game may have tools and functionalities that would support and facilitate a client in connecting with deeper issues, perceptions, and concerns, its application for therapeutic purposes would still require careful mediation with a professional.

INTRODUCTION

Art and play therapies in particular involve facilitating clients to create artwork or work with figures to draw out and give their emotions form and expression. Easily adaptable commercial computer simulations and games (Prensky, 2003) may provide an additional technique for occupational, art, or play therapies. As a learning tool, games provide a safe, nonjudgmental, stimulating, and self-directed venue for exploring and engaging in choices and consequences. Previous studies using computer games in learning settings indicate that while student test scores may not improve significantly, students actually learn to a deeper understanding, and are able to describe why an answer to a test question is correct or incorrect (Squire, 2002). In addition, several studies have shown that use of games in learning provides the player with empowerment, motivation, insight, and engagement (Prensky, 2001). This suggests that digital game-based learning may be of use to healthcare professionals in working

with their clients, especially in treatment of behavioral or attitudinal issues. Electronic Arts' *The Sims2* is one of many games that might be perfectly suited to address this.

The Sims2 is often described as less of a game and more of a simulation or a toy, in that it is not designed around a concrete goal. *The Sims2* game engine allows the user to create families and customize characters by assigning them specific, basic personality attributes such as "shy" or "tidy" to shape their agenda of needs. In effect, a user can participate in the creative process by customizing the game's settings and characters.

For therapists using art or play therapy to support their clients in giving form to deeper feelings, *The Sims2*, with its ready-made, consistent interface, may be a possible modality. A therapist or psychologist could use a game like *The Sims2* to encourage a client to explore how they respond to a situation recreated in an environment that is safely removed from the reality that is contributing to their issues.

Figure 1
A user-created family in *The Sims2*

The strengths of the use of *The Sims2,* which anyone can purchase, include its portability, consistent interface and communication tools, and the simple-to-use feature that allows the user to personalize the game for individual use. It is also worth recognizing that emerging and current K16 learners in the United States and western Europe have most likely developed considerable schema shaped by interacting with computer-based technology; as a result, computer games have gone beyond satiating the game playing public as a source of entertainment and evolved into a meaningful, socially expressive medium (Green, 2004).

However, before clinicians can use *The Sims2* in their professional practice, it is necessary to assess the technological and conceptual issues as they may relate to implementation.

LITERATURE REVIEW

The level of the user's interactivity and consequent sense of empowerment and control over their learning experience will affect the extent to which surface or deep learning will occur (Jonassen, 1988). This seems particularly applicable to a computer-based simulation such as *The Sims2*. Within *The Sims2,* a user can recreate an environment and its elements to relive a specific event by exploring and examining the consequences of their choices, for instance. As a *Sims2* player***,*** the user has a god-like role, able to create characters and to an extent, shape the quality and direction of their lives. In fact, *The Sims2* has been described as a computerized version of doll therapy (Suler, 2003), a therapeutic modality in which clients re-enact interpersonal interactions, using dolls to represent those involved in a specific, often life-defining event.

The Sims2 provides the user with a private laboratory in which to experiment with forbidden behaviors and decisions, a vehicle for high-tech self-gnosis within the context of a computer game (Thompson, 2003). Playing the game can be therapeutic, as it provides a setting in which an individual can vent emotions that may not otherwise be appropriate. Players have been known to torture their *Sims2* characters by starving or drowning them (Suler, 2003), or to program a character modeled after a previous boyfriend or girlfriend to recreate a relationship and examine why the relationship failed (Jenkins, 2003). In fact, some psychologists' patients discuss their *Sims2* games during their therapy sessions (Thompson, 2003). For this type of gameplay, users seem to gravitate towards using the family album in *The Sims2* to document and provide testament to their recreated experiences within the game environ-

ment. Once created, a user can upload their family album, which includes snapshots of gameplay and narrative created by the user, to *The Sims2 Exchange*. *The Sims2 Exchange* is a web space set up by Electronic Arts, developers of *Sims2,* in which users can upload the family albums they create to document their gameplay or to create specific stories. These family albums document a range of topics portraying our human condition, including:

- A woman's drug addiction and recovery
- An African-American girl's adoption by a white family
- Failed relationships
- Abusive relationships

In fact, a recent search on *The Sims2 Exchange* site for stories about "abuse" produced 95 results with the word “abuse” in the story taglines. Existing research has not probed into how to maximize the potential of *The Sims2* as a therapeutic device, although the game-playing population seems to be setting the stage for just that. Research into the extent to which healthcare professionals recognize *The Sims2's* potential for therapeutic purposes would lay the groundwork for the manner in which healthcare professionals choose to incorporate it into their professional practice. The purpose of this pilot study is to examine about the perceptions, options, and attitudes practicing therapists hold about the use of *Sims2* for therapeutic purposes.

Figure 2
A young girl’s story about her newborn and tumultuous family life, as created in *Sims2* and uploaded to the *Sims2 Community* site.

METHODS

To explore the practicality of using a computer-based commercial product like *The Sims2* for therapeutic purposes and to open discussion on what may be its imminent adaptation, researchers designed a qualitative study. This study involved interviews with seven therapists from practice arenas ranging from art therapy, to grief therapy, behavioral psychology, family counseling, and occupational therapy. This study also involved observation of the therapists exploring and using *Sims2.* The therapists ranged in age from 30-60, and had little or no experience with *Sims2.* All were computer literate.

In one-on-one sessions with each therapist, researchers demonstrated *Sims2* and asked them to discuss and respond to potential therapeutic uses. The therapists were then given up to 90 minutes to explore *Sims2* on their own and provide further determinations on the game's potential uses.

FINDINGS

Initial Reactions

While those therapists involved in the pilot study recounted anecdotally how clients are using computer-based games or toys like *The Sims2* to recreate and explore parallel lives, none were using it specifically within their professional practice. However, many recognized, albeit often warily and with reservation, *The Sims2's* potential for use in their work.

Man vs the Machine

Despite the relevance of some of her gameplay to real life outcomes, one therapist explained that she didn't "feel at all engaged in the game." She also did not like the idea of having people go into a computer game to sort out their interpersonal issues, since working with a computer would keep them from confronting those very issues. She explained, "One of the things [about] therapy is that it forces you into interacting with another human being. This is interacting with a machine." She added, "Before we had electricity, we *had* to interact with each other. This game takes away from person-to-person interaction, which is why people are in therapy in the first place."

She added, "There is a need for human beings to share, to express themselves and not keep things inside. In this case, with a game, it feels like people can keep some kind of distance from their real life, of course. [There is] protection and projection into the game. My thoughts are that [the user is] not dealing with many issues."

Despite this counter-intuitive disconnection, most practitioners agreed that *The Sims2* or a related tool could prove to be an effective venue for communication and for eliciting dialogue. This would be especially applicable for particular types of people – those who immerse themselves in their computer, for instance, and who then might be more willing to engage in therapy if it involves using a computer.

POSSIBLE APPLICATIONS

Yet given its immediately apparent limitations, the therapists also quickly recognized possible applications of using simulation games like *The Sims2* in their practice. They indicated that a computer-based dollhouse like the one *The Sims2* might be more pertinent to the articulation and communication needs of an emerging generation that has grown up communicating with and learning with a computer.

Examples in which art and play therapists envisioned possibly using *The Sims2* in professional practice include asking the client to:

- Create a "safe place" or "create a safe home"
- Create the "ideal family"
- Create home before and after the death of a family member
- Project the future of their home life in ten years or one year.

A family therapist recognized similar possibilities of *The Sims2* for families negotiating a divorce or mediating grief. She suggested that one could ask clients to use the game to recreate a family situation before and after the change, and then examine and discuss the differences between the two settings, and the client's feelings about the process.

One therapist added, "Of course, the therapist needs to give direction and to provide scaffolding and consistency [in how people work through the process." The same therapist added

that this kind of application would require "processing time to go back to the game to [compare] the created story with the same situation in the client's own life, to move them towards seeing things as they actually are, not as they'd with they'd be." The therapist recognized other opportunities for other uses with *Sims2*, including directing a client to create a family they aren't happy with. The client would then work with the therapist to identify projection issues and then process through what the client is not happy with it their own family lives. The therapist explained that for this type of application, "The direction might be: if you could create a family of your dreams, what would this be?" *The Sims2* would then be a medium the client could use to express their feelings. However, the therapist strongly cautions against people using *Sims2* to try and sort out issues on their own. She explains that during art therapy sessions, as a client, "You don't have control of the emotional world when you are dealing with the input of the image of abuse. You'll just be painting playfully and then things start coming out and you don't know what to do with the image that's coming out. The real traumatization comes out when there is no one there to help [you] out."

Other therapists responded similarly to the need for the ongoing presence of a professional during a client's interaction with *Sims2*, recognizing its use as a means of facilitating difficult conversations.

EXPLORING CONSEQUENCES

The Sims2 also provides a vehicle for exploring consequences. In the game, if the physical and emotional needs are not met for members within a household, characters can die, and the player can be left with but a shell of the household's previous existence. An occupational therapist who explored *The Sims2* felt that *The Sims2* was an excellent venue in which autistic clients "could learn how important social relationships really are, learn about social interactions. " Such clients could then "process through the mistakes they made with their social interactions." The therapist liked that *The Sims2* is set up to "make the user aware of personal needs, or that others have needs as well." He felt that *Sims2* would be a useful as "a cognitive therapy tool, as a way for building awareness about needs." He also pointed out that people with autism "love computer games and understand them" because they are based on logical, clear-cut cause and effect relationships. "People with autism," he added, "connect with a formal explanation."

Facilitation of Transference

One key issue that emerged from talking with one art therapist was the impact of games on behavior. Many educators argue that games are effective learning tools, while commercial game developers maintain that violent games in particular do not encourage violent behaviors in the users. In fact, transference appears to be the paramount concern of all of the therapists interviewed. While the game may have tools and functionalities that would support and facilitate a client in connecting with deeper issues, perceptions, and concerns, therapists maintain that this new realization requires careful mediation from a professional. A therapist pointed out that it is the job of therapists to help people see what lies in what they have created and [how it relates to] their own emotional landscape. Some people are more fragile, and need help to move on. To use *The Sims2* therapeutically, the art and play therapists in particular urge that implementation would have to be "very structured, about seeing things, analyzing them, taking responsibility, and moving on." The art therapists explain that during the art therapy process, the client goes into the "fantasy" part of their brain to connect with feelings and issues deeply buried in the affective consciousness. As these feelings take form and as the client begins to articulate them through artistic expression, it is the job of the attending therapist to mediate the client through these feelings towards a place of resolution.

One therapist explained, for those using *Sims2* to explore their emotional landscape on their own, "once [their feelings] start coming out there is a lot of impact on [the user]. They could get depressed, and not having someone to recognize what's going on, I don't know what they would do." Another pointed out that using *The Sims2* tools to depict facets of one's emotional schema "might simplify a complex situation and make it worse too. We also don't know what the real missing pieces are. It's hard to help a kid make the connections they need to because of

that, working without the information you need." Mediation would help connect the missing dots.

Implementation Requirements

While all of those interviewed were interested in the possible use of digital simulation games like *The Sims2* in their professional practice and recognized is probable implementation in the near future, many identified factors that would be necessary for its successful use. These included:

- Practitioner and use fluency with the game -these would require upfront time
- Practitioner skills in eliciting the message from the story
- Working effectively within a set timeframe, like that of a therapy session
- The need for "upfront training for the cognitively impaired so that they could play, although [*The Sims2* interface] does force cues from time to time."
- A process for determining how to fit use of *The Sims2* or a related application into their curricula into a specific meeting or session period and over a series of class meetings or sessions
- *The Sims2* templates or pre-set characters and settings "pre-programmed for portable implementation"
- An infrastructure that supports fostering community between other practitioners using the game for identifying features and applications for professional practice.

Finally, the success of implementation comes back to transference. As with the other therapists, this therapist explained, "Transference is important here, how it's done," emphasizing that "someone *has* to be with the user/client during gameplay sessions to facilitate frustration and ensure that the intended learning takes place. "

Points for Future Consideration

At this point, the use of a game or computer simulation in a therapeutic setting is perhaps best described as emergent. Several institutions have used virtual reality to help people deal with phobias and traumas by having people relive, relearn, and reprocess with the facilitation of a healthcare professional. However, in these instances, the interactivity does not involve the client creating all or parts of the virtual world.

Limitations of this Study

This pilot study examines the possibility of using *The Sims2* and computer-based simulation games with similar tools in a therapeutic setting. While its use at this point is for the most part casual and often user-directed, its more formalized use and adaptation by professionals is most likely imminent. To prepare for this, a more careful study is needed to examine how to use *The Sims2* within the context of specific methods used in art and play therapies. Furthermore, those involved in this particular pilot study represent a range of therapeutic practices. A study that focuses on a specific professional practice would clarify which game features may be of use and how best to contextualize them in order to support healing. Finally, this pilot study assumes that people who pursue therapy are interested in using *The Sims2* in their processes; an examination into the interest and feasibility from the client's perspective may indicate that a computer-mediated tool is not as imminent as has been assumed in this study.

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Virtual Reality Protocol: An Instrument to Assess Alcohol-Dependent Individuals

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Abstract: *The use of virtual reality (VR) in the form of a simulated real context can provide a realistic environment in which to study complex naturalistic behaviour (Calhoun, Carvalho, Astur, Pearlson, 2005). Virtual Reality's usually used in clinical psychology to assess and care for anxiety, panic disorder and agoraphobia, binge eating and eating disorders, autism and in sexual deviance or to cue reactivity in controlled simulated tasks with nicotine-dependent patients or in drunk drivers (Bordnik, Graap, Copp, Brooks, Ferrer, Logue, 2005; Freeman, Liossis, Schonfeld, Sheelhan, Siskind, Watson, 2005). On the other hand, it has been explored less in alcohol-dependent subjects. The aims of this article are to: describe a protocol in which interpersonal and intrapersonal factors of alcoholics are assessed using virtual reality; and verify the application of the VR protocol on a patient who asks for an assessment at the National Service Care for Alcohol Abuse. The VR protocol provides all the information that a service care worker receives from an interview, but the time for collecting the information is shorter; the patient is more satisfied than in a traditional evaluation process, and at the end of the VR session the patient expressed a higher motivation for change and willingness to engage in behavior that limits her drinking habits.*

INTRODUCTION

The use of Virtual Reality (VR) in clinical psychology can provide a good assessment instrument and basis of therapeutic programs for psychological deficits and psychopathology. Previous studies have suggested that VR can be effective in clinical assessment and treatment (Hodges, Boltr, Mynatt, Ribarsky & Van Teylingen, 1993; Hodges *at al.*, 1995; North, North & Coble, 1997) because VR can simulate the real world. In fact, one of the main advantages of a virtual environment for a clinical psychologist is that it can be used in a medical facility, thus avoiding the need to venture into public situations. Clinical psychology and rehabilitation specialists use VR to provide a new human-computer interaction paradigm in which users are not only simply eternal observers of images on a computer display, but are active participants within a computer-generated three dimensional virtual world (Riva, *et al.*, 2003). Within VR, the participants are able to assess their problems and can learn to manage problematic situations related to their disturbance. The key characteristics of VR are both the high level of control of the interaction with the tool without the constraints usually found in computer systems and the enriched experience provided for the patient. Virtual environments are highly flexible and programmable. They enable the therapist to present a wide variety of controlled stimuli and to measure and monitor a wide variety of patient responses (Riva, *et al.*, 1999). In fact, VR can be considered a special, sheltered setting where the patient can start to explore and act without feeling threatened by social pressure. In a VR environment patients can control their behavior and choices and monitor their emotions, so they can learn new ways to behave and new forms of emotional control (Molinari & Riva, 2004). The capacity to control emotions and actions is the first step to improving the sense of self-efficacy that precedes the change (Bandura, 2001). In fact, controlled studies show that VR produces significant changes in physiological, emotional, cognitive and behavioral aspects in the patients (Riva, 2005).

Today, VR is used in anxiety, panic disorder and agoraphobia treatments, in binge eating and eating disorder assessment and therapy, in autism educational programs and in treatment for sexual deviance (Riva, 2005). In binge eating, obesity and anorexia, VR is used successfully because virtual environments are efficient in moving the patient's attention from addictive

behavior to VR use (Li, 2005). Several studies show the importance of VR: the patients increase their body awareness during an assessment session and they learn useful strategies in order to change their dysfunctional behaviors during treatment (Bacchetta, Baruffi & Molinari, 2001; Perpina, Botella & Banos, 2003, Fernandez-Aranda, 2003).

In the context of other addictions, Virtual Reality has been used to assess cue reactivity in controlled simulated tasks with drug-dependent patients or in drunk drivers (Bordnik, *et al.*, 2004; 2005; Calhoun, Carvlho, Astur & Pearlson, 2005), but it is less explored in alcohol-dependent subjects where the assessment and therapy involve the use of a traditional case history. The semi-structured interview is the main approach used to explore the circumstances that have led to the first appointment being made and exploring the alcoholic's history. Sometimes, this procedure is considered threatening for the patients because they may enter with the expectation that if they admit the reality of their behaviour they are putting themselves at risk. Patients may believe they are exposing themselves to the reaction of a person they do not know, and they may be afraid of being demeaned by stranger (Edwards, Marshall & Cook, 2006). There are therefore potentially good, apparent reasons for which a patient adopts a defensive posture of protection against these risks. If history taking is clumsily handled and the initial relationship not sympathetically established, the interview will be interpreted as attack and defences are rapidly brought into play. The history obtained will then be filtered trough these defences and be inaccurate. The stereotype of the drinker as someone who "never tells the truth" will have been confirmed, so it can be another risk in evaluating the patient (Edwards, Marshall & Cook, 2006). The disadvantages that stem from neglect of the dynamic interactions of the initial interview are not only that the information obtained will be wrong and the assessment technically unsatisfactory, but also that damage will be done to what should have been the initiation of the treatment. The risks described above could be very dangerous for the assessment of the individual and for the therapy program, so we want to explore the use of virtual reality and its empowerment in case-history setting.

Moreover the first screening has to assess the family history of the patient, previous illness, drinking history, typical recent heavy drinking day, influence of drinking on personality, quantity of consumption and the salience of drinking in a patient's life and subjective awareness of compulsion to drink. This information is very important in describing the patient's personality, and his or her habits and lifestyle, but the therapist doesn't have a lot of time to spend on the case history, so VR could be used to make the assessment process easier.

The aims of this article are: to describe a protocol in which the personality and social behaviour of alcoholics are assessed using virtual reality; and determine if there is a change in self efficacy and motivation improvement before and after protocol session. Specifically, the VR protocol could be used as an instrument to evaluate case history and symptoms and to improve the patient's motivation towards accepting treatment and therefore changing behavior. Thus, virtual reality protocol investigates Intrapersonal factors (Emotional Management and Self Esteem) and Environmental factors (Relational Competences and Social Pressure). During the protocol, the therapist analyzes both verbal and non-verbal behaviour focusing on emotional responses, interactions with the virtual environment and the content of individual answers. In particular, it is expected that VR may improve motivation, self efficacy and awareness in the patient and so enhance the therapy.

PROTOCOL

The protocol is based on four different virtual environments: the park; the apartment, the workplace and the restaurant. It was developed within the NeuroVR Project, a cost-free virtual reality platform based on open-source software. It offers the clinical professional a cost-free VR Editor, which allows non-experts to easily modify a virtual world, best suiting the needs of the clinical setting.

The therapist observes the user's non-verbal behaviour when he/she explores the apartment in which there are many emotional stimuli (wine, alcohol, beers etc…). In particular, the therapist observes: muscular contractions, facial expressions, leg or arm movements and patient's discussions. The therapist uses different questions

to help patients synthesize information and reach conclusions on their own. Usually the therapist poses hypothetical and neutral questions (for example: *What do you feel when you see these bottles? What kind of emotions do you feel? Would you like to take one of these bottles? Which one?).*

The structure of interaction is that the user stands still wearing the head mounted display. He or she handles a joy pad to move up and down within the virtual environment. In the first environment – the park - the interaction has three main goals: teaching the user how to move in the virtual environments; relaxing the user, and making a preliminary evaluation of both emotional and relational dimensions without direct links to alcohol use.

Figure 1. The Park

After the park session, the therapist may customize the two following environments according to the needs of the alcohol-dependent subject. There are two choices: the empty apartment and the alcoholic apartment. In both environments it's possible to add drinks, bottles of vine, food, features and individuals (family, friends, the boss etc…).

In the empty apartment there are no people and only the essential features. In this environment the main goals of the assessment are to explore the patient's habits, living conditions of the patient and family links. The therapist invites the user to look at the house by just rotating his or her head and body and asking the patient to imagine that this apartment is his or hers. The therapist asks if the patient likes the house, is happy, if the house lacks anything, and if he or she wants to change something. At the end of the questions, the patient closes their eyes and the therapist changes the environment.

In the alcoholic apartment there are some bottles of wine, beer, food and cigarettes in the kitchen, sitting room and in the roof garden. The therapist explores the nature and strength of the family and social links; evaluates the emotional arousal when the subject interact with significant others, such as their partner or children, or significant objects such as bottles of wine and drinks; and verifies the patient's typical in-home alcohol consumption patterns. The therapist introduces this context by saying: *"Once in this house lived an alcoholic man/woman who drank a lot. Now, you can look around the apartment."*

Figure 2. Alcoholic Apartment

At the and of brief tale, the therapist asks some general questions and focuses the patient's attention on drink bottles and asks some questions like: *"How do you feel when you see these bottles?"* or "*Would you like to take one of these bottles? Which ones?"* or *"Would you like somebody to drink which? Who?"* or *"How long have you been drinking for?"* or *"How many bottles do you drink a day?"* If the user says that he/she usually drinks at home, the therapist can investigate the emotional management proposing a bad situation and a pleasant situation.

When the patient is in the house the therapist proposes a new situation, a job interview. Here the therapist wants to explore the sense of self-efficacy, the capacity to face an anxious task, the locus of control and the decision-making processes of the patient. The environment is an office in which the patient has an interview. The main goals are to investigate emotional management in a performance task, explore the

sense of self-efficacy, examine behavior before and after the job interview, and understand if alcohol has a role for the patient in performance situations. The patient is asked a series of questions like "*How do you feel when you come back home after work?*" or *"Do you usually speak with your colleagues?"* At the end, the therapist introduces the patient to an office in which there are some people and asks about current job satisfaction and job expectations. If the patient is a student, the protocol provides a "student version" in which the student has to take an exam at the university. If the patient is a housewife, the protocol provides a "housewife version" in which the therapist explores the sense of efficacy, the level of satisfaction, the family links, and the housewife's hobbies outside the home.

The last environment is the restaurant in which there are two rooms: a bar and a dining room. The patient enters in the bar and can drink an aperitif, then goes to eat in the dining room. Here, the therapist observes the behaviours of participants in a social context. The assessment has three main goals; to explore the subject's behaviour when somebody invites him or her to drink; explore the influence of social pressure on drinking behaviour; and evaluate emotional arousal when the subject interacts with significant others not related to the family, such as his or her boss.

Figure 3. The Restaurant

At the end of the session, the subject can take off the head mounted display and the therapist proposes a brief debriefing to comment on the experience. In particular, the therapist summarizes the principal aspects of the interview, specifically emotional management, level of arousal when the subject sees and interacts with alcohol, the family relationship and the management of drinking behavior.

CASE STUDY

This is the case of Maria, a housewife who lives in a northern Italian city. It shows with particular clarity the ability of the proposed approach in dealing with some features of alcoholism disturbance: alcohol abuse on a daily basis without motivation to change her situation. The following describes the history, the measures, and the assessment with the VR approach.

Case history

Maria is 55 years old and she is a Swedish immigrant. She has lived in Italy for twenty years and she speaks Italian very well. She asked for an appointment at National Service Care for alcohol abuse and she has been admitted for an assessment program. She has been drinking alcohol for five years but in the last period the situation has gotten worse. She drinks white wine, one to two liters a day. Maria shows a lot of features consistent with a possible alcohol abuse diagnosis: use of substances for a long period, constant desire to consume alcohol and reduction of social activity and relationships due to alcohol consumption (DSM IV, 1994). For a primary investigation of these symptoms, the patient was asked to give her medical history and to complete two questionnaires.

METHOD

Measures

In addition to the protocol described above patients are asked to complete the following questionnaires

- The Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1976; Dazzi, Pedrabissi, & Santinello, 2004) assesses the personality structure. The Italian version of the scale contains 69 dichotomised items; an example of which is "*I'm a happy person*". According to Eysenck, it's possible to devise three personality structures: extraversion, neuroticism and liar.
- Motivation Assessment of Change (MAC 2-A; Spiller & Zavan, 2005) measures the motivation of change. We use the alcohol-

ism version. It contains 36 items and the participants were required to indicate how true each statement was for them on a 6-point Likert scale that ranged from false to true. It allowed to measurement of the changing steadies according to Transtheoretical Model (Prockasca, Di-Clemente & Norcross, 1992).

- Generalized self-efficacy questionnaire (Schwarzer & Jerusalem, 1995) assesses the sense of self-efficacy in the individual. The test contains ten 5-point Likert scale items ranging from 0 (not true) to 4 (really true). High scores indicate higher levels of self-efficacy.
- ITC SOPI (Lessiter, Freeeman, Keogh & Davidoff, 2001) is divided in two parts, A and B. Part A investigates the level of satisfaction after the VR session; part B investigates feelings, emotions and sensations during the VR session.

Procedure

The patient usually has three appointments with the National Service Care, and in the second appointment the VR protocol is employed. Maria's first appointment was taken by a National Service Care worker who collected her medical history and completed her clinical record. At the end of the interview, the patient completed MAC 2-A (Spiller & Zavan, 2005) and Generalized Self-Efficacy Scale (Schwarzer & Jerusalem, 1995). In the second appointment the researcher presented the VR session and applied the protocol. Then, there was a debriefing and the administration of ITC SOPI (Lessiter, Freeeman, Keogh & Davidoff, 2001). In the last appointment, the researcher and the national service care worker gave a briefing of the assessment's procedure and underlined the principal aspects of patient's problems and disturbances. They proposed the treatment and the patient was sent to a specialist. At the end of the appointment the patient completed MAC 2-A (Spiller, Zavan, 2005), Generalized Self Efficacy Scale (Schwarzer & Jerusalem, 1995) and EPI (Eysenck, Eysenck, 1976; Dazzi, Pedrabissi & Santinello, 2004).

Maria's protocol

When Maria entered the first environment, the park, she learned to move with the joy pad and head mounted display and decided to sit down on a bench. She said she likes this park because it is quiet, and there is sun and open air. She would like to meet a man to start a conversation and have a newspaper. She doesn't want to see her husband. She relaxes and then closes her eyes, then the researcher changes environment. She enters an apartment and says she doesn't like the house because it is too perfect and not very welcoming. She would like to change the furniture, the pictures and add some plants and flowers. The therapist begins to ask questions and the patient freely describes her history. She only drinks white wine. She bought the bottles at the supermarket and she drank all the bottles in a day. She doesn't keep wine in the house. She usually drinks in the morning because when she gets up she hasn't got the strength to do housework. The day is too long and empty. During the day she drinks wine, when she is at home, alone. She doesn't like drinking with other people. On the other hand, in her house she feels sure of herself and she has built a little world with few objects, no relations and the bottles of wine.

She started drinking five years ago when she divorced her husband. He was very aggressive and beat her and their son. The divorce was both a good choice but also a difficult choice. She didn't have a job and so she didn't have any money for her and her son. Now her son is grown up so he is independent and she feels useless. The alcohol is a way to stop her from feeling alone and facing difficult situations. When the therapist presented a pleasant situation and then a bad situation, the patient gave the same answer; she drinks a lot of wine alone and she goes to bed because she is tired. She doesn't express any emotion. The patient is a housewife so the protocol analyzes the sense of self-efficacy and the quality of her life. The patient says that she wants a clean house but she only does the principal activities because she is always tired psychologically. She is worried for her son because she wants everything right for him. If she can't do everything for him she feels guilty.

In the past she tried to find work but she was nearly always unsuccessful; today she does the occasional job for cash in hand. She spends nearly all her spare time at home so she can drink quietly and in private. Her only hobby is gardening and so when she gardens she drinks less than usual.

In the last environment (the restaurant) the patient says that she doesn't like the restaurant because there are too many people, but if she has to go to the restaurant she will drink just like the others. If her friends invite her to go out for a drink she drinks so as not stand out because she's afraid of being different. Also in this situation she drinks white wine but at the table prefers water. After drinking she feels tired and therefore goes to sleep without feeling guilty.

At the end of the VR session the therapist conducted debriefing which underlines: the difficulty in finding a balance between the past and the present. In the last years Maria has had to face a multitude of change: her son's growing up and his independence, loneliness due to being without a partner, starting menopause, and economic problems. Alcohol has therefore become a way to relieve her suffering and to help her carry out her daily routine.

Outcome

Personality test shows a normal personality structure with neurotic traits; in fact the total score of neuroticism scale is 16; one point over the norm (Eysenck & Eysenck, 1976; Dazzi, Pedrabissi, & Santinello, 2004). Other scales are inside the normal range of values. The MAC 2-A is interesting, because there is a difference between the past and the present. Before the VR session, Maria focused her life on drinking and she was sure that she would never have stopped drinking because she hadn't got the strength and the courage and she didn't know any solution for her problem. A week after the VR session, the answers on MAC 2 were very different. Maria was still worried about drinking, but now she understood that there is a way to change her situation through the help of Alcoholism Service's workers, and that the most important way to change is from within herself. In fact the question: "*I think I'll drink forever*" in the first administration, Maria's answer was "Quite true" (Likert point 4); in the second administration she answered "Not true" (point 1). The questionnaire also asks "*I can't resist the temptation to drink*", and at the beginning Maria answered "Really true" (Likert point 6), two weeks after the first appointment and after a week of VR sessions she answered "Half true" (Likert point 3). At the second administration, the total scores in "Desire/Temptation Scale" indicate that the desire to drink was less important for Maria; on the other hand the power of change and willingness increased. For total scores see Table 2. In the third appointment, Maria also discussed her attempt to control her drinking through tight controls imposed upon herself.

Virtual reality could be an instrument that has an impact on patients and helps them to change their behavior. In fact the ITC SOPI test that measures the level of engagement in virtual environments, underlines a very high ecology validity; the patient believes to really be in a virtual world so his/her experience is similar to an experience that he/she could experience in the real world. Moreover the emotions in VR environments are positive; in fact the score on the "Negative Affect Scale" is under the mean score (Ne= 1.6; M= 2.5). The VR protocol is therefore providing an engaging situation and a good experience for the patient, as shown in the table on the following page (Table 1).

On the other hand, the self-efficacy scale didn't show any change. The total score was the same at the beginning and at the end of the assessment process; probably because the VR protocol doesn't provide an environment in which self-efficacy can improve; and the researcher doesn't provide an explicit treatment but only an evaluation.

DISCUSSION

Addictions are some of the more frustrating forms of psychopathology because they involve the whole person and all aspects of his or her social life, affect, relationships and work. The traditional instruments in evaluating this disturbance are well known and used in every national service care; but alcoholism service care operators complain about the difficulty of engaging the patient in treatment and creating an internal motivation to change. VR environments could be instruments to improve the motivation and engage the patient because it is a friendly and enjoyable experience in which the patient is collocated in an immersive context where he/she can test his/her behavior, attitudes emotions and understanding, with the therapist's help. Indeed some aspects may emerge that in a face

Table 1: Tests scores administrated at only one time

TEST	SUBSCALES	SCORE	NORMALITY MEAN
EPI	Neuroticism	0	N < 8
	Lie	10	N < 18
	Extraversion	16	N <15
ITC SOPI	Spatial presence	2,88	M = 2,5
	Engagement	3,08	M = 2,5
	Ecological validity	4	M = 2,5
	Negative affects	1,6	M = 2,5

to face discussion could not. Moreover, the VR protocol assures a greater distance between patient and therapist. The patient is often ashamed to talk about the most difficult and secret aspects of his or her history when facing the therapist. On the other hand, if the patient is immersed in virtual reality he/she doesn't focus on the fact that there is a therapist in the room; it is more likely that the patient can talk about his/her history more freely.

Maria's case shows that the VR protocol is effective in bringing out the intrapersonal and interpersonal factors and the principal aspects of the patient's case history: affects, relations, emotions, intentions and behaviour. When Maria entered the VR environment she talked about her story without stopping. The therapist learned about many aspects of her past and present life, her relationships, her family history, her attitudes, her intentions and her drinking habits. The advantage of VR is that the therapist obtains more information and the patient is calm and feels at ease. Maria's tests administrated before and after the VR session underline that the VR protocol may have been an element that motivated Maria to begin a change in her drinking habits. In fact the answers at MAC 2-A were very different at the end of the assessment and they show a greater engagement in limiting her drinking and more motivation to really change. This VR protocol could be a new form of assessment in alcohol addiction. Of course, these results are preliminary, because it has been applied to only one case and the study is still in progress. In light of these results we intend to increase the sample size. Although the data are promising we have to test this approach in a controlled clinical trial comparing the VR assessment with traditional assessment.

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Table 2: Tests scores before and after VR session

TEST	SUBSCALES	BEFORE VR	AFTER VR
MAC 2-A	Internal shift	96	80
	Self efficacy	66	80
	Willingness to change	50	68
	Desire/temptation	50	34
	Power of change	34	50
SELF EFFICACY	Total score	14	14

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A Virtual Arm to Stop Smoking, A Pilot Perceptual Learning Experiment

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Abstract: *Cigarette smoking is a complex process of conditioning with generalized stimuli and sustained reinforcement of a psychoactive substance (nicotine). Most of the virtual reality (VR) therapies for addictions are oriented on a cue-reactivity approach, cue-exposure therapy (CET). Our pilot experiment is based on operant conditioning, which is characterized by an action–outcome strategy. We designed a virtual arm able to catch and crush cigarettes, which created an action-exposure (AE) in a VR environment. We observed subjects who participated in four (4) therapy sessions in which they had to crush 25 cigarettes in each session.*

The main goal of our study is to explore the usability of this method by smokers and to find out if it can produce some clinical evidence of outcomes by modifying craving and smoking behaviours. In this paper we are submitting the preliminary observations of the first sixteen heavy smokers who participated in our clinical trial.

INTRODUCTION

Smoking cigarettes induces substance dependence with a combination of cognitive, behavioural and physiological symptoms. There is a pattern of repeated self-administration that usually results in tolerance, withdrawal and compulsive drug-taking behaviour (DSM IV-TR, 2000). For example, a one pack a day smoker puts his hand to his mouth an average of 90,000 times a year. It's well known that 70-80% of smokers relapse after their first attempt at quitting and require several more concentrated efforts before becoming smoke free. A ten-year personal clinical survey of 3,700 smokers showed that 50.6% had quit smoking. This was the result of many sessions in our NICOT* program based on the AHCPR 1996, 2000 and WHO 2002 guidelines. Smokers who failed often found themselves at a dead end and despite of their high level of motivation, they were unable to find a solution to their addiction.

VR therapy is an up-and-coming technology that offers new opportunities for relief of certain addictive behaviours (Smith, J. G. 2003). Kwon H. et al., 2006, described the craving as a Pavlovian conditioning or respondent conditioning (cue-outcome). The contexts and objects that become conditioned stimuli (CS) can give rise to the addict's urge (conditioned response: CR) to use the addictive substance. After the conditioning, the addict feels the craving when confronted with CS. Cue-exposure therapy (CET) is used to suppress the conditioned response (CR) through repeated exposure to the cues related to addictive substances, but without the unconditioned stimuli (US). Some studies (Lazev et al., 1999, Sayette et al., 2001, Tiffany et al., 2000, Bordnick et al., 2005) showed increased effects of exposure to smoking cues and cigarette availability in craving and smoking behaviour. CET has been applied in the treatment of a variety of substance addictions, including smoking (Corty & McFall, 1984, Niaura et al., 1999, Lee et al., 2004). However, the effectiveness of CET has been found to be inconsistent (Tiffany & Conklin, 2002) and they have therefore concluded that the treatment must be correlated with a wide variety of objects and contexts.

James, W. 1966, observed that in some perceptual learning experiments the formation of a strong association between two systems of conditioned stimuli (CS_1 – CS_2) can block the conditioned response (CR) and modify the outcome. It's well known that a smoker becomes addicted to smoking by a variety of stimuli (objects, emotions, social contexts, etc…) and that each one possesses his own system of conditioned stimuli (CS_1). On the other hand,

the VR allows us to design a new system of conditioned stimuli (CS_2) in an environment with not only objects and contexts, but also actions. Theoretically, these associations (CS_1 – CS_2) might be able to change some behaviour in smokers.

Our pilot experiment strategy is comprised of a system of sensorimotor stimuli designed in a VR environment and focuses on action–exposure blocking an operant conditioning. We designed a virtual arm in an environment with different visual and auditory stimuli (smoke, white lights depicting cigarettes, ashtrays, sounds of falling water, walking, etc.). The participant is immersed in this virtual environment in which he has to search for cigarettes, grasp them, and crush them with the virtual arm. He is not only a spectator, he is a player.

The main question is if an action–exposure strategy with VR is capable of modifying craving and smoking behaviours and if any clinical evidence can be derived from the procedure. At first we planned an observation study of fifty heavy smokers to evaluate the usability of this method and to explore different variables for future studies. However, the purpose of this paper is to present our initial observations of the first sixteen participants.

MATERIALS AND METHODS

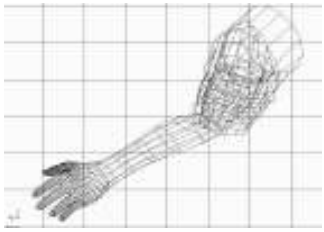
Participants

We introduced the experimental sessions into our regular program NICOT, which included physical evaluation, the prescription of pharmaceutical aids (nicotine gum and patch, Bupropion) and a three-month clinical follow-up for each participant. The participants were recruited from among those who had relapsed. They received general information on cybertherapy, a description of the experimental sessions and specific information on cybersickness. The participants agreed to provide their opinions during and at the conclusion of the experiment. They were assured that they could abandon the sessions at any time and that they were under no obligation to quit smoking.

We completed sixteen of fifty trials. The characteristics of the participants, eight men and eight women, are shown in Tables 1 and 2. They were middle-aged, heavy smokers, and extremely nicotine dependant with a high level of motivation subjectively evaluated on a scale of 1-10. Eight of the sixteen had relapsed at least five times previous to this in our program. There was no significant difference between the two groups. The status (smoker/non smoker) was determined by verbal declaration at the end of the final experimental session. The smokers continued to smoke at the level of pre-session and the non-smokers used zero cigarettes after the fourth session. The status after 4 sessions is recorded at the bottom of Tables 1 and 2.

Equipment:

The design of an arm able to move in a virtual environment enabling its hand to grasp and crush cigarettes was the product of creative professional graphics. We used programs such as XSI from Softimage and 3DS Max from Autodesk (photo 1). We then integrated our 3D work into a game engine from a well-known FPS game called Unreal Tournament 2004 (UT 2004) (photo 2). The game is set in an old castle where the subject can wander through different chambers located on multiple levels.



We hid 25 cigarettes in the castle and added some objects depicting cigarettes and smoke. Due to vertigo in the fourth subject, adjustments to the VR program were made to prevent the feeling of elevation. The hardware consisted of a Pentium IV PC with a Nvidia 7300GS graphics card. We used the eMagin Z800 head mounted display (HMD) with a head tracker. A

Table 1: Characteristics of participants (Women)

Participant	#1	#2	#3	#4	#5	#6	#7	#8	MEAN
Age	39	51	46	43	45	43	40	42	43.6 ± 3.8
Nb. Cig/day	25	15	20	25	20	25	10	25	20.6 ± 5.6
Fagerström	8	8	-	6	5	9	2	9	6.7 ± 2.6
Motivation	8	9	-	8	8	8	9	9	8.4 ± 0.5
Nb attempts	10	3	1	8	2	6	1	4	4.4 ± 3.3
Nb sessions	1	4	4	4	4	3	4	2	-
Status after 4 sessions	S	NS	NS	NS	NS	S	NS	S	-

S: Smoker; NS: Non Smoker

Table 2: Characteristics of participants (Men)

Participant	#1	#2	#3	#4	#5	#6	#7	#8	MEAN
Age	52	48	56	54	54	41	43	50	49.7 ± 5.4
Nb. Cig/day	35	25	15	25	30	15	20	35	25.0 ± 8.0
Fagerström	7	9	9	9	10	6	8	-	8.3 ± 1.4
Motivation	8	7	8	10	8	10	7	-	8.3 ± 1.3
Nb attempts	4	16	6	8	7	2	8	1	6.5 ± 4.6
Nb sessions	2	3	4	4	4	3	4	4	-
Status after 4 sessions	S	S	NS	NS	NS	S	S	S	-

S: Smoker; NS: Non Smoker

resolution of 800 x 600 pixels was needed for the virtual display. The participants used a Logitech wireless game pad to operate the virtual arm.

PROCEDURES

The participants were required to attend a total of four sessions (twice a week for two consecutive weeks) at our clinic. We followed the protocol for reducing cybersickness outlined by the Cyberpsychology Lab UQO (Bouchard, S., 2002). Before the first session, participants had to answer a questionnaire providing information related to immersion propensity. We spent fifteen minutes teaching each subject how to manipulate the arm and position in the virtual environment. The session started only when the participant had familiarized himself with his VR surroundings. He had to find 25 cigarettes (photo 3), reach for them with the virtual arm, and crush them with its hand by pushing a command on the game pad (photo 4). The session ended when the participant had crushed all 25 cigarettes. After the first session, participants filled out two questionnaires pertaining to the state of presence and cybersickness symptoms (Bouchard, S., 2002). A recovery period of 10 to 15 minutes was given after each session. In the event that a participant abandoned the experiment, we contacted them by phone for an explanation as to why.

RESULTS

Most participants compared these sessions to playing a fun, user-friendly video game. They carried on a running commentary during the sessions and they felt a sense of enjoyment waging war on cigarettes. Others hesitated before crushing a cigarette and then regretted doing it. They seemed sceptical, confused and were afraid of being manipulated by an unknown technique. Ten participants (62.5%) completed the experiment. One participant abandoned after the second session because of height phobia, which we continued to treat with VR desensitization. Five participants (31.5%) dropped out after 2 or 3 sessions stating they were not ready to quit smoking. The dropout rate was within the range of the Jorenby DE et al. 1999, who reported that a mean of 34.8% of their subjects discontinued the experimental treatment (Bupropion, nicotine patch or placebo) during their study. Eight (8) participants quit smoking and the mean of smoking cigarettes (22.8 cig/day) by the 16 subjects in pre-session moved down to 12.8 cig/day. This difference is statistically significant at 0.011 with the non-parametric Wilcoxon rank test ($Z_{(16)} = 2.53$, $p < 0.05$).

Adapting to the virtual environment was quick and easy, requiring minimal effort. The average time spent catching and crushing 25 cigarettes was between 20 and 40 minutes, but some completed it in 10. The participants' profiles for specifics variables of VR exposure collected in the first session are recorded in Table 3 on the following page. The immersion propensity and state of presence variables are comparable to the control values. Cybersickness could have been more frequent in the participants but the variance in the data was too high. We noticed that two results (111.4 and 125.3) specifically for disorientation were over the control maximum value (97.4). We also observed a high level of awareness in the smokers and a particular attraction for different objects and cigarettes in the VR environment. We suspected the psychoactive effect of nicotine to be a cause.

After each session, many reported aftereffects such as flashbacks (the virtual arm, sounds, objects), revisiting the virtual environment, the need to crush cigarettes and reliving sessions

Table 3: Specific variables to VR exposition
* in Bouchard, S., 2002

	Control *	Participants
Immersion Propensity	64.1 ± 13.3	55.1 ± 10.0
Presence State	104.4 ± 18.9	122.3 ± 18.7
Cybersickness	9.8 ± 15.0	28.9 ± 29.5

in their sleep. Some participants said that they crushed their cigarettes instead of tapping them in the ashtray while smoking. One participant remarked that she often saw an ambiguous white object that gave her loving care and protected her when she had an urge to smoke. All these phenomena may have been spontaneous or may have been activated by an urge to smoke. Furthermore, two subjects categorically denied crushing cigarettes after their first session. During their second session, they stated that they hadn't crushed cigarettes but had instead put them in their pocket, much like a squirrel does when gathering nuts (storing).

Out of the ten subjects who completed the four sessions, eight decided to quit smoking during the course of the experiment. A follow-up one month later revealed that only one had relapsed. A cessation rate of 70.0% after one month is in the range of the Jorenby et al. (1999) double therapy (Bupropion and nicotine patch) at 66.5%. Smokers who quit found that this method was better suited to their needs and that the urge to smoke had greatly diminished.

DISCUSSION

Our first observation concerned the creation of an integrated sensorimotor system of conditioned stimuli in a VR environment that could be effectively imprinted onto a smoker's brain. Goldstone, R.L., 1998, maintained that perceptual learning involves relatively long-lasting changes to an organism's perceptual system that improves its ability to respond to its environment and is caused by this environment. Imprinting may come from entire stimuli or parts or features of them. Bedford, F.L., 1993, argued that learning is much easier when the entire visual dimension can be shifted or warped to map onto the proprioceptive dimension than when unrelated visual-motor associations have to be acquired. Rumelhart et al., 1986, believed that internal representations can function as acquired feature detectors built up through environment exposure. At a more abstract level, Goldstone, R.L., 1998, reported that topological imprinting can occur when the space and the positions of patterns within the space are learned as a result of training with patterns. This implies the creation of a spatially organized visual network that may favour the formation of a strong association. Psychological manifestations experienced by the participants furnished clinical evidence of a new cognitive map of images and associative actions.

The second observation of our experiment explored the potential capacity of blocking the conditioned response (CR) with an action-exposure strategy. Both humans and animals exhibit behavioural phenomena such as "discounting" and "augmentation" (Kelly, H.H., 1973). One of the best-known cases of discounting is the cue validity effect, first reported by Wagner, A.R. et al. (1969). Rescorla-Wagner, 1972, in her learning model stated that a reinforcer can sustain only a limited amount of associative strength; therefore, simultaneously presented cues must compete with one another as the best predictor – or cause – of the outcome. Castro & Wasserman 2007 said that we are able to predict an effect on the basis of observed cues, but we are also able to predict the effects that our own actions will have on the environment. Instrumental conditioning or operant conditioning relies on the ability of organisms to learn that their own actions can produce action outcomes. "Man's first experience with causes probably came from his own behaviour: things moved because he moved them" (Skinner, 1971). The action-exposure strategy seems to have the potential of blocking a CR like smoking. Our pilot experiment might have influenced the behavioural out-

come of the eight heavy smokers who quit smoking in the four experimental sessions.

The third important observation concerned the subjects who gave up or tried to get around the experiment by storing cigarettes. In perceptual learning with a “changed-response” experiment, Morgan et al., 1966, showed that if the stimulus-response (S-R) association formed the basis of the original learning, great disruption could take place when the subject was forced to change to other responses that had never been associated with the stimuli of the learning situation. Disruption was suspected as the result of certain subjects not being ready to quit smoking.

Our pilot experiment is not conclusive enough to either analyse or generalize these results. It's a small study with few subjects observed over a short period of time. The operating procedures need to be standardized for future studies. However, these preliminary results could be an interesting avenue for research in the treatment of substance addiction.

CONCLUSION

A variety of sensorimotor stimuli in a VR environment seems to ease the imprinting of a new map of associative actions on the brain. This acts not only on the arm's specific movement, but also on all conditioning processes in smokers. The original conditioned response CR_1 (smoking) may be blocked in some subjects who learn a new virtual conditioned response CR_2 (crushing) that will help them quit smoking. As for the subjects who did not complete the experiment, disruption may have been the cause. Two subjects created a new virtual conditioned response CR_3 (storing), which allowed them to keep on smoking. The action-exposure strategy seems to have the potential for blocking a conditioned response and possibly modifying craving and smoking behaviours. This approach (AE-VR) could be considered in the treatment of substance addiction.

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Augmented group presence in PASION project: Presentation of a first applications developer prototype

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Abstract: *PASION is a European project aimed at supporting mediated interaction of large networks of people and augmenting their communication with the provision of group presence cues. These cues consist of indices of the group's activity, self-reported data and physiological information that will be presented to players, and they will improve the group presence. This is the main contribution of PASION. In this paper we present a first applications developer prototype and the first hunting game created with it, Bluenet. Bluenet supports a collaborative activity, treasure hunting, distributed across the large space of a city and mediated by mobile phones (later PDAs, etc.). As such it can be used for applications in which group cooperation must be improved, with the additional advantage of making the degree of cooperation immediately visible as feedback during the game.*

INTRODUCTION

This paper describes the characteristics of a first applications developer prototype for supporting users' collaboration and including augmented interaction features. It is designed within PASION (Psychologically Augmented Social Interaction Over Networks), an ongoing Integrated Project funded by the European Union and involving 18 partners from 8 different European countries. PASION research, technology and applications are aimed at improving the efficiency and effectiveness of goal-oriented groups engaged in social (many to many) interaction in mediated environments (for a review of Computer Mediated Communication, see Thurlow et al., 2004, Walther et al. 2005), with a particular emphasis on large groups in which interaction occurs on a long term basis (e.g. professional communities), creating a complex network of relations. The idea is to create a communication environment where the group-level social presence is made visible to people, in contrast with the great prominence that is usually given to interpersonal presence. The project will identify some relevant group dimensions to be displayed and implemented as cues in the prototypes (Brugnoli, Morabito, Walker and Davide, 2006).

Cues will be obtained from three sources: automated recording of the users' activity and position, self reported data, and physiological data. A great deal of cues will be elaborated by using the methods and metaphors of Social Network Analysis (Wasserman and Faust, 1994), which enables the display of the group structure in an intuitive yet precise way. The structure can be obtained from several different kinds of data; in the prototype it is possible to select the kind of data and visualization that is more appropriate for a specific application. A technology such as the one developed in PASION can serve a variety of purposes, wherever it may be useful to make people engage with each other on the basis of a collaborative activity (e.g. improving cooperation, cohesion, perspective change) and to have the group status visible to the members/ administrator/therapist (e.g. group therapy). For instance, feedback based on the provision of Social Network indices can be used elsewhere to increase people connectedness between people, and avoid the social isolation (Morris, 2005) or to investigate the change in harmony or attitude balance (Heider, 1946) inside small groups acting in a Virtual Environment (Nakanishi, Nakazawa, Ishida, Takanashi and Isbister, 2003).

The applications created using the first prototype such as Bluenet will run on mobile phones; a desktop version with scalable complexity will soon be added. Bluenet is a Bluetooth-Mediated Social Interaction in

Outdoor Digital World; it consists of a Treasure Hunting game where participants have to visit a real city in order to find a final target and the clues leading to it. The communication medium allows the delivery of clues to the participants' mobiles, taking them from site to site till the final one. Once a specific site is approached, the Bluetooth device sends the next clue. Communication among people in a group is necessary to collaborate and interpret the clues, as well as to find the corresponding sites in the city; the technology prevents single members to progress alone in the game or to skip some steps. Participants can locate themselves in the area through a map visualized on the cell-phone, and can also access the data on their group activity in terms of progress made in the game and quality of interaction between them. Bluenet can be used to encourage people to collaborate and exchange information in order to achieve a common goal, and to make them attentive of the communication structure in their group, individuating possible communication breakdowns and isolated members.

A first applications developer prototype

A first applications developer prototype has been developed. The applications developed using it, works on mobile phones and it has been developed in Java; information storage is based on a native XML database, 'eXist'. All elements needed for an application can be grouped into XML schemes. For example for Bluenet, these elements are: (a) the invitation routine; (b) the invitation sentence; (c) the rules of the game; (d) the goodbye message; (e) error messages; (f) the pieces of the map; and (g) the clues for each site. All this grouped information can be automatically translated into a XML scheme as follows:

Instructions
- Invitation - text
- Rules
  - 1 – text
  - 2 – text
  - N – text
- Goodbye - text
- Error – text

– Map and sites
- Map
  - Pieces
    - 1- image
    - 2 - image
    - N – image
  - Clues
    - 1 – text
    - 2 – text
    - N – text

On the basis of this grouping, the XML scheme for Bluenet can be created; it will include the data of the city, the game-relevant sites in the city, the clues to the sites, and will allows to modify, add and eliminate part of the information. This means that the software will have to allow the creation of XML schemes, filling in the existing XML schemes, and finally create mobile applications. Let's consider all these functions one by one.

Creation of XML schemes. The first step before any other development is the creation of the XML schemes. For achieving this, a graphical application has been developed, which allows introducing the different nodes and subnodes that form the XML scheme as well as the type of information of these nodes (text, image, number, sound, etc.).

Filling in the existing XML schemes. Once the XML scheme has been defined, it is necessary to select an existing XML scheme and to assign values to its nodes/fields. This is the way the database is updated; it has to be stressed that no XML knowledge is needed to run this application once developed. Nevertheless, the user has to know how introduce the right data in each part.

Both steps can be joined in a unique application allowing both the creation of XML schemes and the selection of one of them to fill in, and endowed with the following functionalities:

a) Creating new XML schemes and store them in the database (Figure 1).
b) Showing the XML schemes stored in the database (Figure 2).
c) Deleting existing XML schemes from the database
d) Updating existing XML schemes and store the changes in the database (Figure 3)
e) Filling in an existing XML scheme and store it in the database
f) Showing XML files stored in the database
g) Deleting existing XML files from the database

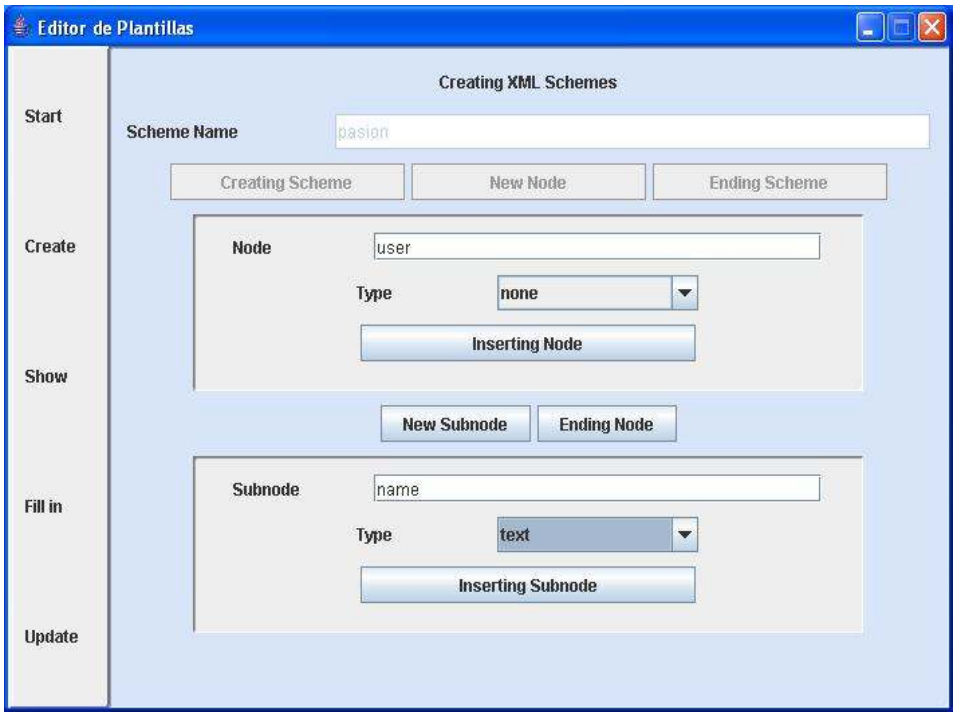

Figure 1. The graphic interface to create XML schemes with nodes and sub-nodes; the XML scheme in this example is called 'pasion'.

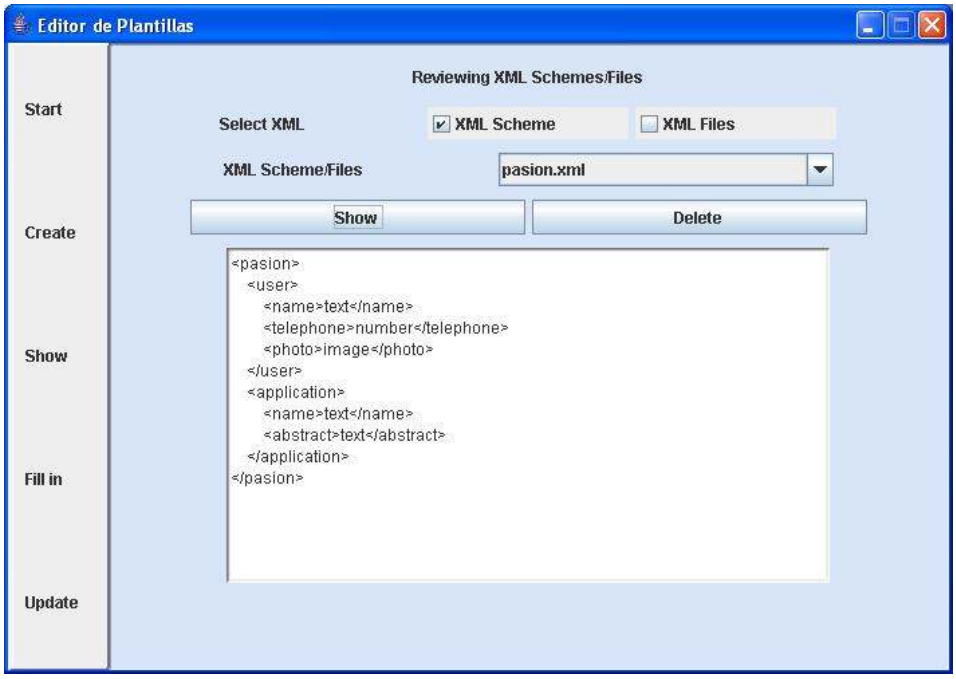

Figure 2. A selected XML scheme/file can be visualized in XML format. The XML scheme is called 'pasion.xml'

Figure 3. The graphic interface to update XML schemes/files by modifying the data contained in its nodes.

Figure 4: The graphical interface to updating XML schemes/files; the XML file is called here ‘pasion1’.

For the time being, the type of information that can be stored in a XML file includes text, number, image and sound. For images and sounds, it is possible to select a file and upload it to a web server. The XML file stores the web address in order to access the image and sound file.

Development of a tool for the creation of mobile applications. Applications will be developed using the XML schemes and files, and Java classes. This first prototype will evolved during the life of the project in an incremental way. In this way the development of the final application will be much simpler, since it will be enough to use the provided classes.

Appearance of Bluenet

Now, Bluenet runs on mobile phones, but later, PDA's and other devices will be used. An example of execution using the Nokia 6600 is presented next. The players will use Bluenet in a way similar to the following script.

	A player arrives to the starting site and is invited to join the game with a message on the cellphone.
	Upon acceptance to participate, the player is invited to join a team; all teams that are currently participating in the game are shown and the player can choose or be assigned to a selected team, according to the rules of the game. The list of clues is shown on the screen of all team members, only one of them providing the correct information. The players in a group can communicate via SMS or phone calls between them. Players pay for the SMS and calls.
	Players' arrival to the right site is detected by a Bluetooth device, and it is notified by a message sent automatically to all members of the group (correct site/incorrect site); in case of correct site, the next list of clues is shown together with a partial image of the site. Site after site, the whole image of the target will be completed as in a puzzle.
	The game goes on until the final site is reached.
	During the game, players can have extra information about their social interaction with other players and a map view (left image). The map view shows the sites already visited by players, using for it the information stored in the Data Base (the sites are recognized using Bluetooth devices)
	When all the pieces of the puzzle have been accumulated, and the complete image of the final site is displayed, the team is able to recognize the target. The game ends when they reach it.

CONCLUSIONS

Bluenet proposes a treasure hunting game that lends itself to a variety of applications in the area of education, therapy and entertainment. Its peculiarity resides in the ability to support mediated interaction, to allow the modification of the set up in order to meet the requirements of each specific usage and to implement the result of psychological research in the area of group feedback. On these bases, other modules of the applications developer will be created in order to obtain an integrated, scalable system that can run in open spaces as well as in fixed stations indoor, and provide a wide variety of social cues to users.

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A Virtual Human Agent for Training Novice Therapist Clinical Interviewing Skills

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Abstract: *Virtual Reality (VR) is rapidly evolving into a pragmatically usable technology for mental health (MH) applications. Over the last five years, the technology for creating virtual humans (VHs) has evolved to the point where they are no longer regarded as simple background characters, but rather can serve a functional interactional role. Our current project involves the construction of a natural language-capable virtual client named "Justin," which derived from a military negotiation training tool into a virtual therapy patient for training novice clinicians the art of clinical interviewing with a resistant client. Justin portrays a 16-year old male with a conduct disorder who is being forced to participate in therapy by his family. The system uses a sophisticated natural language interface that allows novice clinicians to practice asking interview questions in an effort to create a positive therapeutic alliance with this very challenging virtual client. Herein we proffer a description of our iterative design process and outline our long term vision.*

INTRODUCTION

Virtual Reality (VR) is rapidly evolving into a pragmatically usable technology for mental health (MH) applications. As the underlying enabling technologies continue to evolve and allow us to design useful and usable "structural" clinical virtual environments (VE), the next important challenge will involve "populating" these environments with virtual representations of humans. Over the last five years, the technology for creating virtual humans (VHs) has evolved to the point where they are no longer regarded as simple background characters, but rather can serve a functional interactional role (Swartout et al., 2006; Gratch et al., 2002). This will be vital to create MH training tools that leverage the use of VHs for applications that require human-to-human interaction and communication. This would open up possibilities for clinical applications that address interviewing skills, diagnostic assessment and therapy training.

Virtual patients (VPs) are virtual interactive agents who are trained to simulate a particular clinical presentation of a patient with a high degree of consistency and realism. VPs have commonly been used to teach bedside competencies of bioethics, basic patient communication and history taking, and clinical decision making (Dickerson et al., 2005; Fleetwood et al., 2000; Johnsen et al., 2005; 2006; McGee et al., 1998; Stevens et al., 2005). VPs can provide valid, reliable, and applicable representations of live patients (Triola et al., 2006). For example, in Lok's application (Raij et al., 2005, 2006), instead of using the costly and labor intensive approach of hiring professional patients for novice medical students to practice on, they constructed a VE to represent an examination room where a VP could be interviewed verbally using the *Dragon Naturally Speaking* speech recognition software. The goal in this application was to determine, via clinical interview, whether the VPs ailment was due to appendicitis.

Research into the use of VPs in psychotherapy training is very limited (Kiss et al., 2003; Frank et al., 2002). Beutler and Harwood (2004) describe the development of a VR system for training in psychotherapy and summarize training-relevant research findings. We could not find reference to any other use of VPs in a psychotherapy course to date, despite online searches through MEDLINE, Ovid, and the psychotherapy literature.

The USC Institute for Creative Technologies has been conducting similar VH research as part of its primary mission over the last seven years to create highly interactive artificially intelligent agents to be used for VR military leadership and negotiation training (Rickel et al., 2001). This VH effort is built on prior work in the areas of embod-

ied conversational agents (Cassell et al., 1998) and animated pedagogical agents (Johnson et al., 2000), but integrates a broader set of capabilities than any prior work. For the types of training scenarios we are targeting, the VHs must integrate three broad influences on their behavior: they must perceive and act in a 3D virtual world, they must engage in face-to-face spoken dialogues with people and other VHs in such worlds, and they must exhibit human-like non-verbal behavior and emotions. Traditional work on VH in the computer graphics and games community has focused on graphical look, perception and action in 3D worlds, but largely ignored dialogue and emotions.

Our current project involves the construction of a natural language-capable VH agent, named "Justin." The clinical attributes of Justin were developed to mimic a conduct disorder profile as found in the Diagnostic and Statistical Manual of Mental Disorders Text Revision (DSM-IV-TR; APA, 2000). The VP system is based on our existing VH architecture (Swartout et al. 2006). The VH architecture was derived from a military negotiation training tool into a virtual therapy patient for training novice clinicians the art of clinical interviewing with a resistant client. Justin portrays a 16-year old male with a conduct disorder who is being forced to participate in therapy by his family. The system uses a sophisticated natural language interface (Leuski et al., 2006) that allows novice clinicians to practice asking interview questions in an effort to create a positive therapeutic alliance with this very challenging virtual client.

METHODS

The project involved the development of a VP, "Justin", as well as the clinical virtual environment (VE) in which the trainees learn interviewing techniques and knowledge of signs and symptoms of conduct disorder. The environment was modeled after a typical clinician's office and was meant to represent a place that would make the patient feel at home. The model representing "Justin" was meant to represent a typical 16 year old boy with jeans and a baseball hat. (See Image in Figure 1). The VP is capable of responding to clinical questions with verbal behavior and non-verbal human-like emotions and body postures that one might typically observe in a client with this disorder. Several role-playing scenarios between humans were conducted and recorded to gather the dialog and non-verbal behavior and voice of the VP. The preliminary goal is to use the VP to teach diagnostic skills training specifically for conduct disorder, as described below. The eventual goal is to have the VP be utilized in individual trainee interviews, small group and classroom settings.

The structure of the individual trainee interview targets an interview of 30 minutes duration during which there may be pauses for guidance from live supervisors who are in attendance, however, the interview may progress successfully without interruption guided by verbal and emotional interactions between VP and trainee doctor. At the end of the 30 minute period, the trainee is expected to be able to make the diagnosis, having elicited the appropriate signs and symptoms, and conducted a sensitive and effective interview. If the diagnosis or the interview process is not successful within the expected time allotted, the trainee will need additional practice to be considered competent in the clinical diagnosis of conduct disorder.

The VP, "Justin", and the clinicians' activity and verbal behavior can be recorded during the interview and the entire 30 minute interview process may be re-played for review, critique and commentary by child and adolescent psychiatry attendings, as a teaching tool for other residents, or for groups of medical students learning about conduct disorder.

A competency-based set of questions and a scoring system is being developed in order to help child and adolescent psychiatry residents, psychiatry residents, and medical students utilize the recorded versions of the interviews as learner-centered educational tools. A library of various clinician-recorded interviews can be available to be viewed by students who have not actually participated in the interview, and can be interrupted at various points to assess the viewer's own diagnostic skill and response to the interview as it progresses. An example of a scoring system may include demonstration of knowledge of the core features of the disorder (in this case, conduct disorder) and measures of perceived strength and weakness of the interviewer's rapport with the VP. Diagnostic questions can prompt the viewer with respect to

missing diagnostic symptoms or additional information as needed.

Conduct Disorder Diagnosis Skills Training

Teaching interviewing skills with VHs and VPs is still a young discipline. There are no standard methods and metrics. The larger problem of teaching general interviewing skills is even vaguer as there are many techniques and it is not well understood how to properly implement those with a VP. To alleviate this problem we are concentrating on teaching skills required to diagnose a particular disorder, in this case conduct disorder. Our goal is to obtain objective data from an initial intake interview. This will be accomplished by evaluating the questions asked by the trainee to the VP and the corresponding answers. The trainee's interview questions should be guided by the need to determine if the patient is internalizing or externalizing their behaviors and for eliciting information regarding the four general symptom categories prevalent in conduct disorder:

- Aggressive behavior – e.g. fighting, bullying, being cruel to others or animals
- Destructive behavior – e.g. arson, vandalism
- Deceitful behavior – e.g. repeated lying, shoplifting, breaking into homes or cars
- Violation of rules – e.g. running away, engaging in non appropriate behavior for age

The VP system is designed to provide answers to questions that target each of these categories and will respond to a variety of questions pertinent to these areas. Some responses by the VP may be on target, off target, involve "brush away" responses, and in some cases, they may be irrelevant replies. The probability of a specific response being emitted is rated to the question asked. For example if the trainee asks: "How are things going at home" or "Are you having any problems at home" or "How are things going?". The system will respond with "My parents think I messed up." Further questions will lead to finding out that the patient has been running away. This will lead to marking one of the above categories true for the diagnosis in the trainees' interview. In order for the trainee to pass it will require responses in all of the categories. The total set of questions and responses are extracted from role playing exercises, initial subject testing, interviews with doctors and common sense for specific responses. In total a question set would consist of over 100-200 lines of text. The matching of questions to responses is a manual process with automated learning techniques to generate probability values (Leuski et al, 2006). Through an iterative process a good training set is developed.

Virtual Justin: Architecture and Integration

The VP system is based on the VH architecture developed at The Institute for Creative Technologies (Gratch et al., 2002, Swartout et al., 2006). The general architecture supports a wide range of VHs from simple question/answering to more complex ones that contain cognitive and emotional models with goal oriented behavior. The architecture is a modular distributed system with many components that communicate by message passing. Interaction with the system works as follows (See Figure 1): the trainee talks into a microphone which records the audio signal that is sent to a speech recognition engine. The speech engine converts the signal into text. The text is then sent to a statistical natural language system that matches the input text to a question/answer pair which selects an answer. The answer is sent to a non-verbal module which applies rules to create the appropriate gestures and behaviors. A procedural animation system then synchronizes the gestures, speech and lip synching and plays a prerecorded or generated voice of the input text for the character for final output to the screen. The user then listens to the response and asks more questions to the character.

The major components in the system are: (See Figure 1)

- *Speech recognition*: Digitizes the trainee's speech and produces as output a string of words. The speech recognition engine used is SONIC from the University of Colorado, Boulder (Pellom, 2001). The language and voice models that SONIC uses are customized by us for the domain of interest (Sethy et al., 2005).
- *Natural Language Understanding and Dialog Management*: Parses the word string produced by speech recognition and forms an internal semantic representation. This representation selects an appropriate response from a set of statistically ranked questions (Leuski et al., 2006).

- *Non-verbal behavior generation*: Takes the response output string and applies a set of rules to select gestures, postures and gazes for the virtual character (Lee et al., 2006).
- *Intelligent Agent*: Reasons about plans and generates actions. Complex agents can be created with the Soar Cognitive architecture, or simple agents can be created with a finite state machine. Soar is a rule based system that contains goal directed behavior, short and long term memory, a reasoning mechanism, and can deal with input and output in real-time. The complex agents contain task models to reason about what actions to take. They also include a dialogue manager and a model of emotions.
- *SmartBody*: Synchronizes speech output with gestures and other non-verbal behavior to perform character control over the characters in the virtual environment.
- *Rhetorical*: Performs speech synthesis from the text generated by the agent. Or alternatively a set of pre-recorded voice strings can be used as the speech.
- *Unreal Tournament*: The current underlying graphics engine used for the Virtual Environment, we are exploring lower cost Open Source engines such as Ogre and Panda3D.

Virtual Justin: Case Study

The VP is modeled after a conduct disorder case found in the *DSM-IV Casebook* (Spitzer et al., 1994). The virtual Justin is a 16 year old patient residing in the psychiatric unit of a general hospital in the wealthy Los Angeles suburb in which he lives. He had slashed his wrist with a knife, severing nerves and tendons in his left hand, and drifted in and out of consciousness during the night, finally calling a friend's mother for help in the morning. Justin is the son of a Vietnamese mother and an American serviceman. He lived with his mother in Saigon until he was two, when he came to the United States to be adopted by an American family through an agency specializing in adoption of Vietnamese children. He was apparently abused (burned and beaten) in this family, removed to a foster home for a brief period, and, at age four, placed with his current adoptive parents. Although Justin initially did well in his new surroundings and got along well with his friends, his relationship with his parents was turbulent, and they describe him as difficult.

Shortly after starting junior high, Justin began spending the majority of his time with a group of students who were many times truant from

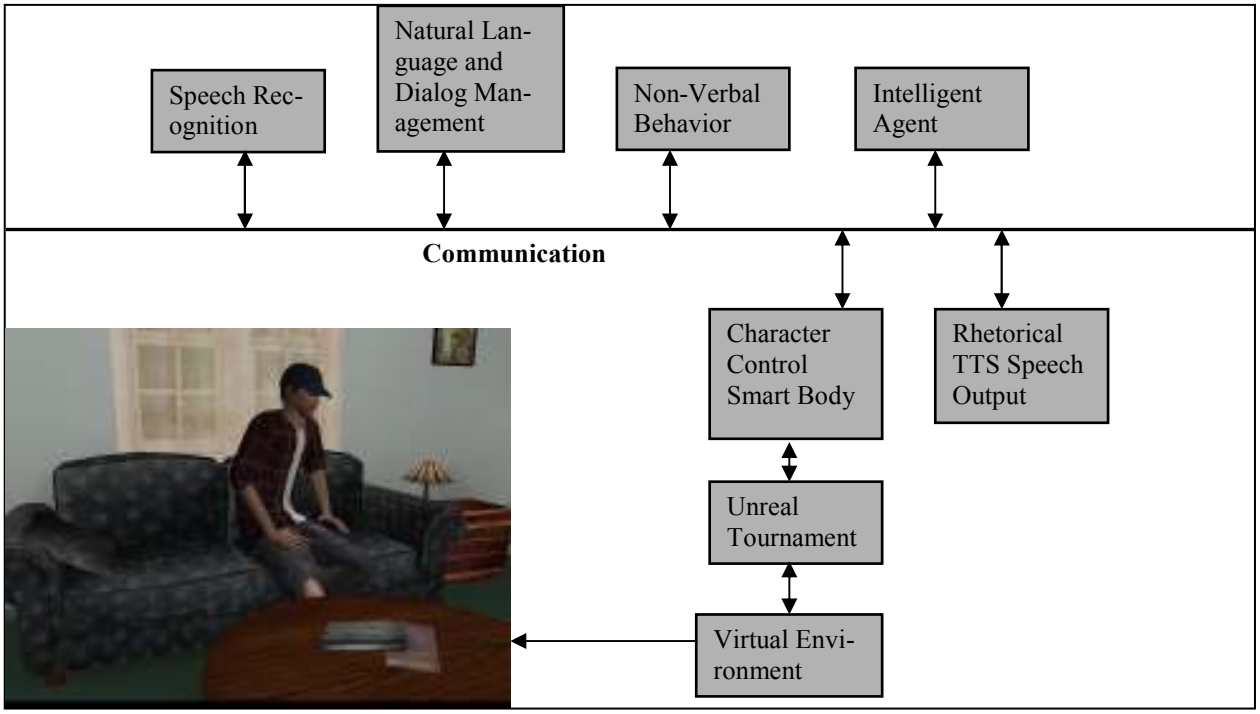

Figure 1. Virtual Human Architecture Diagram

school. He also began adopting the behaviors of these students: smoking marijuana, shoplifting beer from the local supermarket, and belittling the values of parents and teachers. During this time his academics suffered and he was placed on academic probation. His parents' attempts to redirect his attitude and relations were met with hostility. Justin got into trouble for fighting in school, blowing up mailboxes with firecrackers, and throwing darts at the neighbor's cat.

During this time, Justin's parents separated and he decided to stay with his father. The disruption of his parent's separation was accompanied by increased "acting out" behaviors. He and his friends were arrested for "borrowing" a car to go joyriding. Additionally, his truancy escalated to the point that he was absent more days than he was in school. While truant from school he and his friends would actively use drugs—mostly LSD, mescaline, glue, and marijuana.

Virtual Justin: DSM-IV-TR Diagnosis

Differential Diagnosis

Although Justin's ticket of admission to a psychiatric hospital seemed to be a suicide attempt, he later tells us that it was a clever way of avoiding being arrested. Whether or not he is also depressed and did intend to kill himself, there does not seem to be evidence of a full Major Depressive Episode that would justify that diagnosis. Further, we do not have enough information to make a positive diagnosis of Dysthymic Disorder, although his feeling that life is pointless suggests that this is likely (see DSM-IV-TR for major diagnostic criteria; APA, 2000).

Diagnosis

Justin has a history of a chronic pattern of antisocial behavior in which the basic rights of others and age-appropriate societal norms are violated. He has stolen, been truant, broken into someone's car, been cruel to animals, and initiated physical fights. These behaviors warrant the diagnosis of Conduct Disorder of Adolescent-Onset Type with Moderate Severity. It is understood to be of Adolescent-Onset Type because onset of conduct disturbance was in adolescence. The label of Moderate Severity is applied because Justin does not cause considerable harm to others or engage in extensive vandalism or theft (see DSM-IV-TR for major diagnostic criteria; APA, 2000).

Additional Diagnostic Considerations:

It is also important to note that Justin certainly has abused various drugs. We do not have sufficient information to know whether he was ever dependent on drugs. Given that his suicide attempt was related to his use of LSD, it appears that his use of hallucinogens is certainly having negative consequences, justifying the diagnosis of LSD Abuse (see DSM-IV-TR for major diagnostic criteria; APA, 2000). Similarly, the extensive use of marijuana, leading to repeated absences from school, would justify the diagnosis of Cannabis Abuse (see DSM-IV-TR for major diagnostic criteria; APA, 2000). We realize that careful questioning would probably reveal abuse of other drugs.

The diagnosis that best accounts for the current admission is Adjustment Disorder, With Depressed Mood because his depressed mood and suicide attempt seem to have been triggered by the stress of what he believed was an impending arrest (see DSM-IV-TR for major diagnostic criteria; APA, 2000).

CONCLUSIONS

Herein we described the initial plan for developing and using a virtual patient that will be used for examining initial user data from a sample of psychiatric residents and psychology graduate students. This is an initial pilot study that will serve as the basis for a longer term research vision, that of creating a comprehensive Diagnostic and Statistical Manual of Mental Disorders DSM-IV-TR (APA, 2000) diagnostic trainer having virtual humans that are modeled after the symptoms and behaviors that are specified in each diagnostic category. Our long term plan is to also integrate an automated tutor agent that can appear at the end of training interview session to review the interview dialog with the trainee and provide feedback as to how a line of questioning may have properly gathered relevant assessment information or in a case where the effort became side tracked or convoluted.

We believe that virtual patients will play an important role in the future of psychotherapy education for psychiatry residents and psychology trainees. The use of virtual patients could be implemented in several ways. For example, virtual patients could be developed to recognize the essential features and common pitfalls of an

initial psychotherapy interview so that they could give more specific, relevant, and reliable verbal feedback to the residents involved. In addition, the use of virtual patients illustrating common problems such as acting out, transference, intrusive questions, or seductive behavior would allow residents to have an experience with these anxiety-provoking situations in a simulated setting before they occur in their practice. Finally, performance in virtual patient scenarios could be used as an additional source of data for the assessment of resident competency in the psychotherapy domain.

Future work with the system would include: 1) addition of a camera for more user input into the system; 2) addition of more personality to the character; 3) maintain more conversation and world state about what is being discussed in the interview; 4) addition of intonation, prosody, and affect to the speech output (e.g given that persons with Conduct Disorder are prone to anger, it may be appropriate to have him shout his responses when the same question is asked several times); 5) addition of tools to build characters that have several different behavior problems, the dialog they would use and the nonverbal behavior they would manifest. For interview training a series of small vignettes that guide one particular interviewing technique such as reflective listening and following would be useful.

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Cognitive remediation impacts on children with conduct disorder

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INTRODUCTION

Conduct disorder (CD) is defined by persistent disruptive behaviours that affect diverse domains of functioning (DSM-IV-TR; APA, 2000). CD is frequently associated with ADHD in comorbidity (Banaschewski, et *al.*, 2003). ADHD is characterised by the presence of inattention, hyperactivity, impulsivity behaviours (DSM-IV-TR, APA, 2000) and by executive dysfunctions (Barkley, 1997; Shallice et al., 2002; Willcutt et al., 2005). Moreover, CD is frequently associated with social relation difficulties and learning disabilities (Green et al., 2002). CD constitutes therefore an important risk factor for several psychiatric disorders during adulthood (Kim-Cohen et al., 2003), and it is important to develop effective intervention programs, making it possible for these young people to better adapt.

In addition to adaptation difficulties, certain authors suggest the presence of cognitive deficits in young people presenting CD, more particularly with regard to attention and executive functions (Moffitt, 1993; Morgan & Lilienfield, 2000; Oosterland, Logan & Sergeant, 1998; Sergeant, Geurrts & Oosterland, 2002). However, the presence of cognitive deficits in CD remains an object of discussion. In fact, some researchers argue that the presence of executive deficits observed in children with CD are more likely to be associated with ADHD in comorbidity than to CD (Pennington & Ozonoff, 1996; Klorman et al., 1999; Van Goozen et al., 2004). Recently, Oosterland, Scheres & Sergeant (2005) compared the performance of an ADHD group, a CD group, an ADHD+CD group and a group of children who are typically developed on neuropsychological tests. Their results did not show any executive deficit associated with CD. They concluded that the presence of an ADHD in comorbidity explains the cognitive deficits observed in young people with CD. Baving, Rellum, Laucht & Schmidt (2005) used evoked potentials in order to examine attention functions in children with CD not having ADHD as comorbidity. Contrary to the results noted by Oosterland et al. (2005), their results clearly showed that attention functions in children with CD differed from children who are typically developed. More precisely, they demonstrated a reduction in the P3a and P3b waves in the CD group, which both reflect orientation of their attention. The authors discuss that these difficulties would not be easily detected or observed with neuropsychological tests, the tasks used often being too simple to target. Similarly, Baving, Laucht & Schmidt (2000) report abnormal EEG activity over the frontal cortex of children without ADHD. Thus, while children with CD and ADHD are expected to show attention and executive deficits, even those without an ADHD comorbidity can be suspected of subtle deficits in attention and executive functions.

From this point of view, cognitive remediation seems worth investigating as a new intervention strategy for children with CD. Although it does not use virtual reality, cognitive remediation that uses computerized exercises is cybertherapy. Cognitive remediation in general encompasses a spectrum of interventions that aim to improve deficient cognitive functions within a clinical population by strategic teaching or extensive exercising (Medalia & Lim, 2004). Computerized cognitive remediation offers two main advantages. First of all, the difficulty level of the computerized exercises is adjusted according to the performance of each child. Secondly, the computerized exercises can take place anywhere, at school, at home or in a clinic.

For instance, the majority of studies assessing the effectiveness of cognitive remediation have been carried out with individuals with schizophrenia (Fiszdon, Bryson, Wexler & Bell, 2004; Wykes, Reeder, Corner, Williams & Everitt, 1999; Wykes, Reeder, Williams, Corner, Rice, &

Everitt, 2003). These studies have demonstrated that cognitive remediation can have a significant impact on the quality of life and self-esteem of patients and can significantly increase their sensitivity to other conventional psychosocial therapies (Wykes et al., 1999). Recently, Klingberg et al. (2005) evaluated the effectiveness of a computerized cognitive remediation program with ADHD children, addressing the working memory functions. They compared two groups, a treatment group and a comparison program group. In the treatment group, the level of difficulty was adjusted to the performance of the participants. In the comparison group, the same computer program was used but the difficulty level remained at the initial level. The computer program in the comparison group was therefore too weak to be efficient. Their results showed an improvement of working memory and of certain executive functions (inhibition and reasoning).

OBJECTIVES

The objective of this pilot study is to evaluate the effectiveness of a cognitive remediation program centered on working memory to improve cognitive functions of children with CD. Results obtained by Klingberg et al. (2005) with ADHD children lead us to investigate whether a working memory cognitive remediation program could have a similar impact on children with CD. A second objective is to evaluate the impact of the cognitive remediation program on behaviour regulation. For these purposes, the performance of children with CD receiving the program (cognitive remediation group) is compared with the performance of children with CD in a comparison group. It is anticipated that children in the intervention group will improve more than children in the comparison group, regarding cognitive and behavioural measures.

METHOD

Participants: Thirty-six boys were recruited in specialized CD classes. The participants were between 7 and 14 years old (*mean* = 11.3, *standard deviation* = 1.9). They were randomly assigned into two experimental groups, a cognitive remediation group (n= 13) and a comparison group (n= 19). Four additional participants in the cognitive remediation group withdrew themselves from the study and did not complete the cognitive remediation program due to a lack of motivation.

Intervention: The cognitive remediation program specifically addressed working memory skills using computerized exercises. The program included non-verbal tasks (to reproduce the successive positions of an object inside a 5X5 grid in either direct or inverse temporal order) and verbal tasks (to reproduce sequences of letters and figures in direct and opposite temporal order). The difficulty level was adjusted according to the performance of the child.

Procedure: Participants in the cognitive remediation group performed the exercises for 30 minute periods, three times a week over 10 weeks. The program took place at their school, under the supervision of a professional.

Measures: Participants in both groups were assessed before the beginning of the cognitive remediation program (pre-test) and after the program (post-test). The evaluation in pre and post-test included neuropsychological measures that differed from the computerized tasks used in the program. More precisely, sustained attention was evaluated with omission errors and vigilance in a Continuous Performance test (CPT-II; Conners, 2000). Executive control was evaluated with d2 (Brickenkamp, 1982), Color word interference Test (Stroop; D-Kefs, 2001) and errors of commission in CPT-II, and reasoning with Tower Test (D-Kefs, 2001) and Matrices of the Kaufman Intelligence Assessment (K-bit, 1990). The selected tests were already validated and normalized. Finally, working memory was evaluated with visuo-spatial digit and n-back. These tasks were computerized to facilitate their administration.

The behavioural dimension was assessed using questionnaires (parent and teacher versions), namely the ADHD Rating Scale IV (DuPaul, Reid, Power & Anastopoulos, 1998) and the Achenbach System of Empirically Based Assessment (CBCL; Achenbach & Rescorla, 2001).

The participants who usually took medication (methylphenidate) (n = 4 in cognitive remediation group; n = 2 in comparison group) were evaluated without medication, but remained under medication during the cognitive remediation

exercises. For these participants, the amount (mg/day) remained stable throughout the cognitive remediation program.

RESULTS

Mixed 2 X 2 (Groups X Time measure) analyses of variance were carried out on each dependent variable measuring cognitive functions or behavioural aspects. Although a Time effect could reflect test-retest effects, the Group x Time interaction directly reflects differential change between the groups and is the relevant test of the effectiveness of the cognitive remediation program. The extreme data (tabulated at more than three standard deviations above or below the average) was excluded from the analyses and the data that was not normally distributed was transformed (Tabachnick & Fidell, 2001). The results did not show any significant difference between the groups before the beginning of the program.

Cognitive measures

The first analysis conducted was on the commission errors using the CPT-II test. It analyzed the data of only 20 participants (10 in each group) because of technical problems with the testing software. The results showed a significant Groups X Time interaction ($F (1, 18) = 4,489$, $p = 0,048$). The participants who took part in the cognitive remediation program made significantly fewer errors than those in the comparison group.

A second analysis was performed on the commission errors on the d2 test. One participant in the cognitive remediation group did not complete the task. The results again showed a significant Groups X Time interaction effect ($F (1, 29) = 8,596$, $p = 0,007$), with the participants in the cognitive remediation group making fewer errors than those in the comparison group.

The results of a mixed variance analysis conducted on the total score of the D-Kefs Tower test also demonstrated a significant Groups X Time interaction ($F (1, 30) = 4,329$, $p = 0,046$) in favour of the participants in the cognitive remediation group.

Table 1 presents the descriptive data of the cognitive variables for which a significant interaction effect in favour of the trained group was noticed. No significant interaction effect was observed for other cognitive measures, indicating that participants in the cognitive remediation program did not differ from those in the comparison group.

Behavioural measures

Mixed analyses of variance were also carried out on the behavioural questionnaire measures. The questionnaires were collected for 24 participants (9 in the cognitive remediation group and 15 in the comparison group). On the rule-breaking behaviour scale (CBCL- teacher version), the results of the analysis showed a significant interaction effect ($F (1, 22) = 4,975$, $p = 0,036$). Teachers reported significantly fewer rules transgression behaviours, relative to pre-treatment, for the participants taking part in the cognitive remediation program.

Table 1: Means and standard deviation on cognitive measures

	Pre-test Mean (SD) [n]	Post-test Mean (SD) [n]
CPT, commission errors		
Cognitive remediation group	28.10 (6.79) [10]	23.20 (7.66) [10]
Comparison group	24.50 (6.38) [10]	24.30 (5.06) [10]
D2, commission errors		
Cognitive remediation group	17.00 (14.3) [12]	6.00 (4.7) [12]
Comparison group	9.37 (10.1) [19]	8.63 (7.7) [19]
Tower, global score		
Cognitive remediation group	13.23 (2.74) [13]	17.23 (2.62) [13]
Comparison group	15.05 (4.02) [19]	16.74 (2.75) [19]

A significant interaction effect was also noted with the ADHD scale (CBCL- teacher version), (F (1, 22) = 5,289, p = 0,031). The results of the analysis carried out on the Hyperactivity scale (DuPaul- teacher version) also showed a significant interaction effect (F (1, 22) = 10,410, p = 0,004). The teachers reported fewer ADHD symptoms, relative to pre-treatment, for the young people having received the cognitive remediation program, compared to the young people in the comparison group.

Table 2 presents the descriptive data of the behavioural variables for which a significant interaction effect was observed. No other significant interaction was observed for the other behavioural measures.

DISCUSSION

The main objective of this pilot study consisted of evaluating the effectiveness of a cognitive remediation program addressing working memory with children with CD. The cognitive and behavioural results of participants in a cognitive remediation group were compared with those of participants in a comparison group, relative to their initial scores.

The results showed that participants in the cognitive remediation group improved significantly more than the participants in the comparison group on tasks connected with executive control functions and problem solving. The results showed that children with CD who received the program reduced their commission errors on the CPT-II task more than those who did not receive the program. For this task, the commission errors correspond to the number of times the child responded whereas the objective was to abstain from responding.. This task constitutes a measure of response inhibition. Similar results were observed for the d2 task. Indeed, the results indicated that participants in the cognitive remediation group significantly reduced their commission errors, yet treated as many stimuli as the participants in the comparison group. The cognitive remediation program thus caused an increase in the capacity of response inhibition. As observed by Klingberg et al. (2005), these results indicated that working memory remediation benefits executive functions other than those specifically targeted by the program. The authors explain this result mainly by the fact that non-verbal working memory and response inhibition capacity share common neuroanatomical networks. More specifically, the higher parts of the prefrontal cortex underlie the development of storage capacities

Table 2: Means and standard deviation on behavioural measures

	Pre-test Mean (SD) [n]	Post-test Mean (SD) [n]
Rule-breaking behaviour (CBCL-Teacher)		
Cognitive remediation group	4.21 (4.74) [9]	2.33 (2.59) [9]
Comparison group	4.82 (6.31) [15]	4.73 (4.38) [15]
ADHD scale		
(CBCL-Teacher)		
Cognitive remediation group	17.00 (14.3) [9]	10.44 (6.28) [9]
Comparison group	13.93 (10.1) [15]	13.87 (4.12) [15]
Hyperactivity scale		
(DuPaul- Teacher)		
Cognitive remediation group	12.89 (6.19) [9]	6.78 (2.49) [9]
Comparison group	8.93 (5.66) [15]	9.27 (5.52) [15]

for work and response inhibition (Klingberg et al., 2002; Adleman, Menon & Blasey, 2002).

The results also showed that the participants who benefited from the cognitive remediation program performed significantly better with problem resolution tasks (D-Kefs Tower). Contrary to Klingberg et al. (2005), the improvement of problem resolution abilities was not observed with a complex reasoning task (Raven Matrices). This divergence could be explained by the fact that we used a different measure (Matrices of the K-Bit), which could be less sensitive. Other research thus remains necessary to evaluate the impact of the treatment on this type of task. Nevertheless, the results supported the idea that there is a strong bond between reasoning and working memory (Engle, Kane & Tuholski, 1999).

Oddly, two measures of working memory were not affected by the cognitive remediation program. In an attempt to understand this, we noted that the working memory test used in this study, a visuo-spacial digit test, was not standardized, contrary to Klingberg and his collaborators who used the span-board task of the WAIS-RNI. The choice of using a computerized version of this task was made to facilitate the assessment of the children but the low level of sensibility of this task might explain the difficulty in detecting improvement between the pre and post test. Span-board task of the WAIS-RNI should be used in future research. The second measure of working memory was an n-back test. Regardless of the fact that this task has not been normalised yet, it is well known that the n-back task demands mental effort to maintain and manipulate information in working memory (Ciceronne, 2002). However, we noticed that the n-back test used was difficult for the participants to comprehend and consequently, few succeeded. The tasks used were possibly inadequate to evaluate the improvement of working memory following this cognitive remediation program.

These preliminary results are promising and justify further research. Indeed, cognitive remediation in general remains very much understudied and future research is essential to better understand the questions that lie ahead. How and when to use these new findings in daily life remains a capital question.

Furthermore, it is possible to observe an impact of the cognitive remediation program on the behaviours of the children. More specifically, teachers noticed an improvement regarding the rule-breaking behaviour, attention span and hyperactivity. These improvements follow suit with the improvements observed in response inhibition tasks. Indeed, according to Barkley (1997), an inhibition deficit involves, in a secondary way, deficits concerning executive functions and behaviour self-regulation. It is thus possible that the improvement of the response inhibition allows the improvement of self-regulation. However, parents did not notice improvement in the behaviour of their children. This difference remains to be explored. It is important to note that very few parents completed the questionnaires following the program.

This project remains a pilot study and includes some limits. In particular, the small number of participants constitutes an important limit for the interpretation of the results. Furthermore, the unequal loss of participants is another limitation in the result's interpretation that has to be addressed. In fact, the loss of participants in the cognitive remediation group only is mostly related to motivational aspects, often seen in children with CD condition (DSM-IV-TR; APA, 2000). Another limitation of this research comes from the fact that the comparison group was not provided with an intervention. Therefore it did not take the placebo effect into account. We believe that from an ethical point of view, it was more important to observe significant results with a comparison group prior to the inclusion of a placebo effect control condition. Nevertheless, the use of such a control group remains an important preoccupation that will be addressed in future research.

It should also be stressed that the participants were recruited directly from their schools, inside specialized classes for children with CD. For the majority, the diagnosis was thus made by educators from the school. In addition, the divergences observed on behaviours between the evaluation by the parents and by the teachers remains a source of questioning. From this point of view, the use of more ecological measures should be planned to evaluate the impact of cognitive remediation programs on the behaviours and the adaptation abilities of children with CD. In particular, direct behavioural observation would be an interesting strategy to explore.

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Software Gearing in a Virtual Environment: The Effect on Perception of Optic Flow

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Abstract: *Immersing patients in a Virtual Reality environment whilst walking may engage and motivate them, stimulating a greater level of effort than exercise alone. Initial work has demonstrated that walking speed may be manipulated by controlling the rate of optic flow, which has potential for enhancing the recovery process for patients undergoing rehabilitation. However, it has been reported that there is a perceived mismatch between walking speed on a treadmill and the presented rate of optic flow when it is set to be equivalent to current walking speed. The consistency of this "gain mismatch" within and between participants is currently unclear and further clarification is needed if the beneficial effect of manipulating optic flow in a Virtual Rehabilitation setting is to be optimised. Preliminary findings of a study investigating this gain mismatch in a treadmill-mediated Virtual Environment indicate that substantial changes in optic flow are required before they are perceived as unmatched, and that slightly fast optic flow speeds are more likely to be perceived as normal than slightly slow optic flow speeds.*

INTRODUCTION

Slow movements, and in particular slow walking, are a common consequence of illness and ageing, decreasing the ability to function effectively in the community. There have been some promising studies using treadmill training to improve walking speed (Ada, Dean, Hall, Bampton, & Crompton, 2003; Sullivan, Knowlton, & Dobkin, 2002), but there is a need to find ways to engage and motivate patients to actively participate in their rehabilitation.

Virtual Reality (VR) is a rapidly developing area of rehabilitation research, and early work in this field has demonstrated a range of benefits in a variety of clinical applications, including motor rehabilitation (Broeren, Rydmark, & Sunnerhagen, 2004; Gourlay, Lun, Lee, & Tay, 2000). An extensive review of the use of VR for motor rehabilitation (Holden, 2005) concluded that it is a promising therapeutic approach with results which are transferable to the real world. Moreover, the use of virtual environments has been shown to increase engagement with therapy (Rizzo & Kim, 2005) and have pain-reducing effects (Hoffman, 2004). However, previous studies have indicated that treadmill walking alters the perception of the speed of optic flow in a virtual environment (Distler, Pelah, Bell, & Thurrell, 1998; Durgin, Gigone, & Scott, 2005).

Gain mismatch

The altered perception of visual speed has implications for development of the rehabilitation environment, as a system designed to have a 1:1 gearing between the real and virtual worlds (i.e. 1m on the treadmill produces 1m of movement through the virtual environment) may actually be perceived by the participant as too slow. To correctly calibrate a virtual rehabilitation system it will be necessary to establish the perceived normal for each participant. However, the level of this "gain mismatch" is not currently known, nor whether this is consistent within and between participants.

Motor Rehabilitation Interfaces

The potential of physically challenging interfaces (exertion interfaces) in the gaming industry has, in recent years, been recognized and commercially developed, for example the Nintendo Wii and the Sony Eyetoy (Nintendo, 2006; Sony, 2004). Exertion interfaces generally work in contrast to traditional human-computer interfaces, which are designed for ease of use. These more physically challenging interfaces provide the potential for significant motor rehabilitation opportunities, and rehabilitation researchers are becoming aware of the potential of exertion interfaces to enhance therapeutic

interventions. Several centres are developing novel interfaces to virtual environments, which require a deliberate and focused physical effort (Boian, 2004; Fung et al., 2004; Mohler et al., 2004). However, there is a lack of data available for the design and optimisation of both the interface and environment in order to fully exploit the health benefits of the Virtual World.

A VR training program for locomotor rehabilitation at speeds above preferred walking speed may facilitate both short and long-term gains in walking speed. Furthermore, the benefits of engagement and motivation available with Virtual Reality can be used to great effect within such a program. Despite this, to date there has been no systematic evaluation of the interactions between exertion interface, user and the virtual world, and thus there is insufficient data to properly inform the development of such a rehabilitation system. It is not yet known how factors such as screen size, realism of the environment and interactive content will influence the rehabilitation experience. Indeed, even the baseline flow rate for perception of "normal" walking speed has not yet been established.

This study aims to investigate the phenomenon of gain-mismatch in order to inform the development and calibration of treadmill-mediated virtual rehabilitation environments. The extent of the gain-mismatch and the consistency within and between subjects will be analysed.

PRELIMINARY INVESTIGATION

A self-driven treadmill interface has been constructed that connects to a personal computer to accurately record participant walking speeds using a photoelectric sensor, which detects movement of the treadmill flywheel. The output from this sensor is routed through a measurement and automation peripheral (LabJack U12), which is then interfaced to the USB port of the computer. A C++ program processes the count and timestamp (in ms) from the sensor input and uses a software gearing ratio to alter the display speed of the virtual environment.

The environment consists of a virtual walkway flanked with columns spaced at 5m intervals (Figure 1). The model was created in 3D Studio Max and displayed using WorldToolKit. The scene is back projected onto a 5m wide and 2.5m high screen using a pair of polarising projectors to produce a stereoscopic view, and the treadmill input is used to drive the movement of the viewpoint through the model, giving the illusion of walking through the virtual environment.

Figure 1: Screenshot of Virtual Walkway

Pilot-Study Design

Results from a pilot study with three participants have been analyzed, although a larger study is currently taking place. These participants were healthy adults between the ages of 23 and 36. The full study will have 20 participants between the ages of 18 and 40, with normal or corrected to normal vision and no motor or cognitive deficits. All participants are drawn from students and staff at the University of Portsmouth, UK.

A within-subjects design was used, where the gearing between the speed of the treadmill and the display speed through the environment was altered in discrete steps. Two conditions were presented in counterbalanced order. Both conditions presented the participant with 40 gear changes in each trial, ranging from 0.1 (10m in real world moves 1m in the virtual world) to 2.0 (10m in real world moves 20m in the virtual world) in increments of 0.1. The first mode (stepwise) started at 0.1 and increased the gear by 0.1 at each gearing change, descending in the same manner once a gearing of 2 was reached. The second mode (random), generated two of each gearing level and randomised the order in which they were presented. The actual distance walked and timestamp was recorded 5 times per second, and the current software gearing was recorded each time a participant's response was entered.

Participants were familiarised with the task using a demo program which presented very fast, normal and very slow gearings. They then walked steadily on the self-paced treadmill, observing

their movement along the virtual walkway (Figure 2). The participants received both the step wise and random conditions, in counter-balanced order.

Figure 2: Participant walking through the virtual world using the treadmill interface

After each gearing change the participants gave a verbal judgement of the on-screen speed:

1. "Slow" (on-screen movement appears too slow)
2. "Normal" (on-screen movement appears to match walking speed)
3. "Fast" (on-screen movement appears too fast)
4. "Unsure" (after careful observation, the participant is still unable to decide)

After a short rest, the trial was repeated, and then the same process was carried out for the second experimental condition (four trials in total for each participant).

The participants were in control of how long they need to make a decision as the gearing changes were initiated by the recording of the previous response. Each trial took approximately 5 minutes to complete.

RESULTS

The study is ongoing but preliminary analysis, from three participants, suggest that there is indeed a mismatch in the perception of visual speed when compared to walking speed. For all participants across all conditions, there was a wide range of gearing which was perceived as matched (Fig 3), even though only the 1:1 gear was actually correctly matched to the walk speed. The ranges of "slow", "normal" and "fast" appeared to be fairly consistent within participants, although there was generally overlap between the ranges. For example, in Fig 3 the participant was first presented with gear 1:1 as the 10th gear change, and perceived it as normal. When presented with the same gear as the 30th gear change, the participant perceived it as slow. These ambiguous responses tended to occur on the boundary between perceived slow/normal and perceived normal/fast.

Although there was some within-subject variation, there appeared to be a degree of consistency between the conditions for individual participants. Furthermore, the pattern of responses appeared similar whether the gearing changes were presented incrementally or in random order.

Between the subjects there was some variation, but again evidence of a pattern of response, with the range of gear values perceived as normal tending to be those above normal rather than below (Fig 5).

Participants were generally able to make a decision on the perceived speed within a few seconds, and were fairly certain of their judgements.

DISCUSSION

Early results indicate that substantial changes in visual flow are required before they are perceived as unmatched. This is consistent with the findings of Monen and Brener (1994) who observed that participants had considerable difficulty detecting changes in velocity based on visual information alone. Moreover, the perceived mismatch was also direction biased, as faster optic flow speeds were more likely to be perceived as normal than slower optic flow speeds. This would support the findings of Distler et al. (1998) of a perceived reduction in optic flow speed when treadmill walking. This shift appears so far to be fairly consistent both within and between participants, although at this preliminary stage no formal statistical analysis of the data can been undertaken.

The incidents of the same gear eliciting different responses typically occurred on the boundaries between perceived slow/normal and perceived normal/fast, suggesting that the participants had some difficulty in detecting small changes in visual velocity.

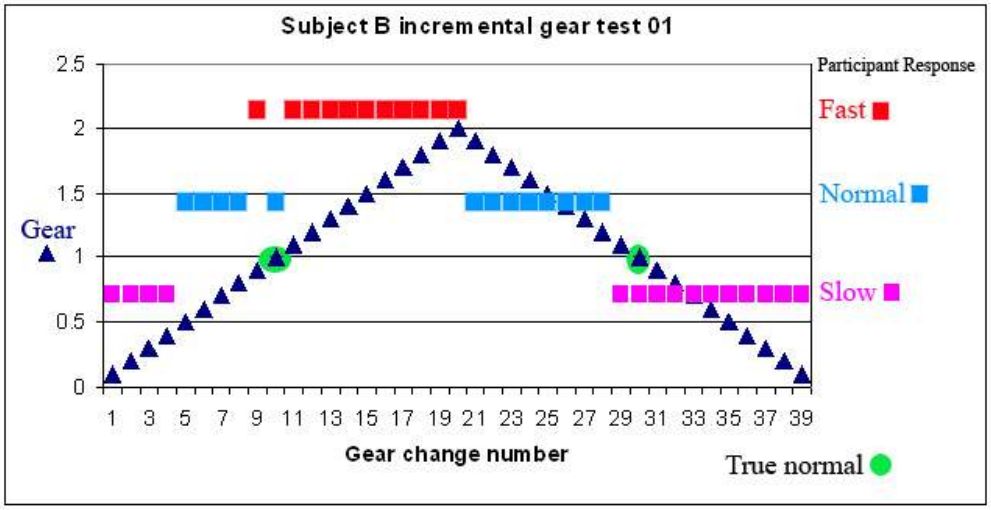

Figure 3: Typical example response range from one test of a single participant through one trial of 40 gear changes

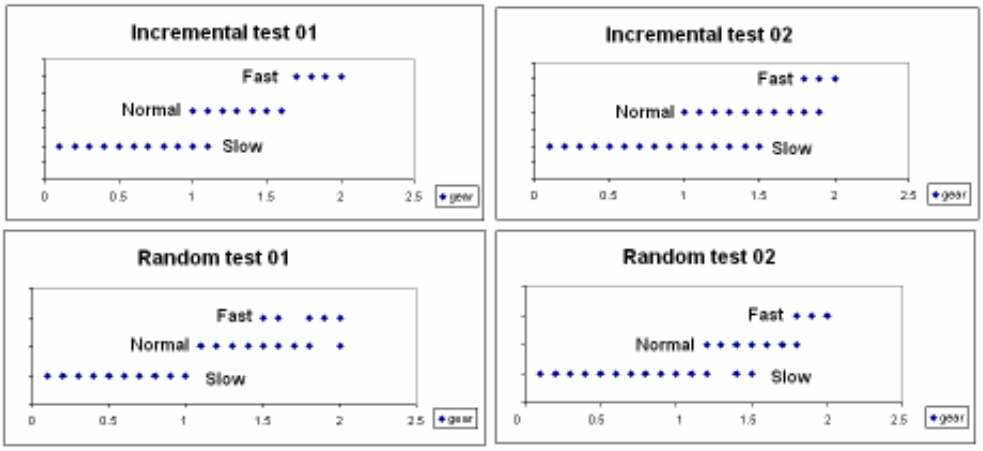

Figure 4: Subject C - comparison of response ranges across all four conditions with 40 gear changes in each (duplicate responses for the same gear level appear as 1 data point)

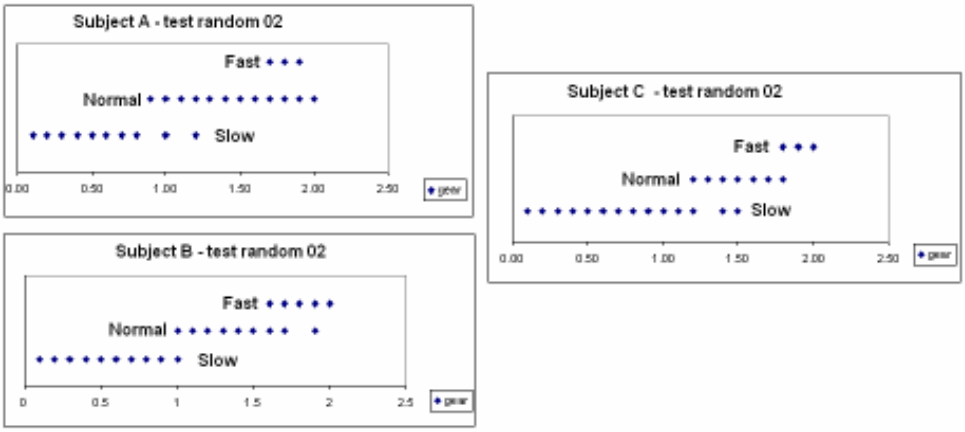

Figure 5: comparison of response ranges across three subjects for the second presentation of 40 random gear changes (duplicate responses for the same gear level appear as 1 data point)

These preliminary findings tentatively suggest hat the visual flow in a rehabilitation environment is likely to need setting slightly higher than the participant's walking speed, to be perceived as matched, although further data collection and analysis is currently underway to enable identification of the range of mismatch which can be detected.

CONCLUSION

A treadmill interface to a virtual environment has been successfully developed to facilitate the study of the perception of visual speed and establish a perceived normal gearing level for a virtual rehabilitation environment.

Unlike a traditional gearing system, which requires an increase in physical effort to drive the treadmill as the gearing increases, this software gearing system allows the biomechanical effort to remain constant whilst altering the rate of progress through the virtual world. Incorporated into a rehabilitation program, increasing the perceived rate of progress could provide positive feedback and encouragement even at very low walking speeds, whilst also providing the potential to decrease the rate of flow to promote faster walk speeds (Powell, Hand, Stevens, & Simmonds, 2006). Further investigation of the gain-mismatch in such treadmill-mediated environments will enable correct calibration and optimisation of the rehabilitation potential.

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A feasibility study for the use of a multiplayer virtual reality game to enhance the "talented" individual's organizational cohesion

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Abstract: *In this paper, we present some first results from an ongoing project for the investigation of the usage of commercial or custom multiplayer virtual reality scenarios that could enhance end empower the "talented" individual's organizational cohesion. The target organization for this project is the private health organization in the city of Kozani, Greece, which has more than 29, previously assessed, "charismatic" or "talented" workers at high-ranked positions in 8 different departments like the IT department, the Emergency Medicine department, the Surgery department and the Chronic care department. Increasingly, talented and highly qualified individuals in this organization select roles based on how much 'flow' they can achieve at work. Flow is achieved by designing jobs around signature strengths or choosing employees whose strengths present a good fit for the role. First the researchers collected data using the Sense of Coherence (SOC) concept by Antonesky (1987) for handling the demands of life and their performance in a standard "emergency incident drill" that involved all the talented individuals' roles from all departments. We then introduced to the workers a very new multiplayer game called, Battlestations: Midleway multiplayer by Eidos, which puts the player in many different perspectives, playing as a pilot, a gunner, a submarine captain or even a carrier fleet commander. The rational for this study was that the introduction of the "virtual reality game", would act as a mediator between the Sense of Coherence of the talented individuals and their generalized resistance resources (GRR's), which are the resources they have at their disposal for handling the demands of emergencies and stressful events. The exploratory experimental design included a session in the game for all the individual workers in all of the game perspectives for a maximum of 8 simultaneous players per game. At the end of all the game interactions the researchers assessed the SOC again. In addition, we collected another performance measure using a different "emergency incident drill" which again involved all of the talented workers in this health organization. As a result, conclusions were drawn regarding the possible integration of this game in the organizational cohesion research portfolio and also some interesting remarks were made regarding the implications that such an approach might have on a more positive realization of the ongoing "war for talents".*

Keywords: *Multiplayer game, future applications, health care, talented persons, organizational cohesion, stressful events.*

INTRODUCTION

The target organization for this study is a private psychiatric health organization in the city of Kozani, Greece, which has more than 29, previously assessed, "charismatic" or "talented" workers at high-ranked positions in 8 different departments like the IT department, the Emergency Medicine department, the Surgery department and the Chronic care department. The fact that very skilled or talented individuals are leaving the country and/or private health organizations, directly impacts the basic nursing care rendered. Psychiatric care is the core business of the Health Care Industry in Kozani and with the shortage of skilled professionals the health industry faces a dilemma. The in-process trainees are not yet up to standard to deliver excellent care.

All of these processes are costly, whether "talented" professionals are trained, oriented to the new job environment, undergoing induction, labor court cases are held, disciplinary hearings, and recruitment and selection are done. The normal staff reduction process (involving retirement and, to a lesser extent, disability) no

longer contributes to accurate manpower planning. There is simply no accurate way that one can plan or make provisions for future resignations. Nursing skills develop over time and with experience. New recruits need to be mentored and taught, and this requires experienced professionals with the necessary skills to do it. It is postulated that there may be factors other than money which act as motivators for leaving the current job environment and home life to go abroad to culturally different countries. Perhaps something within the Company may force a person either to seek more money or to be paid well elsewhere for the same non-rewarding job. Perhaps some people are just not happy individuals, and are restless. If this is the case, it is believed that certain "talented" applicants must be eliminated before they enter the health care field. Aspects such as personality variables, degree of job satisfaction and sense of cohesion may play a major role in the "talented" professional's decision to either leave the current job or to remain.

Because psychiatric nursing is a job filled with emotions when dealing with healthy, ill and dying patients, the personality aspect of sense of coherence will be an important factor to consider because it refers to a person's enduring and pervasive global orientation with respect to his/her feelings about his/her ability to comprehend, manage and find meaning in the world (Antonovsky, 1987). It is a key concept in Antonovsky's (1984) theoretical model of salutogenesis, which attempts to explain the origins of health. Sense of coherence might therefore be an important variable mediating the relationship between job satisfaction and organizational cohesion. Therefore this study is focusing on the sense of cohesion (SOC) alone as the main variable that will interact with the virtual reality game setting, as well as the talented individuals from the study performance under stress.

The sense of coherence

Sense of Coherence (SOC) (Antonovsky, 1987) is one of several psychological concepts, which have been developed as a way of conceptualizing the personal qualities of individuals who seem particularly effective at responding positively to life's demands. It has similarities to Kobasa's (1979) concept of hardiness and Rosenbaum's (1988) concept of learned resourcefulness. SOC has three components, and individuals with a high SOC have an enduring sense of:

- comprehensibility – they experience events as structured, predictable and explicable;
- manageability – they believe they have the resources to cope with the demands posed by changing events;
- meaningfulness – they perceive these demands as challenges, which are worth engaging in and investing energy to meet.

The stronger the level of SOC, the more the individual actively utilizes generalized resistance resources (GRR's), which are the resources they have at their disposal for handling the demands of life (Antonovsky, 1987). If a strong SOC has to be maintained, the following four spheres of life must be included: (1) personal feelings, (2) immediate interpersonal relationships, (3) the major sphere of activity, such as work, and (4) the existential issues of death, inevitable failure, shortcomings, conflict and isolation (Antonovsky, 1987).

People with a strong sense of coherence are said to believe that their internal and external environments are structured, predictable and comprehensible. They believe they possess the needed resources to meet environmental demands, and these demands are interpreted as challenges to be met and mastered (Antonovksy, 1987). Individuals with a stronger sense of coherence can more effectively neutralise the deleterious effects of stress and they appear to realize greater mental and physical health. Thus, those with a stronger sense of coherence appear to experience less anxiety (Frenz, Carey, & Jorgensen, 1993; McSherry & Holm, 1994), less depression (Frenz et al., 1993; McSherry & Holm, 1994), less stress (Frenz et al., 1993; McSherry & Holm, 1994), less anger (McSherry & Holm, 1994), and fewer physical symptoms of illness (McSherry & Holm, 1994).

The different dimensions of sense of coherence, namely comprehensibility, manageability and meaningfulness, appear to originate from different sources. According to Antonovsky (1991) consistent experiences provided the basis for the comprehensibility component. The individual needs stability and, if faced with continual chaos, danger and inconsistent experiences, the individual has difficulty making sense of this world. The individual is unable to learn what to do in the

situation because the situations to which he is exposed are inconsistent. A history of inconsistent experience may inhibit the development of the comprehensibility component of sense of coherence (Antonovsky, 1993).

Although not all coping styles are equally successful, the individual with a high sense of coherence will choose the most appropriate coping style when facing a particular stressor. This ability to discriminate between the different coping styles and to choose the correct one is probably enhanced by a stronger sense of comprehensibility. To do this, the individual has to be exposed to consistent opportunities to validate his choice of coping strategies (Antonovsky, 1991). Balanced load experience is needed for the manageability component to develop. The individual has a consistent experience in using his resources, both internal and external, to deal with situations that are appropriate to the resources on hand (Antonovksy, 1991). A balanced load would be a load of experience exposure that provides optimal demands on the individual to cope successfully with his available resources, so that he ends up feeling that he can cope. A strong sense of manageability leads the individual to feel that he has the necessary resources to cope within a given situation. People are often exposed to 'overload' if they are exposed to too many demanding situations, and this 'overload' situation may have a detrimental effect on the development of the manageability component of sense of coherence (Antonovsky, 1993).

Experiences of participation in shaping outcomes are important for the development of the meaningfulness component of sense of coherence and refer to the meaning one gives to an experience because one has chosen to take part in and undergo the experience (Antonovksy, 1993). The meaningfulness component gives the individual the motivation to understand why he should do what needs to be done, and he has the freedom to choose whether he should undergo the experience or not (Antonovsky, 1991). Wolff & Ratner (1999) explained that the sources from which these components of sense of coherence are derived comprise all spheres of life. An individual's perception that he can cope in a situation leads to a coping approach, which results in a more positive outcome for the individual. This perception that the individual has the ability to cope can be linked to Bandura's (1986) concept of self-efficacy. Bandura (1986) postulated that an individual who expects to succeed in a situation is more likely to succeed in that situation.

The research setting

Little is known about how to create cohesive groups with positive group climate. One way that has been suggested to manage groups is experiential training and team building activities. Training groups experientially can help group members to become aware, explore, establish, or create their rules and goals as a whole. Team building activities are a type of experiential education that requires groups to solve problems in a new setting where participants cannot rely on their previous experience to deal with the new situations (Wagner & Campbell, 1994), which then promotes team development (Hatch & McCarthy, 2005).

Objectives for experiential training include improving leadership, team building, problem solving, trust, and communication skills (Williams, Graham, & Baker, 2002). Leadership skills are enhanced by offering challenges that require decision-making and risk taking. Team building occurs when challenges require that the entire group work together in order to accomplish the task. Problem solving is increased when the number and type of challenges presented to the group vary. The group will increase trust when the barriers are presented and the group is encouraged to move past the barriers. Additionally, activities that require and demonstrate the importance of effective listening can improve communication (Williams, Graham, & Baker, 2002).

Various authors have described strategies for building or studying this kind of participation and sense of coherence (SOC) within an online virtual or gaming environment. For example, Jim Blascovich (2002) from the Univ. of California Santa Barbara is studying the social influence within immersive virtual environments and Haythornthwaite, Kazmer, Robins, and Shoemaker (2000) suggested three basic strategies for enhancing an online user's sense of cohesion: 1) promote initial bonding, 2) monitor and support continual participation, and 3) provide multiple means of communication. Over the past several years, our work has been directed at applying

community building and self-efficacy directed strategies within our virtual reality for emergency response and stress inoculation training (Tarnanas & Tsirgogianni, 2003).

However this is the first time that we are using a "commercial" multiplayer game for that purpose and not a specifically designed virtual environment. The game that we used was "Battlestations: Midway" multiplayer online tactical action game, which made the "talented" professionals experience the true intensity of large scale aerial and naval combat from multiple perspectives, playing as a pilot, a gunner, a submarine captain or even a carrier fleet commander, in a unique mix of direct action and tactical play. Our purpose was to use the "combat" nature and different perspectives of this game to create a dynamic "overload" situation that would help the "talented" professionals experience their participation in shaping "combat" outcomes.

In order to do that we "experimented" using the 4 different perspectives of the game (gunner, pilot, submarine captain and carrier fleet commander) as four different sessions with direct mapping to the four stages of development during a group's life (forming, storming, norming, and performing) (Gladstein, 1984). In our model, the term forming represents the "gunner's" group of activities used to establish a pattern of interaction within a group. Through these behaviors, group members develop a level of attraction and cohesion to one another. Storming, on the other hand, occurs when group members have conflicts of interest and significant differences of opinion about group functioning, goals, and tactics. Activities related to managing conflicts and disagreements occur during storming periods. We chose the "pilot's" perspective in order to explore this stage. Raven and Rubin (1976) define norms as "standards against which the person can evaluate the appropriateness of behavior ... providing order and meaning to what otherwise might be seen as an ambiguous, uncertain, perhaps threatening situation" (p. 314). Thus, the "submarine captain" perspective in our model represents a set of activities directed toward the establishment of these standards. In our model, performing represents a class of behaviors that are directed toward task accomplishment. These include problem solving, decision-making, and various "implementing" activities as a "carrier fleet commander". We hypothesized that forming, storming, norming, and performing may occur many times during a group's life. Thus we "circulated" all 29 workers in all of the game's perspectives with their choice of possible pairs as "gunners" and "pilots" for a maximum of 8 simultaneous players per game. That way every worker experienced all of the game perspectives and had a chance to state his own choice and motivation for the team member to position in a different perspective as well.

We chose the above procedure because these workers operate in a diverse organizational system in which the rules, roles, task definitions, information, and resources needed for the group to perform effectively are not readily and rigidly dictated by the organization, the circumstances, or a group leader (i.e., not an excessively strong organizational context). Our model is based on situations where groups have some discretion or flexibility in their work processes. Thus, this model may be less applicable to groups operating under very tightly controlled conditions. The hypothesis was that this kind of participation would be important for the development of the meaningfulness component of sense of coherence and refer to the meaning one gives to an experience because one has chosen to take part in and undergo the "combat" experience in four different perspectives (Antonovksy, 1991). Groups must be able to coordinate themselves in a flexible manner, and there must be commitment to group goals that both direct and motivate members. Gladstein (1984) suggests that successful groups require open communication, mutual supportiveness, effective conflict management, discussion of strategy, and the appropriate weighing of individual inputs into group decisions.

To test this hypothesis we first gave the professionals the Greek version of the Antonovsky's sense of coherence scale (Tselebis et al, 2001) before and after a series of sessions in the game. The SOC scale has 29 items, eleven of which contribute to comprehensibility, ten to manageability, and eight to meaningfulness. The items are scaled along a 7-point semantic differential with two anchoring phrases at each extreme. A total score ranges from 29 to 203, where higher scores reflect a stronger sense of coherence. Thirteen items are reverse scored to avoid a response set bias. The reverse scored items in-

cluded the following items: 1, 4, 5, 6, 7, 11, 13, 14, 16, 20, 23, 25 and 27. The long version of the SOC consists of 29 items and a 7-point Likert scale was used with answers to vary between two poles. A typical question would be: "Do you have the feeling that you do not really care about what goes on around you?" The SOC questionnaire is divided into three subscales, namely:

- Comprehensibility – this scale measures the way in which one arranges, predicts and perceives one's world. The items specifically measuring this subscale are 1, 3, 5, 10, 12, 15 and 26.
- Manageability – this scale measures the manner in which one copes with stressors and the items are 2, 6, 9, 13, 18, 20, 23, 25, 27 and 29.
- Meaningfulness – this measures the perception of the meaningfulness of one's life and items to measure this are 4, 7, 8, 11, 14, 16, 22 and 28 (Antonovsky, 1987).

Antonovsky (1993) warned that the components should not be considered as subscales, since, firstly, the items were constructed by using a facet analysis design so as to vary the content systematically along a number of dimensions; secondly, from his point of view, he concluded that factor analysis of the scale was likely to produce a single factor solution, which would not reflect the three components. Antonovsky (1987) found positive proof of construct, criterion and predictive validity. With regard to construct validity, he found a negative correlation between SOC and stress levels, which means that people with a high sense of coherence will evaluate stressors as stimuli on which to act. Frenz, Carey and Jorgensen (1993) found a negative correlation with the State and Trait Anxiety Inventory of Spielberger and the Beck Depression Inventory. This proves the construct validity of the SOC.

In addition we collected a live performance measure using an "emergency incident drill" before and after the game, which involved all of the talented workers in this health organization as a "team", since we hypothesize a relationship between perceived controllability, sense of cohesion and performance. Literature states that participants who operated under the cognitive set that organizations are controllable, maintained a strong sense of coherence, set challenging goals, and exhibited effective analytical thinking. A previous study (Tarnanas et al, 2003) found that, as individuals begin to form a self-schema of their efficacy through further experience, the performance system was influenced more strongly and intricately through their conceptions of self-efficacy. Therefore one's cognition, emotions and behavior will all play a role in the development of self-efficacy in an "emergency incident drill" before and after the game, and one's past experiences and current resources are important factors in achieving and mastering one's performance.

DISCUSSION

The Wilcoxon test is a nonparametric test, which was used to determine whether the pre- and post- SOC questionnaire for the experimental group was significantly different with concern to Comprehensibility, Manageability and Meaningfulness. The Wilcoxon test is the nonparametric alternative to the paired t-test. Results of the Antonovsky's sense of coherence scale showed a significant increase ($T = -2.388$, $p = .001$), skills from pre- to post "multiplayer game" (Table 1).

On average, "talented" individuals' ratings changed .51 points from 3.38 (neither weak nor strong) to 3.85 (somewhat strong). Empirical results from the performance of the team on the "emergency incident drill" before and after the game also showed an improvement, although the quantitative measure of the reaction times during the two "emergency incident drills" did not significantly change. There were many observational data however (video) of an enhanced "immersion" in the stressful situation and "flow". Those data were collected using after action review and analysis of behaviors observed in real-time using our video feedback. We defined "flow" according to Csikszentmihalyi (1997): "when people are in a flow state [they] shift into a common mode of experience when they become absorbed in their activity. This mode is characterized by a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out; by loss of self-consciousness; by a responsiveness to clear goals and unambiguous feedback; and by a sense of control over the environment it is this common flow experience that people adduce as the main reason for performing the activity" (p72). When this experience occurred

Table 1. Pre-test/Post-test SOC Means and Differences

Experimental Group (n = 29)					
Subscale	**Pre**	**Post**	**Difference**	**Z**	**p**
comprehensibil-ity	3.45	3.94	+0.49	-2.37	.00
manageability	3.33	3.84	+0.51	-2.39	.00
meaningfulness	3.39	3.89	+0.50	-2.38	.00

during the game it was associated with a positive emotional state and was characterized as an optimal experience, where nothing else matters but the game (high level of presence).

The above results from this exploratory experiment raise a few questions for future investigation. By way of statistical methods, numerous studies have investigated the validity, reliability, and applicability of the SOC scale with positive results. In this paper we explore the idea, the concepts, the theory and the operationalization behind a "commercial" virtual multiplayer "combat" game in correlation with Antonovsky's basic idea of coherence. The conclusions are: 1) it seems that Antonovsky's basic idea of coherence, for which he coined the term sense of coherence, as the basis for the highly popular salutogenic orientation is outstandingly good, in spite of the lack of statistical evidence; 2) the chosen key explanatory concepts of comprehensibility, manageability, and meaning through a virtual "online combat" game experience, seems to be a fair, although mental, conceptualization of this idea; 3) A complete theory of how exactly the "commercial" virtual multiplayer "combat" game predicts performance at the real-life "emergency incident drill" was unfortunately much less clear, as Antonovsky assumed predictability to be very important for the sense of coherence, especially for comprehensibility and manageability. This notion of predictability leaves its footprints in this operationalization of the "commercial" virtual multiplayer "combat" game into the SOC theory.

Our analysis is promising in a way because it convinced us that a "commercial" virtual multiplayer "combat" game is likely to be a fair materialization of the idea of coherence but unlikely to predict empirical performance of the team during a stressful event correctly. Before the application of this idea at large scale in an organization, it is very important to understand how team-building activities affect the group's climate, cohesiveness, and development because a group's growth affects group effectiveness. Although this exploratory experiment has been a push to examine the effects of a multiplayer "non-immerisive" virtual reality game on a group's sense of cohesion, there is still a lack of research, in the experiential multiplayer virtual reality field, examining a group's development life to predict empirical performance. We can only hypothesize that if such team building activities affect group development, then groups that experience team building activities will move through the stages (forming, storming, norming, and performing) at a different rate (faster) than groups that do not go through a multiplayer virtual reality game team building experience.

However, our opinion at this stage is that the usage of a multiplayer virtual reality game team building experience should correspond to the "context" of the stressful event or situation that needs a performance improvement. For example, if the development of a high functioning war veterans rehabilitation team is the goal, then a virtual multiplayer "combat" game might not be the right tool for the job. On the other hand if we aim at high performing teams responding to major disasters, then a virtual multiplayer "combat" game might better empower the self-oriented dimension activities that contribute to the expatriate's self-esteem and self-confidence. There are three subfactors in this dimension: (1) reinforcement substitution, (2) stress reduction, and (3) technical competence. In order to investigate the possible advantages of virtual multiplayer "combat" games in relation to the usual role-playing games already used in large at organizations, more research needs to be done.

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Original Research

Hormonal related variability in auditory dysfunctions

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Abstract: *Despite tinnitus and hyperacusis being considered hearing dysfunctions typical of old age or of occupational hazards in noisy work environments, a rapidly growing number of women suffer from idiopathic tinnitus/hyperacusis from unknown aetiology. Female hormone cyclic shifts affect the ear, and therefore, possibly the perception of loudness. The goal of this study was to use self-assessment methods to explore auditory dysfunction fluctuations in women in relation to hormonal variability. Human physiological research demonstrates hormonal related variability in sensory processing in females. Its hypothesized effect on auditory dysfunctions is explored in a questionnaire addressed via Internet or standard mail. As expected, the main factor discriminating participants involved by Internet was age, followed by education level. Preliminary results show changes in perception of auditory dysfunctions in relation to hormonal cycles. In a future report, this data must be validated with double blind procedures, which must be adapted for Internet methodology.*

INTRODUCTION

Until recently, tinnitus was considered a hearing dysfunction typical of old age or a occupational hazard in noisy work environments, but a rapidly growing number of women suffer from idiopathic tinnitus or hyperacusis unrelated to either causes. Female hormone cyclic shifts affect the ear, and therefore, possibly tinnitus and hyperacusis. The goal of this study is exploratory in order to assess the most efficient way to obtain self-assessment of perceptual fluctuations in women in relation to hormonal variability.

Gender and demographic prevalence –Tinnitus is generally considered a hearing dysfunction more common during aging and/or in individuals working in noisy environments, more frequently in males. Recent studies (Baribeau, 2005, 2006) showed a rapidly growing number of women suffering from idiopathic tinnitus. Andersson (1999) had shown in the population over 40, that 20% of normal individuals experience tinnitus for some period in their life. Ten to 15% of them report it as distressful to the point of adversely affecting daily functioning. Tinnitus is the 10th most commonly reported symptom among the elderly in primary care and is rapidly growing in affecting middle-age women (Andersson, 2002). Preceding studies showed fewer responses to polls about tinnitus in the female population when using the Internet as opposed to newspapers and community group networks (Baribeau, 2004; Baribeau, Gordon & Roy, 2005).

In middle-age women, idiopathic tinnitus and hyperacusis go often unreported in Quebec health statistics, remain considered a non-medical condition and as untreatable (RQPA, 2004). Idiopathic tinnitus and hyperacusis are not presently medically treated with predictable results despite the fact that on average, they last from several months to several years, with no scientifically demonstrable curative method.
Hormonal variability. Most of the review of physiological literature below demonstrates hormonal related variability in sensory processing in human females (Johnson, 2000). Objective measures of thresholds and brainstem auditory evoked potentials vary with the menstrual cycle in women (Campbell et al, 1981; Laurent et al, 1986a; 1986b). On the other hand, variance is also reported in terms of auditory dysfunctions in schizotypal personality, which is known to be prone to auditory perceptual illusions (Baribeau & al, 1994, 2006; Roth et al, 1994; Roth et al, 1996).

The inner ear has receptors dedicated to estrogenic hormones. Estrogens may have an effect on the functioning of the cochlea and on hearing (Stenberg et al, 1999). The impact of hormone cycles in the auditory system include changes in

blood pressure which are different in men and women (Chen 1996), changes in hearing sensitivity in women during menstruation cycles (Swanson et al 1988), changes in the acoustic reflex during hormone shift (Laws et al, 1986), and in the immune system which may also directly influence the health of the cochlear structures (Angstwurm et al, 1997), and finally, modulations of brainstem and middle-latency auditory evoked potentials in auditory pathways in women (Campbell et al, 1981; Picton et al, 1978; 1984). These studies involve younger females, prior to middle age.

Animal research demonstrates significant changes in auditory responses in relation to biocycles (Baribeau et al, 2006) and when ovaries are removed (Cooper et al, 1999). There is also evidence that hearing changes take place which prolong processing in older female subjects, and that are directly linked to blood estrogenic levels. Johnson (2000) is in the process of duplicating the present study with a larger number of subjects and with a more detailed daily assessment of tinnitus ratings. Removing the ovaries produces changes in cardiovascular function that effect changes in the blood flow to the cochlea and therefore could potentially have an impact on auditory function (Laugei et al, 1987). Embryological studies show that the ear is an encapsulated epidermal tissue including hormonally influenced cells. Its blood rich *stria vascularis* lines the wall of the cochlea. Cyclical hormone fluctuations are thought to be responsible for some of the changes in the metabolic function and neurotransmission in the *stria vascularis* of the inner ear. On the other hand, several demographic studies demonstrate shifts in blood pressure between men and women until women enter menopause, at which point gender differences become non-significant. After menopause, this risk tends to equalize between the sexes. In conclusion, in addition to clinical observations by audiologists (e.g. Johnson, 2000), many empirical findings support the hypothesis that auditory dysfunctions such as tinnitus are influenced by hormonal variations.

Idiopathic tinnitus and hyperacusis - Although tinnitus is often related to hearing loss, long-term noise exposure, and medications, idiopathic tinnitus and hyperacusis demonstrate no known aetiology. Often, the cumulative factors required for specifying aetiology are not consistently reported in medical files or clinical studies (Andersson & Lyttkens; 1999). However, careful analysis with comprehensive questionnaires demonstrates higher frequencies of aetiological categories and distressing symptoms than the statistics derived from medical records (Baribeau, 2005).

In Québec, subjective idiopathic tinnitus and hyperacusis are more frequently correctly diagnosed in patients who care to make the extra requests for follow-up with one or another of the few available audiologists who specialize in tinnitus assessment (Baribeau, 2005). A minority will undergo an exhaustive diagnostic investigation including repeated ORL examinations and extensive audiometric testing. Because patients with cumulative and chronic distressing idiopathic symptoms do not receive treatment, they are often excluded from clinical statistics. In addition, because women's tinnitus may more often be linked to other non-audiological disorders, many cases might have gone unnoticed in health statistics.

Degree of distress and perceived loudness. - Preceding studies by Baribeau et al (2004; 2005) showed that out of 500 individuals identified as having tinnitus and/or hyperacusis, approximately 350 indicated significant tinnitus and, according to the method of questioning, 16% to 37% expressed severe distress with impact on daily activities and quality of life.
Even higher incidence was derived from comparisons of different quantifiable and verifiable methods of data collection, which provided standardized questionnaires administered in semi-structured interviews in order to improve validity and reliability (Baribeau et al, 2004). The lowest rate of 16% derived from objective behavioural estimates based on the frequency of behaviours demonstrating seeking help. This largest rate of 37% for distressing tinnitus is significantly higher than the 15% reported in less exhaustive surveys (Andersson, 1999) and frequently includes hyperacusis. This highest incidence number was based on a method of interviews detailing impact of distress on specified lists of daily activities. This indicates that, with proper reaching out and questioning, affected women might account for a larger percentage of distressful tinnitus than in general statistics.

According to Budd (1996), individuals with distressing joint tinnitus/hyperacusis experience significant stress and major dwindling in their quality of life, because of stress, of the annoyance factor associated with tinnitus, and related symptoms such as hearing deficits and sensitivity to noise (hyperacusis). According to Meric et al (2000), rates of report of distress are higher with a more elaborate questionnaire. According to Baribeau et al (2004; 2005) activities of daily living are affected in proportion to the distressing characteristics of the tinnitus, its qualitative aspects as much as its intensity (Baribeau et al, 2004, 2005) largely unrelated to voluntary control. Because of their monthly experience with stress tolerance in relation to menses, it is hypothesized that women make a conscious connection between their experience of tinnitus, their stress tolerance and menstrual variability. The potential relation between intensity of the auditory dysfunction, its perception and monthly fluctuations deserves to be explored in women, until more systematic and complex direct measures of hormonal fluctuations are ascertained.

Goal. The present study attempted to attend to untreated female tinnitus/hyperacusis sufferers in order to more fully assess the phenomenology of such symptoms in relation to their experience of monthly hormonal variability.

The review of literature reports studies on how female hormones affect hearing in young healthy subjects, but few studies report perception of tinnitus in middle age women in Québec. A link between variations of female hormone cycles, hyperacusis and tinnitus perception was suggested in a previous study using open-ended questions (Baribeau et al, 2004) and was observed by practitioners in clinical practice (Johnson, 2000)

This issue demands consideration of demographic parameters and polling approach. The goal of the present study is to examine the incidence of idiopathic tinnitus in women in relation to hormonal variability. Women were recruited via standard mail procedures or via internet-mediated support network for individuals affected by tinnitus. The question asked to women in this study is whether they noticed changes related to their menstrual cycles in their auditory dysfunctions in relation to loudness perception.

METHODS

The present study investigates self-assessment methods in order to analyze responses obtained in standard mailed questionnaires and in an internet/email-based method, from middle-aged female participants. Given the nature of this goal, obviously, double-blind procedures were not applied. Double-blind procedures require a laboratory environment in order to be properly applied in self-assessment approaches.

Procedure. Due to the formal definition of tinnitus and its link to aging and auditory dysfunctions, many middle-aged women with stressful tinnitus are not recruited in tinnitus studies. In order to circumvent this communication issue and in order to reach out to the middle aged female population, potential subjects were recruited through internet, using advertisement for widely publicized public events related to music, such as concerts and music shows (Meetings of l'Association des musiciens de Montréal'05, Salon de la musique 2005, Music Fest Show'05, Place Bonaventure-Journées de la musique'05etc). The Internet address was thus distributed to hundreds of potential subjects via such media, along with a basic definition of key words such as "acouphène" and tinnitus. In itself, this resulted in hundreds of email responses and Internet communications. When email addresses were missing subjects were contacted by phone.

Participants. In response to first contact, participants were offered support and answers to their questions while obtaining responses to items derived from a standardized questionnaire (Baribeau, 2004; 2005). Out of approximately 350 individuals expressing a need for support groups, 230 signed in, out of which 98 followed up with semi-structured open-ended questions, of which approximately half were women. Approximately 50% of the sample were 40 years of age or older. These volunteers originated from 4 regional locations: Québec, Montréal, Victoriaville, Trois-Rivières. About half were from a major city (Montreal) and half from the regional smaller town locations. All volunteers were offered alternative support via regional support group meetings and peer counselling (non professional) via the RQPA telephone help line.

Subjects. Selected women participants were screened for minimal tinnitus/hyperacusis duration of 6 months and for presence of auditory distress. Since there were no major differences between urban and smaller regional towns, the data from subjects of regions and cities were pooled. Inclusion criteria: 40 to 65 years of age, cycle regularity between 27 and 31 days. Exclusion criteria: any other medical condition, hormone therapy. For 35 subjects, tinnitus variance was reported in a structured interview with a grid covering a 2 month period, and questions targeting the degree of related discomfort. In the rest of the sample, similar questions were asked on an open-ended questionnaire covering the same period, complemented by a list of objective questions on the ways tinnitus affected daily activities (Baribeau et al, 2005). In the first group, 90 individuals in the target age range received the invitation to participate in a mailed distribution of a bulletin. A sub sample of 20 women was analyzed in order to verify potential differences from the rest of the sample. Due to absence of significant differences, the 2 sub samples were merged. Overall, out of a pool of approximately 350 contacted individuals 98 provided contact by email/internet. In total, forty women met the age criteria between 45 and 65, met the cycle regularity requirement and did not take hormone therapy and 35 of them also filled a calendar-type grid.

Data collection. Table 1 gives a summary of dependent and independent variables. These cases were examined with reference to rating scales, varying from 1 to 10, going from absent, difficult to rate, light, moderate to severe: A) monthly variability. B) Intensity of tinnitus and/or hyperacusis C) Impact on daily activities D) Distressing quality of tinnitus and/or hyperacusis. Subjects were asked to rate their perception in reference to the same daily point in time and following the standard procedure in the audio logical literature: the loudness rating required that subjects rate the hyperacusis experience and listened to the tinnitus in a quiet place for a few seconds until confident about rating its loudness on a 0-10 scale, where 0 would be completely silent and 10 would be as loud as a jet engine of an airplane. Responses were organized using a calendar type grid with cycles varying from 27 to 31 days. In order to compare results between participants with varying cycle length and since there was little variability in the 1rst and 3rd quartile, 1 to 4 days were removed in order to obtain comparable cycle length of 28 days for all participants. Due to the importance of collecting data during menses, ratings were taken at 2-day intervals during menses and at 3-4 day intervals between menses.

Based on preceding validation studies of the questionnaire (Baribeau et al, 2004, 2005, 2006), 24 items of a 70-question survey (QDDT v.1) were used to serve as reference points to categorize and compare mailed and internet/ phone reports. Responses and follow-up questions were presented in a standard format using most of the formulations of the QDDT, and responses from participants were rated using the same procedure. The internal consistency of these questions was assessed with 79 subjects (with no missing values) in order to measure Cronbach alpha index of internal consistency. Similar methods to Zachariae et al (2000) were used. This internal validity index calculated for the 24 items used in the Internet version of the present questionnaire in French is excellent, with a value of .92. It is significant and comparable to other questionnaires formatted in English (Meric et al, 2000), and Danish studies (Zachariae et al, 2000).

Statistical analyses - For the structured questionnaire items, group differences were assessed with t-tests for ratio variables and Chi square tests for frequency counts. For content analysis of text, frequency and category data were analyzed with non-parametric Chi square statistics. Other demographic data were analyzed with t-tests with significance p value set at .05. Monthly variations were not tested for significance given the large number of data. Tests will be done with larger samples in future analyses.

RESULTS

Item analysis. Responses were examined with reference to three categories of questions, using a similar method to other comparable internet studies (Coulson, 2005) for support: such as affective, informational/factual, networking and professional or paramedical help). Most women mentioned interest in better understanding the relation of hormones to their auditory

Table 1 – Top: Dependent and independent variables—Bottom: Monthly variability of loudness ratings and distress ratings*

Demographic information	Age	Education	Occupation	Gender
Auditory dysfunctions	Hearing deficit Left/Right	tinnitus/hyperacusis characteristics	Onset and triggers	Impact on daily activities: total score (QDDT)
Hormonal cycles	Abnormalities endocrine conditions	Ovary related conditions	Pre-menopausal circumstances	Peri-Menopausal
Tinnitus loudness rating 1-10	Mean week 1/5 Day 1/3/6 etc	Mean week 2/6 Day 10/13/16 etc	Mean week 3/7 Day 20/23/26 etc	Mean week 4/8 Day 26/28/30
Mean distress Rating 1-10	Mean week 1/5	Mean week 2/6	Mean week 3/7	Mean week 4/8 Menses
Monthly variability	Loudness Rating / Distress Rating	Variance/Variance Loudness / Distress	Loudness/Distress Correlations	P value
Day 1	7,1 / 7,9	37,15 / 36,02	,87	.05
Day 3	6,1 / 6,5	36,05 / 36,14	,85	.05
Day 6	5,1 / 5,9	37,05 / 39,48	,75	.06
Day 10	5,5 / 5,6	36,55 / 36,41	,70	.11
Day 13	5,5 / 5,9	36,06 / 38,08	,69	.15
Day 16	5,4 / 5,2	35,57 / 34,90	,67	.53
Day 20	5,3 / 5,2	35,90 / 35,70	,63	.55
Day 23	5,6 / 4,9	35,17 / 34,01	,78	.16
Day 26	5,3 / 5,9	35,29…….37,09	,81	.08
Day 28	6,3 / 6,3	34,90 / 33,90	,83	.05
Day 30	7,5 / 7,1	36,25 / 36,39	,84	.07
Day 33	6,7 / 6,8	35,04 / 35,71	,79	.06
Day 36	5,5 / 5,4	35,42 / 35,38	,72	.12
Day 40	5,2 / 6,0	36,04 / 39,39	,62	.23
Day 43	5,6 / 5,5	36,52 / 37,01	,57	.25
Day 46	5,5 / 5,7	36,09 / 36,87	,61	.41
Day 50	5,5 / 5,4	35,55 / 37,01	,59	.46
Day 53	5,5 / 5,6	36,23 / 37,09	,60	.16
Day 56	5,3 / 5,9	35,69 / 38,31	,75	.07
Day 60	6,7 / 6,8	35,40 / 35,74	,76	.05
Day 63	6,3 / 6,9	46,33 / 42,01	,71	.06
Mean	5,3 / 6,2	32,76 / 36,67	,72	
Note: Johnson sample with daily	(2000) is in the reports)	process of	collecting such	data on larger

dysfunctions. About 10% provided systematic daily ratings of tinnitus loudness and distress perception for 90 days. The majority presented weekly ratings for two months in relation to their menstrual cycle. Reports were quantified with the same rating scale for all participants with the standard TRS, from 0 to 10 for each factor: loudness perception and distress rating.

Comparisons of contents between questionnaire methods showed no significant difference between women 45 to 65 from the younger age group in the Baribeau (2006) study, which confirms equivalences reported earlier. In the open-ended questions section, item analysis shows that primary contents were concerned with the communication of factual information between hormones and auditory dysfunctions, particularly with questions about symptom quality, intensity, duration, prognostic factors, and medical causative variables. Secondary contents invoked a theme related to the interpretation of evolution of symptoms over time. The 3rd category related to requests for references to medical and health practitioners; the 4rth theme referred to issue of care, to ways of handling symptoms and related impact on stress tolerance, depression, anxiety, and fear of aggravations.

Comparisons of demographic data (age, education, location) between the mailed and Internet reports showed the following. As expected, the main factor discriminating participants involved by Internet and those involved by mail was age, followed by education level. The Internet group was 12 years younger with a higher level of education of 2 years. As expected, the main factor discriminating participants involved by Internet and participants not available on the Internet were age and location, followed by educational level. Age was confounded by the location variable since a large pool of younger subjects were recruited via internet addresses distributed at the music events, as opposed to the community group web sites.

There were no differences in number of females between age groups or regions. There was no significant difference in frequency in reports or in number or nature of questions about distressing symptoms of tinnitus and/or hyperacusis. The large majority of women could not dissociate tinnitus from hyperacusis in their ratings. Thus the values for the 2 dysfunctions were averaged and merged. All data about these 2 dysfunctions were pooled for future analyses. In the following figures, the reported values refer to frequency counts measured for each group. Reference to distress was counted only once according to one or the other of 24 items of the questionnaire, most items referring to how tinnitus/ hyperacusis affected daily domestic, familial, work and social activities. The total count is reported here as an index of distress. Participants reported tinnitus/hyperacusis-related distress, depression, and daily annoyance with the percentages illustrated below. Immediately following the support-groups, about half the participants showed appreciation of reassurance and satisfaction at the information obtained. The same ratio of appreciation was expressed in the Internet group. There was no significant difference between women assessed via Internet versus mailed questionnaires.

Content analyses showed some heterogeneity amongst factors of tinnitus/hyperacusis intensity. Hearing acuity was defined as a “significant problem” by 25% of respondents. Many women had experienced tinnitus or hearing impairment following excessive use of *walkman* types of devices (33%) or in relation to hearing distress in a noisy environment (receptionist, telephone operator, machine operator). Approximately half of the women asked for information about ear protection if they were aware of the potential for permanent hearing loss (50%) or were advised by a medical professional (50%). In summary, the analysis of women’s responses suggested that approximately a third of them have experienced tinnitus after exposure to loud sounds. This was the main difference with the older female age group reported in the literature (Baribeau, 2005). According to Figure 2, the mean counts of distress reports were comparable between mailed (38) and internet/phone reports (39).

The temporal changes in mean and variance of tinnitus perception is presented in table 1 for the subgroup of women (n=35) who reported regular ratings. Trend analyses will be presented in a future report, which will take into account missing values. For this reason, significance tests are not considered statistical esti-

mates but p values are rather reported as trend indicators and for their exploratory value. It is apparent that on days –1 to day 3 of the menstrual cycle at time of menses, mean values and correlations between tinnitus and hyperacusis loudness and distress ratings indicate that women report perception of significantly higher tinnitus/hyperacusis intensity. This is a trend indicating that middle-aged women indeed present monthly variability in their report of auditory dysfunctions. The variability in the hyperacusis responses and its interaction with tinnitus loudness and distress indicates that future studies must address the issue of dissociating such interactions.

DISCUSSION and CONCLUSION

Despite age and educational differences between the two women groups, these results suggest that women responding via the Internet refer to similar contents and symptoms to the larger sample accessible via standard traditional mailing approaches.

This Internet based approach generated more responses than via community organizations. It thus appears as a feasible method to obtain tinnitus data from this segment of the female population. High dropout rates or delay in communication can be a characteristic of studies using the Internet with the older age group, but should be contrasted with the cost effectiveness and accessibility of the Internet.

The most frequently invoked theme in the open-ended questionnaire related to the interpretation of evolution of symptoms and to obtain advice in handling symptoms and related impact on stress tolerance, depression, anxiety, fear of aggravations, stress and insomnia. Before contact, few individuals were informed of relevance of hormonal condition on their experience of tinnitus. Most women mentioned interest in better understanding the relation of hormones to their auditory dysfunctions. This provides the basis for the offering of an internet-based service for women suffering from tinnitus and hyperacusis.

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Revising the factor structure of the Simulator Sickness Questionnaire

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Cybersickness (McCauley & Sharkey, 1992), or more appropriately, virtual reality induced symptoms, is the term commonly used to describe the temporary side-effects caused by an immersion in virtual reality. Cybersickness does not represent a disease but rather a normal physiological response to an unusual stimulus (Lawson, Graeber, Mead & Muth, 2002). Following McCaulay and Sharkey's 1992 paper, cybersickness is often compared to motion sickness, although Cobb, Nichols, Ramsey and Wilson (1999) and Lawson et al. (2002) argued that the aetiology of the side-effects of immersions in virtual reality is significantly different. Typical symptoms include nausea, dizziness, headache, eyestrains, blurred vision, vertigo, difficulties keeping balance, sweating and general discomfort.

Reviewing the literature about the side effects of virtual reality is complex because side effects are caused by several factors, many of which depend on the technology used (e.g., HMD vs CAVE technology, weight and field–of-view of the HMD, or speed and accuracy of motion trackers and computers), the task performed by the user (e.g., intensity of motion and head movement), and individual differences (e.g., people from the general population vs highly trained military personnel) (Cobb et al., 1999; Frey, Harting, Ketzel, Zinkernagel & Moosbrugger, 2007; Golding, 2006; Lawson et al., 2002; Nichols & Patel, 2002). Since a detailed literature review on cybersickness is outside the scope of this paper, the reader must keep in mind that incidence rates of virtual reality side effects can vary significantly according to the aforementioned factors.

Symptoms of cybersickness appear to be common among people immersed in virtual reality. In general, about 5% of the users do not experience any side-effects and 5% experience side-effects so strong that they have to stop the immersion (Lawson et al., 2002). Cobb et al. (1999) and Wilson (1997) summarized the results of a comprehensive research program conducted with 148 civilians and 75 non-civilians using a variety of virtual environments, tasks and equipment and for immersions that varied between 20 to 120 minutes. They found that 20% of their civilian participants did not notice any side-effects. Among the remaining participants, only a few (5% of the total sample) experienced side effects severe enough that they had to stop the immersion. The other participants reported side-effects that, usually, were mild and subsided within 10 minutes after the immersion. Symptoms usually occurred within the first 15 minutes of the immersion. Howarth and Finch (1999) assessed nausea symptoms every minute with 14 civilians immersed for 20 minutes in a virtual environment. They found a progressive increase of symptoms over time, followed by a steep reduction after the immersion. Using data collected during 938 military flight simulations, Kennedy, Stanney and Dunlap (2000) demonstrated that longer immersions (sometimes more than three hours) progressively induced more side-effects and that symptoms tend to be less severe after a few repeated immersions.

The dominant theory for virtual reality induced side-effects is the sensory conflict theory (Golding, 2006; Oman, 1982; Reason, 1978). This theory proposes that symptoms occur during immersions primarily as a result of conflicts between three sensory systems: visual, vestibular and proprioceptive. An example of conflicting stimuli during an immersion would be if, while wearing a HMD, the eyes perceive a head movement that is out of sync by a few milliseconds with what is perceived by the vestibular system, whereas the remainder of the body remains almost motionless. This theory has been questioned (Stoffregen & Riccio, 1991) and alternative explanations have been proposed, such as the postural instability theory (Bonnet, Faugloire, Riley, Bardy & Stoffregen, 2006; Riccio & Stoffregen, 1991). Since this is not a matter of wide debate in the literature, the debate is still open.

Although a few instruments exist to measure virtual reality induced side effects (e.g., Ames, Wolffsohn & McBrien, 2005; Golding, 2006; Lawson, 1993), the Simulator Sickness Questionnaire (SSQ) from Kennedy, Lane, Berbaum and Lilienthal (1993) is the most-often used instrument to measure virtual reality induced side effects. The symptoms of the SSQ are supposed to form three factors: nausea (e.g., vomiting, dizziness), oculomotor (e.g., eyestrains, blurred vision, headaches), and disorientation (vertigo, imbalance). The factor structure of the SSQ is based on the Kennedy et al. (1993) study with a sample of 1,119 military participants who were immersed in a variety of Navy simulator training exercises. The original pool of items and the scoring method were drawn from the Motion Sickness Questionnaire (Kellogg, Kennedy, & Graybiel, 1965). Kennedy et al. (1993) performed a principal factor analysis with varimax rotation and, after comparing factor solutions with three to six factors, concluded that a three factor solution was the most interpretable. They observed that a large portion of their sample had very few symptoms, so the analysis was repeated with approximately 600 observations from the five simulators that induced the most symptoms. The three factor structure was confirmed, along with the existence of a second-order more general factor.

Unfortunately, as Kennedy et al. (1993) noted, many items of the SSQ load significantly on more than one factor. Therefore, some items are scored on two different subscales and, following the Kennedy et al (1993) scoring procedure, are scored twice in the calculation of the total score. The items “general discomfort” and “difficulty concentrating” were assigned to both the nausea and oculomotor subscales, and the items “difficulty focusing” and “blurred vision” were assigned to both the oculomotor and disorientation subscales. Given the slightly blurred factor structure of the SSQ and, most importantly, the fact that it was administered to military participants using simulators, the current factor structure of the SSQ may not be adequate for research and treatment using virtual reality with a population of adults from the general public. The goal of the study was therefore to assess the factor structure of the SSQ with a sample of people drawn from the general population, including people suffering from anxiety disorders.

METHODS

Sample

The sample consisted of 371 adults (71% female) recruited from the general population either for research on anxiety disorders (n = 164 received a DSM-IV diagnosis based on a structured clinical interview) or experiments with “normal controls” (n = 207 screened for the absence of anxiety disorders based on a structured clinical interview). Among the 164 anxious participants, the most frequent diagnosis was specific phobia, followed by social phobia, generalized anxiety disorder, panic disorder with agoraphobia and post-traumatic stress disorder. The mean age was 35.2 (s.d. = 12.96, range from 18 to 68).

The project was approved by the Research Ethics Board and participants had to remain in the waiting room 15 minutes after the immersion before leaving the laboratory. While in the waiting room they received a handout describing what cybersickness is and contact information in case they experienced after-effects or prolonged side-effects.

Measures

Simulator Sickness Questionnaire (Kennedy et al., 1993) (SSQ). It consists of 16 items listing virtual reality side effects rated from “0” (none) to “3” (severe). A French translation of the SSQ was used in this study. The instrument was first translated from English to French by the authors of this paper. The translation was further reviewed by bilingual psychologists in order to obtain independent assessments of the quality of the translation. Following Kennedy et al.’s (1993) recommendation, the SSQ should be first administered prior to the immersion in order to rule-out symptoms that could be already present prior to the immersion, and then administered post-immersion. Data collected at the pre-immersion were not used for the current study since most participants scored zero on all items. Only post-immersion data were analyzed and, in the case of participants who were immersed in virtual reality more than once, only data collected after the first immersion were used. If participants had to stop the immersion

because of severe side-effects, the SSQ was completed immediately. The Cronbach's alpha for the SSQ in the current sample was .87.

Table 1. Corrected item-total correlations for the SSQ in this sample.

SSQ Items	Item-total correlations
General discomfort	.65
Fatigue	.42
Headache	.53
Eyestrain	.48
Difficulty focusing	.54
Increased salivation	.37
Sweating	.36
Nausea	.60
Difficulty concentrating	.52
Fullness of head	.61
Blurred vision	.45
Dizzy (eyes open)	.53
Dizzy (eyes closed)	.62
Vertigo	.47
Stomach awareness	.52
Burping	.42

Corrected item-total correlations were all satisfactory (see Table 1).

Structured Clinical Interview for DSM-IV (First, Spitzer, Gibbon, & Williams, 2000). This is a semi-structured interview used for screening every participant and diagnosing mental disorders according to DSM-IV criteria (APA, 2000).

Presence Questionnaire and **Immersive Tendencies Questionnaire** (Witmer & Singer, 1993). Presence was measured with these frequently used instruments. The 24 items of the Presence Questionnaire were scored according to Witmer and Singer's (1993) recommendation. The Immersive Tendencies Questionnaire assesses an individual's proneness to experience presence in a virtual environment. The 19 items were scored according to Witmer and Singer's (1993) recommendation. French versions of these two instruments were used to describe the sample. The average score on the Immersive Tendencies Questionnaire was 70.29 (s.d. = 14.79) and the average score on the total score of the Presence Questionnaire was 90.32 (s.d. = 15.84).

Brief rating of anxiety. After the first five minutes of immersions, participants were asked verbally to rate on a "0" to "10" scale the intensity of their anxiety "right now". The brief verbal assessment was performed in order to correlate anxiety with items of the SSQ. The brief anxiety rating was collected only on 132 of the 164 participants who were diagnosed with an anxiety disorder.

Material

In order to maximize the generalization of the results, participants were immersed in virtual reality with different technologies (HMD, CAVE-like), different HDM (I-Glass, Cy-Visor, nVis, V8, Visettre-pro), different trackers (Intertrax^2 , Inertia CUBE, IS-900), and performed different tasks (i.e., exposure to feared stimuli, exploration, attention) and for different durations (immersions lasted between 5 to 60 minutes).

RESULTS

A principal factor analysis was performed, followed by a varimax rotation. The number of factors was assessed based on three criteria: eigenvalue higher than one, the scree-plot test and the interpretability of the factor solution (including reducing cross-loadings to a minimum). The eigenvalue criteria pointed towards a three-factorial solution but between two to four factors were examined. The three factor solution was appealing, but the number of cross leadings was high (5 items loaded higher than .40 on two factors). The two-factor solution was clear and interpretable. All loadings were larger than .40, with no cross-leadings, with nine items on Factor 1 and seven on Factor 2 (see Table 2). To substantiate our decision to retain the two-factor model, the quality of fit of both our two-factor model and the three-factor model suggested by Kennedy et al. (1993) were put to the test with two indices used in structural equation modeling to compare mod-

els, the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC). Both indices document the parsimony of a model by assessing how well it fits the data and adjusting for the complexity of the model. The AIC is based on the number of parameters estimated and the maximum likelihood function, where a good fit obtained with a simpler model will lead to a lower AIC value than a more complex model or a worse fit. The BIC uses a Bayesian approach and gives more weight to the number of observations and penalizes overfitting more severely than the AIC does. In both cases, there is no significance test to interpret AIC and BIC; the lower the value the better. The AIC showed that the two-factor model provided a better fit of the data than the three-factor model (AIC = 354 vs 369, respectively), information that was confirmed with the BIC (BIC = 498 vs 536, respectively). Separate factor analyses were also performed for the clinical and the non-clinical sample and they matched with the factor model found with the entire sample. The only significant difference between the factor structure obtained with each sample was that the order of the two factors was reversed (i.e., Factor 1 became Factor 2 in the clinical sample).

Our results suggest that, in our sample and with a French translation, the SSQ items belong to two distinct but correlated (Pearson r = .56, p < .001) factors. The first factor consisted of items 1, 6, 7, 8, 12, 13, 14, 15 and 16 and was characterized by Nausea symptoms. The second factor was about Oculomotor symptoms and was made of items 2, 3, 4, 5, 9, 10 and 11 from the original SSQ.

The total SSQ score in the current sample was 5.03 (s.d. = 5.42, range between 0 and 42). Participants suffering from an anxiety disorder scored higher (M=6.72, s.d. = 5.9) than those who do not suffer from an anxiety disorder (M=3.86, s.d. = 4.6) [$t_{(369)}$ = 5.5, p < .001]. The subscale scores were 2.07 (s.d. = 3.14) for the Nausea factor and 2.95 (s.d. = 2.99) for the Oculomotor factor.

The brief verbal rating of anxiety after five minutes of immersion correlated significantly at p <.01 with items 2 (r = .23), 3 (r = .27) and 10 (r = .29), and at p <.05 with items 1 (r = .18) and 9 (r = .17). For these items, there may be an overlap between anxiety and cybersickness symptoms. The correlation between the SSQ and the Presence Questionnaire was very low (r = -.02, ns), as well as with the Immersive Tendencies Questionnaire (r = -.06, ns).

Table 2. Factor structure of the French SSQ in the current sample. N = 371.

Items	Factor 1 Nausea	Factor 2 Oculomotor
General discomfort	.70	
Fatigue		.44
Headache		.56
Eyestrain		.72
Difficulty focusing		.76
Increased salivation	.54	
Sweating	.61	
Nausea	.67	
Difficulty concentrating		.51
Fullness of head		.66
Blurred vision		.79
Dizzy (eyes open)	.52	
Dizzy (eyes closed)	.63	
Vertigo	.62	
Stomach awareness	.69	
Burping	.48	

Note. Factor loadings lower than .40 are not reported.

DISCUSSION

The aim of this study was to examine the factor structure of the SSQ in a population that is closer than Navy military personnel to what researchers and clinicians using virtual reality are likely to encounter in the general population. As pointed-out by Lawson et al. (2002), military personnel may be less likely to experience cybersickness as they could be involved more frequently in challenging vehicle motion, be in better physical shape or be able to remain immersed in virtual reality longer despite feeling side-effects.

Our results suggest that the SSQ was comprised of two factors (Nausea and Oculomotor).

These two factors were very clear, included all items and did not involve cross-loadings. This is different from the known factor structure of the SSQ, where a third Disorientation factor was found by Kennedy et al. (1993). Comparison with our two-factor solution and Kennedy et al., (1993) three factor solution revealed that a two-factor model was more parsimonious (an adequate fit with less parameters). How to account for these differences? It is our opinion that the difference in factor structure is related first to the sample used (military vs general-population), and also to the kind of tasks performed (Navy simulations vs exploration or exposure to anxiety situations) and to the equipment used (VR and CAVE-like system vs flight simulator). But some limitations must be addressed before such a conclusion is reached. First, the current study was performed with a French-Canadian sample using a translated version. Even if this limit is minimal because cultural differences with the United-States are small and the translation of physical symptoms is pretty straightforward, this option cannot be ruled-out until this study is replicated. Nevertheless, it is important to highlight that our study confirms Kennedy et al.'s (1993) work on the reliability of the SSQ, with a high internal consistency and a factor structure to which all items are contributing significantly.

Further studies are necessary to assess if the Oculomotor factor is specifically related to the technology used to display the images, such as resolution and weight of the HMD or image clarity, and if the Nausea factor is more relevant to sensitivity to postural imbalance or in reaction to the tasks performed during the immersion. Factor analytic studies should compare large samples of participants from the general population immersed using different technologies (e.g., HMD vs CAVE) or under different kinds of tasks (e.g., exposure to feared situations vs exploration). The overlap between anxiety symptoms and virtual reality induced side-effects should also be examined. A strategy would be to administer post-immersion a measure of anxiety and the SSQ and examine which items load on similar factors.

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A Relaxing Journey: The Use of Mobile Phones for Well-Being Improvement

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Abstract: *The new generation of mobile phones has many additional features -as PDA (Personal Digital Assistant), camera and media player- that make it a potentially powerful tool for cyber-psychology. The aim of this project is to test this potential by analysing the effectiveness of mobile narratives to improve relaxation and reduce anxiety in a sample of commuters.*

Mobile narratives, narrated video experienced on mobile phones, are used in this study to perform relaxation exercises aiming at introducing emotional changes in participants, to improve their well-being in everyday life stress situations (Green M. C., Brock T.C., Kaufman G., 2004). The narratives guide the subjects during the exploration of four different areas of a tropical island, proposing different relaxation techniques based both on the "Progressive Muscular Relaxation" protocol (Jacobson, 1938) and the "Authogenic Training" protocol (Schultz, 1977).

The project sample is composed of 120 commuters: college students aged between 20-25 years old (60 female and 60 male), recruited on the Varese-Milano local train (70 minute trip). Specifically, the sample has been randomly assigned to four different conditions: Vnar group: who experienced the mobile narrative on a mobile phone during their daily train trip; Nnar group: who experienced video contents only (the beach of a virtual tropical island) on a mobile phone during their daily train trip; Mp3 group: who experienced only the audio contents (the relaxation exercises only) on an mp3 player during their daily train trip; Ctrl group: a no intervention condition. Each participant was administered State, Trait and Presence questionnaires before and after the experience. In the Vnar condition results show a significant anxiety level decrease ($p<.001$) assessed by Stai State questionnaire. No significant differences were found in other conditions. In Vnar condition results show a significant relaxation increase ($p<.001$) assessed by Vas questionnaire. No significant differences were found in other conditions.

INTRODUCTION

The new generation of mobile phones has many additional features–such as PDA (Personal Digital Assistant), camera and media player–that explain their success: now it is possible to write text (SMS, Short Message System), to send images (MMS, Multimedia Messaging System), to watch television, and to listen to music. Before the advent of this new technology, Computer Mediated Communication (CMC) was exclusively a verbal communication, but now it is enriched with new contents through effective sensory integration (e.g. audio-video contents) that give mobile communication an emotive value and allows stimulation, in a global way, three of the four senses: hearing, sight, touch. These innovations make the mobile phone a potential powerful tool for cyber-psychology. The aim of this project is to investigate the efficacy of the mobile phone as a positive emotion induction instrument. In this context "emotion" corresponds to phenomena that suddenly arise and involve the whole person (Legrenzi, 1997). The relationship between an event and the individual interest for the event itself generates an emotion. Each emotion is linked to a particular situation, defined as an emotional antecedent, which activates the subject and modifies his reaction (Lazarus, 1966). From this point of view it is important to use a specific narrative to increase the interac-

tion and the emotional elicitation in a subject inside a virtual context. In this particular case the subjects' emotional answers will be analysed with reference to the presentation of video content on the mobile phone, presented with a specific mobile narrative, created to induce a relaxed sensation in a commuter sample. Narrative, in this sense, is used as a fundamental vehicle for emotion induction (Harvey, 1998) because it allows the subject to improve interaction with the surrounding environment.

In order to create a feeling of engagement in a particular virtual environment, Freeman (2003) studied Emotioneering techniques (32 categories). Emotioneering refers to a large body of narrative techniques that can create in the participant a deep sense of presence in the game or in other interactive experiences. Barfiel, Zeltzer, Sheridan and Slater (1995) define Presence as the "participant's sense of being there" in the virtual environment. Specifically, Lombard & Ditton (1997) analysed the sense of presence as a "perceptual illusion of non-mediation": through sense of presence, the participant forgets that his environment perception is mediated by new technologies. This concept is fundamental in order to create a deep sense of engagement between the subject and the virtual environment proposed.

The concept of sense of presence is used to analyse the engagement level of the participant in a specific task: the higher the sense of presence perceived during an activity, the higher the subject's engagement will be during this activity (Riva, 2004). Usability is the fundamental characteristic that a medium must have to be able to activate a higher sense of presence in the user (Norman, 2004). This concept is related to the importance of technology to be "invisible to user" (Riva, 2004), in order to give to the participant the possibility to concentrate only on the task required rather than on the media used. Sense of presence and narrative are two related concepts: one of the instruments to increase sense of presence in a participant is to use a good narrative (Riva, 2004).

Starting from this remark, mobile narrative has been used in the protocol of this study. Mobile narratives, narrated video experienced on mobile phones, are used in this study to perform relaxation exercises aiming at introducing emotional changes in the participant, improving well-being in stressful situations in everyday life (Green M. C., Brock T.C. & Kaufman G., 2004). The narratives guide the subjects during the exploration of four different areas of a tropical island proposing different relaxation techniques based both on the "Progressive Muscular Relaxation" protocol (Jacobson, 1938) and the "Authogenic Training" protocol (Schultz, 1977).
The aim of this research is to check if a narrative experience, associated with video content, can influence emotional subject state. This research is the second part of a pilot study (Preziosa, Grassi, Villani, et al, 2005) aimed at analysing the efficacy of mobile narratives implemented on mobile phone to induce a state of relaxation. Authors have decided to replicate this study by adding an Mp3 condition, an audio only content condition, for better understanding the efficacy and the importance of mobile narrative compared with the video only content.

In particular, authors want to investigate if mobile narratives that guide subjects in a mediated experience, related to video content presented on mobile phone, could induce emotional changes in a subject. Specifically, authors want to study if a mobile narrative could bring a significant anxiety decrease and improve a deeper sensation of relaxation in the user. Besides, researchers want to understand if mobile narrative induces a higher sense of presence during video presentation. For this reason, anxiety level, relaxation level and sense of presence will also be measured in a condition lacking narrative content.

METHODS

Experimental design
This study has a mixed design (4x2). The first independent variable refers to experimental intervention and is measured between subjects on four levels: video and audio content (Vnar); only video content (Nnar); only audio content (Mp3); control group (Ctrl). The second independent variable refers to time as unit of measure (pre and post intervention) with repeated measures analysis. It is a within subjects analysis.

In this study four conditions were compared: Vnar (mobile narrative condition): video content

of a virtual island associated with audio content; Nnar: video content of a virtual island; MP3: audio content; Ctrl: no intervention group.

Dependent variables:

- Emotional state dimension;
- Emotional trait dimension;
- Sense of presence.

Sample

The sample is composed of 120 subjects (60 female and 60 male), university commuter students, aged between 20-25 (M= 23,27, ±1,38). The sample has been randomly divided into four conditions: Vnar, Nnar; mp3 and Ctrl group; each group is composed of 30 subjects. No difference among groups was found before the intervention.

Protocol

The experimental protocol aims to increase a relaxed sensation in a commuter sample during their daily train trip. Procedure is organized in four sessions performed during two consecutive days, each one lasting 10 minutes. In Vnar and Nnar conditions video contents present four different parts of a virtual island, two daytime scenes and two nigh-time scenes, a wave's sound in background is associated to those experiences. In Vnar condition video contents are associated with audio contents: a narrative guide subject during the island exploration and the fulfilment of the relaxation exercises. In Mp3 condition subject tests only the audio contents. Consecutive video sceneries, in both Vnar and Nnar conditions, are presented along with audio content. Audio contents are the same as in Mp3

condition. Ctrl group had only to complete the questionnaire battery without being administered any intervention.

Session 1: beach 1, daytime scenery.
The subject, at the end of a short island exploration, is invited to sit down on a deck chair on the shore. In front of him is a relaxing landscape: ocean waves, a beautiful sunshine and a few seagulls flying in the sky. Audio content guides the subject in some relaxation exercises: breath control exercises, following wave movements, and arm relaxation exercises where the subject has to move his shoulders slowly.

Session 2: cloud, nighttime. Subject is invited to sit down on a deck chair to watch a big cloud in the sky, which slowly expands and narrows itself. Subject is invited to do breath exercise following the cloud's slow movement. Relaxation exercises concern the lower body parts; the subject has to concentrate his attention on his legs. He has to slowly swing his weight from foot tip to heel and vice versa.

Session 3: waterfall, daytime scenery.
The waterfall is surrounded by a ridge of mountains. At the end of the waterfall a small river flows to the sea. A few leaves float slowly on the river. Those leaves represent the subject's worries of the day. The subject is invited to perform some breath control exercises and neck relaxation exercises, following the voice narrative.

Session 4: beach 2, nighttime scenery.
After a short island exploration, the subject is invited to sit down on a deck chair in front of the sea. Waves arrive slowly on the shore, and a light breeze moves palms. The subject is invited to do breath exercises following wave movement. Subject also has to draw little circles in the sand with his foot for sweetly stimulating his legs.

Narrative during these four experiences is based on Progressive Muscolar Relaxation, Jacobson's protocol (1938), and on Autogenic Training, Schultz's protocol (1969). At the end of each session subjects had to complete a questionnaire battery to measure their anxiety, relaxation and presence level.

Material

1. 4 Motorola A925, display 208x320: mobile phones with UMTS technology. Headphones were used;
2. 4 videos representing a virtual island. Videos are associated with a specific narrative and to a musical background that reproduces sea waves;
3. 6 Mp3 to support the audio condition. Headphones were used.

MEASURES

Three different kinds of questionnaires are used in this study: State questionnaires, trait questionnaires and presence questionnaires. The questionnaires are submitted on paper.

State Questionnaires:

1. STAI (State-Trait Anxiety Inventory, Spielberger, Gorush & Lushene, 1970). This questionnaire aims to measure state anxiety level with 20 items;
2. PANAS (Positive Affect Negative Affect Scale, Watson, Clark & Tellegen, 1988) This questionnaire is composed of 20 adjectives. Subject has to decide, referring to a likert 5 point scale, how a particular adjective describes him;
3. VAS (Visual Analogue Scale, Gross & Levenson, 1995). This questionnaire is composed by 8 adjectives that describe subject's emotion.

Presence Questionnaires:

1. UCL-SUS (Slater, Usoh & Steed, 1994) The aim of this questionnaire is to analyse subject's sense of presence perceived in relation to the mediated experience. The questionnaire is composed of 3 items.
2. ITC-SOPI (Lessiter, Freeman, Keogh & Davidoff, 2001) This questionnaire is composed of 44 items, divided into 4 scales: Spatial presence, Engagement, Ecological Validity, Negative Effects. The aim of this questionnaire is to measure sense of presence in a mediated environment.

Trait Questionnaires:

1. COPE (Coping Orientation to Problems Experience, Sica, Novara, Dorz &

Sanavio 1997) The aim of this questionnaire is to analyse different coping skills. This questionnaire is composed of 60 items, divided into five scales: social support, positive attitude, avoidance strategies, problem advice, religion.

2. Generalized Self-Efficacy scale, Schwarzer & Jerusalem, 1995) The aim of this questionnaire is to measure self efficacy subject level. It is composed of 10 items.
3. STAI Y, in the trait version. This questionnaire is composed of 20 items.

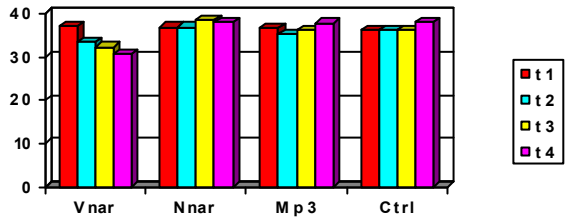
PROCEDURE

Vnar and Nnar conditions follow the same procedure. The difference among the three groups is in the kind of intervention they are submitted to: in Vnar group subjects are invited to watch mobile narratives on a mobile phone; in Nnar group subjects are invited to watch only the video contents on the mobile phone; in Mp3 group subjects are invited to listen to only the audio contents through Mp3.
On the first day of the experiment, during a morning train trip, the subject has to complete baseline questionnaires: Stai State, Vas, PANAS, Stai Trait, Cope, and Self Efficacy. At the end of the submission he has to experience the mediated experience during his train trip. During the evening train trip, the subject has to watch the second mediated experience and then submit a new questionnaire battery: Stai State, Vas, PANAS, UCL-Sus, ITC-Sopi. During the second and last day of the experiment on the train, the participant has to submit another questionnaire battery: Stai State, Vas, Panas; and then he has to experience the third mediated experience. During his evening train trip the user has to submit the fourth and last mediated experience and then to complete the following questionnaires: Stai State, Vas, PANAS, UCL-Sus, ITC-Sopi, Stay Trait, Cope, Self efficacy.

Procedure for the Mp3 condition is the same as in Vnar and Nnar conditions, but in the questionnaires submitted there aren't Presence questionnaires: UCL-Sus and ITC-Sopi questionnaires. During the morning train trip on the first day of the experiment and during the evening train trip on the second and last day of the experiment, participants of the Ctrl group have to submit the following questionnaires: Stai State, Vas, PANAS, Stai Trait, Cope, Self efficacy. Ctrl group had only to complete the questionnaire battery without being administered any intervention. The sample has always taken the same train for the duration of the experiment, the train they usually take to go to university.

RESULTS

At first, data have been analyzed for normality and distribution control, kurtosis and skewness control and the absence of significant differences between groups before the intervention. At first repeated measures ANOVA have been made to analyze time influence between the beginning and the end of the intervention. Afterwards a between subjects analyses has been made to understand the possible differences between groups. The "State" dependent variables showed a significant variance in time. Repeated measures Anova results, in Stai State questionnaire, show significant differences in time ($F_{(3,114)}$= 4,646, p< .05) and in time x condition ($F_{(3, 348)}$= 6,194, p< .005) referring to anxiety level. Means were compared in graphic n.1 and in table 1.



Graphic n. 1 Stai state questionnaire

Means results demonstrate that Vnar condition shows a significant anxiety level decrease in time, assessed by Stai State Questionnaire. This anxiety decrease is not significant in Nnar, Mp3 and Ctrl conditions. In these conditions mean shows an anxiety level increase in the time.

Looking at these results is possible to argue that the audio and video contents, proposed on the mobile phone, are effective to reduce the anxiety level in a commuter sample.

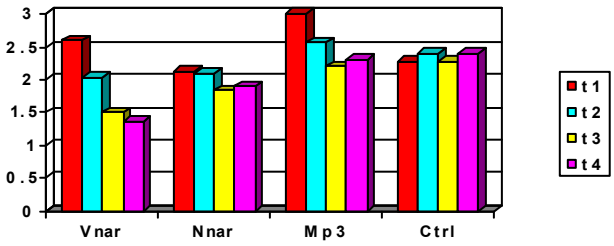
A significant anxiety decrease in Vnar condition is confirmed also by VAS Questionnaire analyses. For the "anxiety" item in the Vnar condition, an anxiety level decrease is confirmed. Repeated measure Anova results show a significant decrease of anxiety level in "anxiety" item ($F_{(3,\ 348)}$= 12,904; p<.001). Means were compared in graphic n.2 and in table 3.

Table 1

Time	Cond	Mean	Std. Deviation
T1	1	37,10	6,47
	2	36,77	9,07
	3	36,13	7,04
	4	36,63	8,36
T2	1	33,37	4,91
	2	36,93	8,60
	3	36,13	6,78
	4	35,20	7,73
T3	1	32,20	6,18
	2	38,37	10,36
	3	36,13	7,04
	4	36,20	10,35
T4	1	30,63	4,61
	2	37,87	8,97
	3	37,93	7,30
	4	37,70	13,20

Table 2 Contrast analysis shows a significant difference in the interaction Time x Condition, assessed by Stai State questionnaire

Time	Mean Square	F	Sig.
Level 1 vs 4	458,431	14,261	.000
Level 2 vs 4	162,697	5,793	.001
Level 3 vs 4	78,142	3,238	.025



Graphic n. 2 Vas questionnaire item « anxiety »

Table 3

Time	Cond	Mean	Std. Deviation
T1	1	2,60	1,04
	2	2,13	1,28
	3	3,00	1,46
	4	2,27	1,17
T2	1	2,03	1,07
	2	2,10	1,21
	3	2,57	1,17
	4	2,40	1,19
T3	1	1,50	,82
	2	1,83	1,02
	3	2,20	1,10
	4	2,27	1,17
T4	1	1,37	,76
	2	1,90	1,18
	3	2,30	1,26
	4	2,40	1,19

Table 4 Contrast analysis shows the efficacy of the intervention as a great decrease in anxiety level, specifically between the first and the third time.

Time	Mean Square	F	Sig.
Level 1 vs 4	31,008	31,973	.000
Level 2 vs 4	9,633	11,481	.001
Level 3 vs 4	,208	,176	,676

Besides, results show a significant anxiety level decrease in Nnar and Mp3 conditions, but with lower values compared to Vnar condition.

Relaxing variable, assessed by Vas Questionnaire in "Relax" item, shows a significant difference in time x conditions ($F_{(9,348)}$= 6,949, p< .001). Means are shown in table number 5 and in graphic number 3.

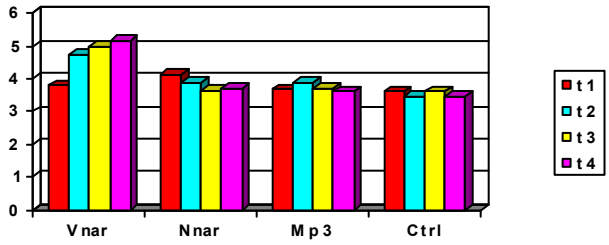
In Vnar condition there is a significant relaxation level increase from the beginning to the end of the intervention. In the other conditions there isn't a significant change. These results are confirmed by the contrast analysis of time x conditions interaction (table number 6).

Presence questionnaire, UCL-Sus and ITC-Sopi questionnaires were administered in Vnar and Nnar conditions. Sus questionnaire results show a significant difference in sense of presence between t2, answers gotten during the

baseline presence questionnaires, and t4, answers at the end of the intervention ($F_{(1.58)}$= 6,938, p<.05). Means were compared in table number 7. In Vnar condition results show a significantly higher value for sense of presence from the beginning to the end of the intervention, as shown in contrast analysis in Table 8.

Table 5

Time	Cond	Mean	Std. Deviation
T1	1	3,80	1,03
	2	4,13	1,25
	3	3,67	1,09
	4	3,60	1,38
T2	1	4,73	1,14
	2	3,87	1,17
	3	3,90	1,21
	4	3,47	1,25
T3	1	4,97	1,16
	2	3,63	1,45
	3	3,70	1,47
	4	3,60	1,38
T4	1	5,17	1,32
	2	3,70	1,09
	3	3,60	1,52
	4	3,47	1,25



Graphic n. 3 Vas questionnaire item «relax »

Table 6

Time	Mean Square	F	Sig.
Level 1 vs 4	19,433	10,079	.000
Level 2 vs 4	3,053	4,930	.003
Level 3 vs 4	,719	,714	.545

Table 7

Time	Cond	Mean	Std. Deviation
T2	1	3,97	1,30
	2	2,47	1,11
T4	1	4,33	1,12
	2	2,43	1,45

Table 8

Time	Mean Square	F	Sig.
Level 2 vs 4	1,667	6,938	.011

Questionnaire results show significant differences in the anxiety level in the interaction between time and conditions ($F_{(3,116)}$= 5,072, p<.05). As means and contrast analysis illustrate (Table number 9 and 10) at the end of the treatment Vnar condition shows a significant anxiety level decrease compared to other conditions. These results are not confirmed in the other conditions. In particular in Nnar and Mp3 conditions results show a little anxiety level increase.
Self efficacy Questionnaire shows significant

Table 9 Stai Trait

Time	Cond	Mean	Std. Deviation
T1	1	39,27	8,65
	2	41,33	12,25
	3	41,20	10.83
	4	38,57	8,28
T4	1	36,33	9,58
	2	42,20	11,95
	3	41,63	11,59
	4	38,30	7,65

Table 10

Time	Mean Square	F	Sig.
Level 2 vs 4	1,667	6,938	.011

differences in self efficacy state among the conditions ($F_{(3,116)}$= 10,404, p<.01). As means and contrast analysis illustrate (table number 11 and 12) at the end of the treatment Vnar condition shows a significant increase of self-efficacy state. Results do not confirm this positive change in the other conditions.

Table 11

Time	Cond	Mean	Std. Deviation
T1	1	29,57	3,78
	2	28,63	3,91
	3	29,03	2,71
	4	28,93	2,99
T4	1	31,10	3,67
	2	28,67	4,12
	3	28,80	2,94
	4	29,30	2,83

Table 12

Time	Mean Square	F	Sig.
Level 1 vs 4	18,186	10,404	.000

Coping results show a significant difference among conditions for Social Support variable ($F_{(3,116)}$= 3,790, p<.05). Specifically, as means and contrast analysis shows (table number 13 and 14), there is a significant increase in Vnar condition for Social Support, compared to other conditions.

Table 13

Time	Cond	Mean	Std. Deviation
T1	1	31,17	6,64
	2	31,13	8,59
	3	30,67	8,08
	4	31,60	7,72
T4	1	33,00	6,81
	2	30,77	8,24
	3	30,87	8,37
	4	32,20	7,93

Table 14

Time	Mean Square	F	Sig.
Level 1 vs 4	18,186	10,404	.000

DISCUSSION

The aim of this study was to investigate if a mobile narrative is able to induce positive emotions in a commuter sample. Specifically authors wanted to check if mobile narrative is able to induce a deep relaxation sensation and a significant anxiety sensation decrease. At first, authors compared differences found in questionnaire results among the four session intervention between conditions (Vnar, Nnar, Mp3 and Ctrl; within subjects analysis); then they compared differences among conditions (between subjects analysis). Within subjects analysis shows significant differences in time intervention assessed by State questionnaire, specifically in Stai State questionnaire and Vas questionnaire analysis. Stai State questionnaire results show a significant anxiety level decrease in the Vnar condition, not found in the other conditions. Results assessed by Vas questionnaire, for the item “anxiety”, show a significant anxiety level decrease for all the experimental conditions (Vnar, Nnar and Mp3), but the higher result is found in Vnar condition. At the end of treatment, in the Ctrl group, results show an increase of anxiety level. Besides, data show the efficacy of mobile narrative (Vnar condition) for positive emotion induction compared to only audio content (Mp3), only video content (Nnar) and Ctrl condition. In fact data show a higher efficacy in time intervention in Vnar condition for relaxation variable, assessed by the Vas questionnaire. In the other experimental conditions, results do not show a significant relaxation sensation decrease. These results underline the efficacy of mobile narrative (audio content associated with video content) in emotion induction, in particular in relaxation induction. Audio contents presented to subjects of Vnar and Mp3 conditions were based on two different relaxation techniques: the “Progressive Muscular Relaxation” protocol (Jacobson, 1938) and the “Authogenic Training” protocol (Schultz, 1977). The aim of audio contents was to induce in users a feeling of relaxation and to create in them a deep sense of presence in the environment proposed. In fact Sus questionnaire results show in the Vnar condition a significantly higher value for sense of presence between t2, answers gotten during the baseline presence questionnaire, and t4, the answer at the end of the treatment; results not found in Nnar condition (only audio content group). Besides, the ITS-Sopi questionnaire, for Spatial Presence variable, shows a significant difference between t2 and t4 in the Vnar condition. In the Nnar condition there weren’t significant differences in time intervention. Finally Self-efficacy questionnaire results showed a significant self-efficacy increase only in Vnar condition. In the end, analysing these results, it is possible to confirm the efficacy of mobile nar-

rative, supported on the mobile phone, to induce a positive emotional state in users, to improve their well being in stressful situations in everyday life and to create a deep sense of presence in the environment proposed.

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Using Videos, Vikings and Teddy-bears to Reduce Anxiety
A methodology for implementing and evaluating *fun* experiences in the treatment of Social Anxiety Disorders

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Abstract: *This series of studies was initially motivated by a need to provide effective anxiety-reducing activities to long-term patients at the Brisbane Royal Children's Hospital. The ComeRideWithMe project (Newman 2005) conducted in 2002 used text-based online communication environments to present narratives while also allowing an effective feedback loop for the patients to engage with the fictitious characters. The motivating assumption of these studies was that Fun is a useful weapon against anxiety and therefore it would be useful to be able to measure and describe Fun. The Fun Unification Model (Newman 2004) was developed as a broad spectrum model for describing the experience of Fun upon which these studies are built. The paper describes the experimental project Albert in Africa which sought to measure Fun in three different communication environments. With regard to the different communication environments, the results suggest that the communication environment itself was not significant in determining the level of Fun a subject experienced, though it was significant in affecting the subject's intention to revisit. With regard to the overall levels of Fun experienced, the findings do suggest that playful narrative and role-playing activities in online communication environments hold much potential to provide effective anxiety-reducing activities.*

Fun as a treatment for anxiety

This series of studies began in June 2001, a collaboration between the Royal Children's Hospital Foundation of Brisbane and multimedia researchers at Griffith University's School of Computing and Information Technology. The parties met to discuss ways to engage children, in the 12-15 year age group in hospital care, particularly, but not exclusively, the boys in this age range. This target group had been identified as being particularly difficult to provide interesting and *fun* activities for. Moreover, as a group, they are statistically likely to show a comparatively high incidence of depression and anxiety.

While these discussions were motivated by an intuitive sense that having *fun* is good for a person's psychological and emotional well-being there are a number of instances where *fun* figures more prominently in the clinical research literature and particularly in the area of anxiety reduction. Treatment of anxiety in adults by *systematic desensitization* (Ginsberg and Walkup 2004, pp 184) involves the pairing of a fear with an incompatible response such as relaxation, positive imagery games and *fun* activities. As the pairing progresses from the least to most anxiety provoking these activities are thought to desensitize the subject to the anxiety via the process of counter-conditioning the responses. Similarly, one accepted treatment of Separation Anxiety Disorder (SAD) focuses on teaching parents of anxious children to create a playtime of warm interaction, enjoyment and *fun* (Pincus et al, 2005, pp281). Parents are praised for using imaginative "play talk" that promotes *fun*.

It is not surprising then that anxiety can destroy *fun* altogether. A relatively common form of anxiety disorder, which can be persistent, is Social Anxiety Disorder (Crozier et al, 2001). Symptoms include: fear of meeting or talking to people; avoidance of social situations face to face interactions and eye contact; reduced social group and apparent shyness.). For these anxious young people normal age-appropriate activities such as parties, school or social events and games may be viewed as chores rather than *fun*, and they will tend to be less

involved and less enthusiastic (Kendall et al, 2004, pp337).

Chorpita (2002, pp 177) uses various statements about *fun* to measure the constructs of the Tripartite Model and Dimensions of Anxiety and Depression. Statements such as "Nothing much is *fun* anymore" is used to indicate *Depression* while "When I see a chance for *fun* I take it" and "I will try something new if I think it will be *fun*" are used to indicate *Positive Affect*. The use of *fun* in Chorpita's survey does not come with any attempt to define the term but rather relies on each subject to interpret *fun* in their own way.

Various professional groups seem to have intuitively employed comparable methods of treatment for anxiety using various *fun* activities. These include the use of resources such as puppets, dramatherapy and roleplay in situations as diverse as counselling in bereavement, eliciting evidence in abuse cases, alleviating anxieties prior to medical procedures, for subjects with emotional disturbances or mental health issues, and health education projects. One well-established group, "Patient Puppets Inc" (2007) develops products to reflect specific medical procedures to clarify it for the patient whilst at the same time packaging the experience in a likeable, soft and friendly persona in order to create a fun, toy like, quality providing comfort and promoting empathy whilst alleviating fear of the unknown.

Within this context of investigating *fun* as a vehicle for anxiety-reducing activities it is helpful to be able to measure and describe it. The following sections describing FUM and the associated *Albert* experiments describe a methodology that was designed to address this need. In the Albert experiments, not only was the *Fun* measured but the same scenario was played in three different communication environments to ascertain whether a particular environment was inherently more *Fun*.

Measuring and describing the experience of *Fun*.

The Fun Unification Model (Newman 2005) is broad spectrum theoretical model that attempts to unify three aspects of the *Fun* experience into a single coherent model. The model is predicated upon the argument that the individual experience of *Fun* is best understood when broken into three aspects - individual predisposition (Am I *fun*?), action in an environment (Is this *fun*?), and response to stimuli (Did I have *fun*?). Although the model draws on previous theoretical models of experience (Witmer and Singer 1998, pp 225, Agarwal and Karahanna 2000, pp665), it differs in two key respects. Firstly, in the way it divides the constructs into the three dimensions of individual predisposition, action in an environment, and response to stimuli, and secondly in the way it seeks to incorporate theories of narrative tendency (McNeil 1996. pp331) and narrative engagement (Newman 2005, pp45) in order to model the innate human tendency to 'have *fun*' finding and creating narrative structures within the environment. A full discussion of the FUM constructs, and the data collection instruments used in this study can be found online at Newman (2007a).This model was used to design a series of experiments where *fun* activities were combined with measurement and description instruments to provide insight into the users' experience. These experiments are described in the next section.

Suitable questions or statements for measuring the constructs of the FUM are discussed in this section. Since some of the constructs are derived from the existing literature these constructs have sample questions which have been used in previous studies. This is the case with immersive tendencies and its sub-constructs (tendency to focus, gaming tendencies and tendency to become involved) where Witmer and Singer (2002, pp230) give a complete listing of the questions they used including correlation values to validate the consistency of each question to its relevant sub-construct It is also the case with the response constructs of temporal dissociation, focused immersion and heightened enjoyment, for which the previous studies by Agarwal and Karahanna (2000, pp672) provide questions. The new constructs being introduced in the model are narrative tendencies (individual predisposition) and narrative engagement (individual response) and for these constructs a set of questions are here introduced. As discussed in section 4.3, the narrative tendencies construct divides into two sub-constructs: tendency to find narrative and tendency to create

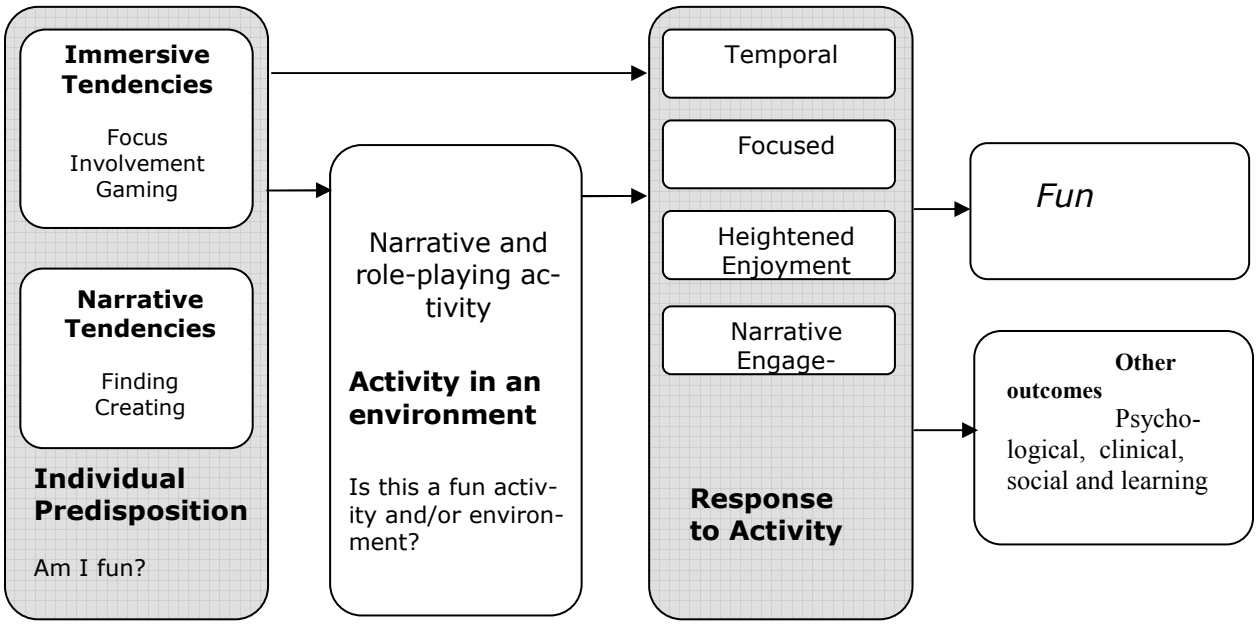


Figure 1. *Fun* Unification Model with constructs for Narrative and Role-playing activity, previously published in Newman (2005, pp47)

narrative. This may also be thought of in terms of a tendency to willingly hear narrative (finding) and a tendency to willingly tell narrative (create).

The statements proposed for this study are here listed under the relevant construct and sub-construct. For each statement, responses are meant to be given with a level of agreement on a seven-value Likert scale, the responses being [1] Strongly disagree [2] Disagree [3] Mild disagreement [4] Neutral [5] Mild agreement [6] Agreement [7] Strong agreement. Asterisks show where the questions are derived from:

- * Question derived from Witmer and Singer (2002)
- ** Question derived from Agarwal and Karahanna (2000)
- *** Question developed by the author (Newman, 2005)

First the individual predispositions – *immersive tendencies* and *narrative tendencies* statements are listed.

Immersive Tendencies

Tendency to become Focused

I easily become deeply involved in movies or TV dramas. *

I sometimes become so involved in a television program or book that people have problems getting my attention.*

I am good at blocking out external distractions when I am involved in something.*

I sometimes become so involved in doing something that I lose all track of time.*

Tendency to become Involved

I frequently find myself closely identifying with the characters in a story line.*

I sometimes become so involved in a daydream that I am not aware of things happening around me.*

I am able to concentrate well on enjoyable activities.*

I sometimes get excited during a chase or fight scene on TV or in the movies.*

I sometimes get disturbed by something happening on a TV show or in a movie.*

I sometimes remain apprehensive or fearful long after watching a disturbing movie.*

Gaming Tendency
When watching sports, I sometimes become so involved in the game that I react as if I were one of the players.*
When playing sports, I become so involved in the game that I lose track of time.*
I often play arcade or video games. (OFTEN should be taken to mean every day or every two days, on average.

Narrative Tendencies
Finding Narrative
I enjoy hearing funny stories.***
I do not enjoy a story with cliché plots or characters.***
When I am part of a spontaneous humorous conversation I would rather listen than join in.***

Creating Narrative
I enjoy making people laugh with my stories.***
I enjoy telling stories.***
My best stories are about things that have happened to me.***
I often exaggerate a little to make my stories more entertaining.***

Next the proposed statements for assessing the individual response constructs are listed; temporal dissociation, focused immersion, heightened enjoyment, and narrative engagement/play.

The Fun Response
Temporal Dissociation
Time went by very quickly while I was communicating online **
I lost track of time while I was communicating online.**

Focused Immersion
I was absorbed in what I was doing while communicating online.**
I noticed things going on around me while I was communicating online.**

Heightened Enjoyment
I had fun communicating online.**
The interaction gave me a lot of enjoyment.**
I enjoyed using the communication system.**
Communicating online bores me.**

Narrative Engagement/Play
I felt I was joining in with a story in this activity/environment.***
I was able to participate in and contribute to the story.***
I was able to be spontaneous and imaginative in this activity/environment.***
I found it difficult to participate in the story.***
I found the whole idea of the story of this activity/environment a bit silly.***

Lastly some statements relating to the subjects' intention (if they had the opportunity) to revisit the activity/environment. The intention to revisit is not part of the fun response but is included in this study because it is a primary consideration for the design and management of environments and activities that aim to be engaging and it would be of interest to see the degree of correlation between an individual's level of fun experienced and their intention to revisit.

Intention to revisit
I would like to participate in this activity again in the future.**
I could easily become interested in this activity/environment.**
I'm not really interested in what happens in this activity/environment.**

These statements taken together are proposed to measure the constructs of fun as outlined in the Fun Unification Model. The statements break logically into two sets, the predisposition set and the response sets, and it would be reasonable to expect that in a controlled experiment, a subject would be asked to respond first to the predisposition statements, then take part in an activity in an environment, and finally respond to the response statements. This is the approach taken in this study and the design of the three experiments is described in chapters 5-7.

The Albert Experiments
The activities in these experiments are based around online communication with a fictitious teddy-bear named Albert (pronounced Al Bear), who travels the world on a motorbike making video stories. Albert was first used in the ComeRideWithMe project (2002) and in several studies since. The character of Albert ticks a lot of boxes as a vehicle for anxiety reduction. He has no fear of people (peers or strangers), or the unfamiliar. As a teddy-bear he tends to invoke a sense of playful *Fun* in those he encounters and as the subjects see others treating him as a real

person this becomes a shared joke among the audience/community. The three experiments discussed here were run with 60 subjects divided into three different communication environments; Text based, Avatar-based, and Video-based (figures 1-3).Each subject spent about 30 minutes communicating with Albert (who was played by a research assistant) who had the task of following a loosely defined script.

Albert has been riding across North Africa and making documentaries about his adventures. At the time of speaking to the subject he is currently in the town of Sfax in Tunisia, where Barbarossa the pirate began his career smuggling refugees from the Spanish Inquisition to Sfax. Albert wants to make a documentary about Barbarossa but unfortunately his production assistant has eaten a bad batch of sticky date pudding and is currently in hospital in Rome. He is looking for someone to act as his production assistant for two weeks. During the course of the conversation with the subject it occurs to Albert to offer the subject the job.

Subjects had no prior knowledge of Albert. They ranged in age from 16 to 65 (average 24) and were randomly invited from various academic and community groups. At the beginning of a session each subject was surveyed with a series of statements about their tendencies, and after the activity they were further surveyed about their response to the activity.

Figure 2. Experiment 1 - Text-based environment

Figure 3. Experiment 2 - Avatar-based environment

Figure 4. Experiment 3 - Video-based environment

Table 1. Experiment 1: Scores for Response Questions

Age	Gender	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
50	MALE	7	6	6	6	6	5	5	4	5	5	5	3	4	4	4	4
19	MALE	4	5	3	4	5	4	5	3	4	4	4	4	5	3	4	3
19	MALE	6	6	4	4	6	4	6	3	5	6	4	2	4	5	5	3
20	MALE	6	6	6	4	6	6	4	2	7	6	6	1	1	5	5	1
18	FEMALE	7	7	7	7	7	7	4	3	5	6	5	1	1	7	7	2
27	MALE	5	2	2	5	5	6	1	1	5	5	4	5	2	6	6	2
22	MALE	6	5	6	5	7	6	4	2	2	6	6	2	6	3	1	6
19	FEMALE	5	6	6	4	6	6	5	2	7	6	6	2	2	5	6	1
18	MALE	3	1	2	6	3	3	2	1	3	6	4	2	5	3	6	5
19	MALE	5	6	5	2	5	6	6	4	6	5	5	4	5	5	3	2
38	FEMALE	7	7	7	4	6	6	6	2	6	6	6	2	2	6	6	2
36	MALE	7	6	6	2	7	7	7	1	6	6	6	1	1	5	3	5
27	MALE	5	6	6	5	6	6	6	2	6	5	5	3	4	5	6	3
25	MALE	7	7	6	6	7	7	6	1	7	7	7	2	1	7	7	1
24	FEMALE	7	7	7	2	7	7	7	1	7	7	5	1	1	7	7	1
24	FEMALE	7	5	5	1	7	7	7	5	7	6	6	1	1	7	7	1
20	FEMALE	6	5	4	2	5	6	6	7	6	6	4	1	4	5	4	4
21	MALE	7	7	7	7	5	2	5	3	5	1	1	1	7	1	1	7
25	FEMALE	7	7	7	6	7	6	6	4	5	6	6	2	6	4	3	5
21	FEMALE	5	6	4	7	5	6	4	3	6	6	4	1	1	6	5	1

The results across three experiments.
Once the *Fun* sub-constructs are averaged to give a single value for *Fun* there is a surprising lack of difference between the three experiments (5.3, 5.3, 5.0).

It was further reasoned that since each group contained a similar distribution of subjects with high, medium and low levels of Immersive Tendencies and Narrative Tendencies the differences in responses to the experiments could be attributed to the experience of the communication environment. The results of experiment 1, the text-based environment are given as an example in Table 1. Experiment 1 involved 20 subjects, ranging in age from 18-50 with an average age 24.5.

The data tables of all three experiments can be found online (Newman, 2007, pp134-139). A comparison of the responses across the three very different environments is interesting in how little the communication environment actually affected the subjects' experience of *Fun*. The exception to this is the mean Temporal Dissociation a one-way analysis of variance showed that the subjects' Temporal Dissociation did vary significantly across the three experiments with F = 5.84 and p =0.005. This was mostly because there was significantly less agreement in the video chat environment with the statement that they (the subject) had lost track of time, or sensed time passing quickly during the activity.

The mean Focus, Heightened Enjoyment, Narrative Engagement/Play, Fun responses and Intention to Revisit for subjects in experiments 1, 2 and 3 did not vary significantly across the three experiments, as shown in Table 2. A further step in the analysis of the experimental data was to investigate whether any correlation existed between the predisposition constructs and the response constructs.

It was found that weak but still significant correlations can be seen in all three experiments suggesting that the individual predisposition constructs may be useful in predicting an individual's.

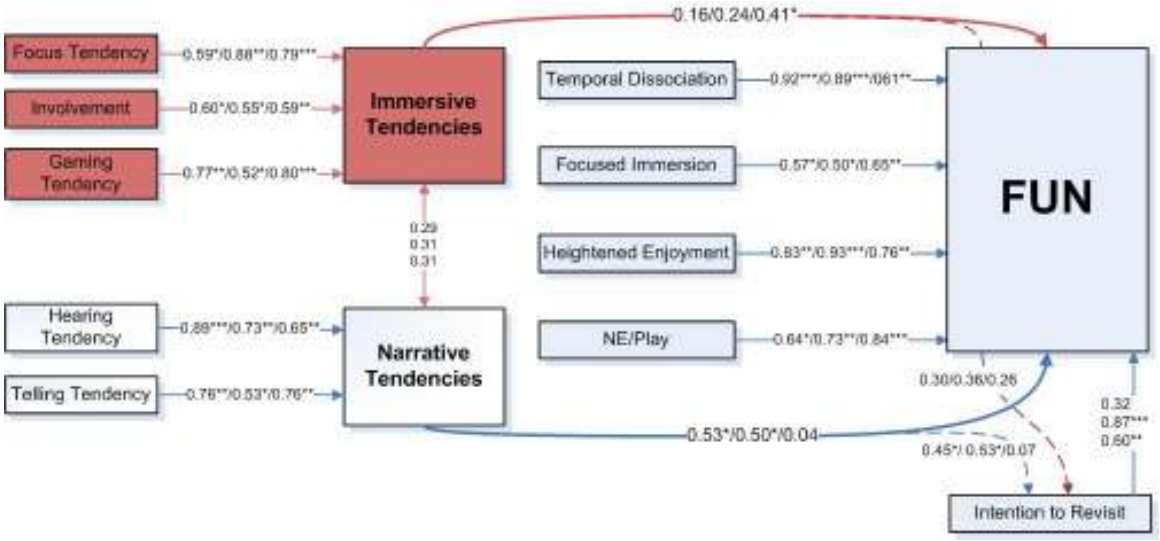
In the Text Chat and Avatar-based experiments, Narrative Tendency was the better predictor of the *Fun* response -0.53 and 0.50 respectively. In the video chat environment, however, Narrative Tendency showed no correlation. Instead Immersive Tendency emerged as the better predictor of *Fun* with a correlation of 0.41. This suggests a *measurable* difference in the way video communication environments are experienced.

In terms of developing activities for clinical treatment of anxiety these results suggest that no particular communication environment emerges as being inherently more *Fun* than any other, though the *Intention to Revisit* (0.32, 0.87, 0.60) shows a much higher correlation to *Fun* in the avatar-based environment. The FUM correlations give a good quantifiable comparison of how the activities were experienced, but

Table 2. A comparison of responses across all three experiments

Comparison of responses using one-way anova.

	Mean Exp1	Mean Exp2	Mean Exp3	*F*	*p*
Temporal Dissociation:	5.8	5.5	4.7	5.84	0.005
Focus:	4.9	4.9	4.9	0.005	0.99
Heightened Enjoyment:	5.6	5.8	5.7	0.24	0.78
Narrative Engagement/Play:	5.0	4.9	4.8	0.22	0.80
Fun:	5.3	5.3	5.0	1.10	0.35
Intention to Revisit:	4.6	4.8	4.4	0.52	0.60



Pearson correlation coefficient probabilities: $p<0.05$, ** $p<0.01$, *** $p<0.001$
Figure 5. Correlations of the predisposition and response constructs for all three experiments. On each vector the three correlation values are for experiments 1, 2 and 3 respectively.

it has imitations. It is also useful to describe behaviors that emerged that were typical of a high or low *Fun* response. These observed behaviors are described in the next section.

Observed behaviour of Subjects

Working from the assumption that anxious subjects are less likely to experience *fun* in these activities than their less-anxious peers, it was useful to identify behaviour that tended to suggest the level of *fun* experienced.

While a great deal of individuality was expressed in the sessions certain typical behaviors emerged to do with the acceptance of the playful elements of the activity which were indicators of the *Fun* level experienced. Some, like Kati (Table 1), began with an immediate strong acceptance of Albert's story and a very quick, slipped into role-playing.

On the surface, Kati exhibited behaviour typical of subjects who seemed to be enjoying themselves. She laughed, made comments to the interviewer such as "I like talking to this teddy-bear", and, at the end of the session was very curious to know more about Albert and how she could talk to him again.

Other subjects did not want to accept even the initial claim that Albert is a teddy bear. Jay is representative of the users who did not want to accept any of the narrative elements Albert was offering (Table 2). From the outset he did not embrace the role-playing and did not appear to be enjoying the experience.

Jay was typical of subjects who on the surface did not appear comfortable engaging with the role-playing. He looked repeatedly away from the screen, sometimes at his watch. He made skeptical faces that communicated to the interviewer that he thought this activity was pointless. Typically these subjects reported low levels of *Fun* – Jay himself reported one of the lowest measurements of *Fun* and *the* lowest measurement of intention to revisit, of all the tested subjects.

SUMMARY

The assumption that interacting with Albert in this activity would be inherently *Fun* was found to be true for a majority of subjects. It was also found that individual predisposition had a measurable influence on the likelihood of a person experiencing *Fun* from the activity. In terms of the communication environments tested it was found that the differences in the communication environment had surprisingly little affect on the level of *Fun* experienced.

Table 1. Strong acceptance of role-playing elements

Kati: ello al bear Albert: ello kati! …	All sessions began with a standard greeting.
Albert: thats a nice name you have! kati: are you a real bear?? kati: thankyou Albert: i am indeed. 100% teddy bear Albert: and are you a real human? …	Kati's first response may seem on the surface to be a block but the way she is asking leaves open a possibility that Albert is indeed a teddy.
kati: who were all the people talking to you in the slide show? kati: yes..i think so.. Albert: oh you know...everybody...its hard being so popular Albert: hehe kati: hehe kati: this is *Fun*ny …	Kati very quickly accepts that Albert was in Algeria talking to various people. Her comment, "this is *Fun*ny", along with her body language and focus seemed to express a high level of *Fun*.
kati: and we can talk again one day Albert: for sure!	Kati's last communication with Albert communicates a wish to talk again.

Table 2. Strong rejection of role-playing elements

Al: Hello there! Al: I'm Albert Jay: hey Al: who are you? Jay: Jay Al: Jay Al: nice to meet you Jay: likewise …	Even in his opening greeting Jay sounds hesitant.
… Al: a real teddy? Jay: my sister has one Al: not many of us around Al: Does it TALK Al: is it FAMOUS? Jay: apparently it even talks to her Jay: but I think she's just crazy Al: hehe Al: No some bears talk Al: some don't Al: and some are FAMOUS like me!@ Jay: are they aware of their own existence?	Jay doesn't want to acknowledge a world where teddy bears can talk. His question about teddy bears being aware of their own existence suggests he is too serious-minded to engage in role-play involving teddy bears.
Al: of couse we are Jay: ooh kay Al: even the ones that don't talk Al: Ever been to Tunisia?	The ‚ooh kay' spelling clearly communicates that Jay doesn't believe or agree with Albert's statements. Albert in the meantime is trying to get past the teddy bear issue and make some progress in the script.
Jay: so why the fascination with teddy bears Jay: no but ive been to south Africa Al: COS IM A TEDDY BEAR Al: AND IM FASCINATING! Jay: prove it	But Jay does not want to move on. He wants Albert to admit he is not a teddy bear – "prove it".

Based on the premise that experiencing *Fun* can be helpful as a treatment for anxiety this study demonstrates a theoretical model for measuring *Fun*, and presents an example of an activity which addresses several of the most common causes of anxiety. Albert's character has no fears as he invites the subject to ride with him. The subject is in a safe communication environment - a social game – and within this environment is protected from many of the common causes of anxiety: fear of the unknown, fear of talking to strangers, fear of strange places, fear of peer opinion, fear of poor performance. The subject is protected by the communication environment and by the playful nature of the activity, while simultaneously vicariously experiencing situations, which in real life would terrify them. This simultaneous pairing of an activity with a playful response in many ways emulates the processes of Systematic Desensitization (Ginsberg and Walkup 2004, pp 184) by allowing the subject to take the sources of their anxieties and have *fun* with them.

In comparable studies involving puppets in treatment of anxiety (Argent, 2007) the advocates stress that the puppet, and by extension the communication environment, is never the whole therapeutic medium. Rather the efficacy of the treatment lies in the potential of the various game-factors to engage the subject in a manner that is *fun* and by its nature relies to some extent on playful narrative. The effectiveness of any such anxiety relieving aids is therefore heavily dependant on their method of utilization, the skills and engagement styles of the practitioner, and the appropriateness to, and the narrative tendency of, the subject. The FUM model then could provide a means of measuring the *fun* response, of various implementations of activities with various subject groups, to inform appropriate matching of activity to subject.

The authors contend that the methodology investigated in these experiments - designing *fun* activities in online communication environments which address causes of anxiety and using the FUM to measure the subject's *Fun* levels - can inform the design and measurement of the user experience. Furthermore, the overall levels of *Fun* emerging from these experiments do suggest that playful narrative and role-playing activities in online communication environments hold much potential to provide effective anxiety-reducing activities.

Future Directions

Future directions in this research include plans to;

- Run controlled clinical tests with a sample group of subjects with varying levels of anxiety.
- Introduce a two-way video communication environment using FUM to measure benefits.
- Refine data collection techniques, and survey statements to better capture levels of anxiety.
- Introduce biometric data into the experience measurement

In particular, our focus for future research is on developing increasingly effective *fun* activity models which can be used in treatment for anxiety disorders. The most recent project *Albert in the Land of the Vikings* (Newman 2007), uses online video story-telling via rapid low-cost production to provide a stimulus for interaction between subjects.

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Virtual Reality Cognitive Performance Assessment Test

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Abstract: *Virtual Reality Cognitive Performance Assessment Test (VRCPAT) is a virtual environment-based measure of learning and memory. We examined convergent and discriminant validity and hypothesized that the VRCPAT's Total Learning and Memory scores would correlate with other neuropsychological measures involving learning and memory, but not with measures involving potential confounds (i.e., Executive Functions; Attention; and Processing Speed). Using a sequential hierarchical strategy, each stage of test development did not proceed until specified criteria were met. The 15 minute VRCPAT battery and a 1.5 hour in-person neuropsychological assessment were conducted with a randomly selected sample of 20 healthy adults that included equivalent distributions of men and women from ethnically diverse populations. Results supported both convergent and discriminant validity. That is, findings suggest that the VRCPAT measures a capacity that is 1) consistent with that assessed by traditional paper and pencil measures involving learning and memory; and 2) inconsistent with that assessed by traditional paper and pencil measures assessing neurocognitive domains traditionally assumed to be other than learning and memory. We conclude that the VRCPAT is a valid test that provides a unique opportunity to reliably and efficiently study memory function within an ecologically valid environment.*

INTRODUCTION

While standard neuropsychological measures have been found to have adequate predictive value, their ecological validity may diminish predictions about real world functioning (Chaytor et al., 2006; Farias, Harrell, Neumann, & Houtz, 2003; Gioia & Isquith, 2004; Odhuba et al., 2005). Traditional neurocognitive measures may not replicate the diverse environment in which persons live. Additionally, standard neurocognitive batteries tend to examine isolated components of neuropsychological ability, which may not accurately reflect distinct cognitive domains (Parsons et al., 2005).

Virtual Reality (VR) technology is increasingly being recognized as a useful tool for the study, assessment, and rehabilitation of cognitive processes and functional abilities. The ability of VR to create dynamic, immersive, three-dimensional stimulus environments in which all behavioral responding can be recorded, offers assessment and rehabilitation options that are not available using traditional assessment methods. In this regard, VR applications are now being developed and tested that focus on component cognitive processes including: attention processes (Parsons et al., in press; Rizzo et al., 2006), spatial abilities (Parsons et al., 2004), memory (Matheis et al., 2007), and executive functions (Baumgartner et al., 2006; Elkind et al., 2001). The increased ecological validity of neurocognitive batteries that include assessment using VR scenarios may aid differential diagnosis and treatment planning.

The Virtual Reality Cognitive Performance Assessment Test (VRCPAT) project focuses on the refined analysis of neurocognitive testing using a virtual environment to assess recall of targets delivered within the context of a virtual city. Following the general psychometric conventions, any measure purporting to quantify a particular neurocognitive domain should be highly correlated with other measures of the same neurocognitive domain (convergent validity), whereas it should not be too highly correlated with tests of different neurocognitive domains (discriminant validity). Herein we report on the psychometric properties of data gained from human pilot testing with the VRCPAT.

METHODS

We acquired data on the implementation of a virtual reality battery (i.e. VRCPAT) in a normative sample that also received a traditional paper and pencil battery. Because the VRCPAT was designed to tap very specific neurocogni-

tive systems and not to mirror a traditional paper-and-pencil battery, our goal is not to replace the traditional battery for all neurocognitive domains. We aim to assess the psychometric properties of the VR and paper-and-pencil measures. Hence, scores were correlated with demographic and other performance test measures administered. Standard correlational analyses using a brief demographic survey and pencil-and-paper cognitive tests aid our initial assessment of both the concurrent and divergent validity properties of this form of assessment.

Our plan for the development and implementation of the VRCPAT's psychometric properties involved systematic refinement analyses that acted as a component of an ongoing dialectic between measurement and substantive research. We aim to make the VRCPAT a well-developed measure that facilitates substantive advances. We determined the content homogeneity of each of the VRCPAT's unidimensional facets. The establishment of the VRCPAT's psychometric properties removed the possibility that results reflect correlates of the target construct (memory and/or attention) but are not prototypic of it. We also assessed the level to which all aspects of the target construct (memory) is under- or overrepresented in the VRCPAT's composition, and assess whether the experience of some aspects of the virtual environment introduced variance unrelated to the target construct.

Participants: The study sample included 20 healthy subjects (Age, mean = 24.45, SD = 3.05; 50% male; and Education, mean = 14.05, SD = 0.51). Strict exclusion criteria were enforced so as to minimize the possible confounding effects of comorbid factors known to adversely impact cognition, including psychiatric (e.g., mental retardation, psychotic disorders, diagnosed learning disabilities, Attention-Deficit/ Hyperactivity Disorder, and Bipolar Disorders, as well as substance-related disorders within two years of evaluation) and neurologic (e.g., seizure disorders, closed head injuries with loss of consciousness greater than 15 minutes, and neoplastic diseases) conditions. Subjects were comparable in age, education, ethnicity, sex, and self-reported symptoms of depression.

Procedure: The University of Southern California's Institutional Review Board approved the study. Experimental sessions took place over a two hour period. After informed consent was obtained, basic demographic information and computer experience and usage activities were recorded. Subjects then completed a neuropsychological battery administered under standard conditions. Following completion of the neuropsychological battery, subjects completed the simulator sickness questionnaire (Kennedy, Lande, Berbaum, & Lilienthal, 1992), which includes a pre-VR exposure symptom checklist. Next, all participants were administered the VRCPAT as part of a larger neuropsychological test battery.

The following traditionally used paper and pencil neuropsychological measures were used as convergent validity measures because each is considered to have an important memory component, and has been used clinically to estimate memory abilities: To assess verbal learning and memory we used the Hopkins Verbal Learning Test – Revised (HVLT-R; Brandt & Benedict, 2001); to assess nonverbal learning and memory we used the Brief Visuospatial Memory Test – Revised (BVMT-R; Benedict, 1997); and to assess Lexical-Semantic Memory we used Controlled Oral Word Association Test (FAS: Benton, Hamsher, & Sivan, 1994); 2) Semantic Fluency (Animals; Gladsjo et al., 1999);

Discriminant validity measures that were drawn from the corpus of traditionally used paper and pencil neuropsychological measures included: to assess Attention we used Digit Span (Forward and Backward) from the Wechsler Adult Intelligence Scale –Third edition (WAIS-III; Psychological Corporation, 1997); to assess processing speed we used Digit Symbol Coding from the Wechsler Adult Intelligence Scale – Third edition (WAIS-III; Psychological Corporation, 1997), and Trail Making Test Part A (TMT; Heaton, Grant, & Matthews, 1991; Reitan & Wolfson, 1985); to assess executive functioning we used Trail Making Test Part B (TMT; Heaton, Grant, & Matthews, 1991; Reitan & Wolfson, 1985) and the Stroop Color and Word Test (Golden, 1978).

The VRCPAT is a 15-minute measure, in which participants (referred to as "users" in the follow-

ing text) then go through the following steps:

Acquisition Phase – Users are presented with 10 pieces of language-based information to be learned, without any context for what they will need to do with this information. The information stimuli is primarily language based (i.e., blue car, intact barrel with stenciling on it, red shipping container with numbers 7668, etc.), although stimuli includes minimal imagery to provide opportunities for more context relevant stimulus creation. The acquisition phase is initially standardized to three one-minute trials. At the end of each trial, users are then asked to name the objects that they studied as an assessment of initial declarative recall memory. It should be noted here that the item pool of stimuli that is being used in the formal tests was generated during the initial development phase. At that time, various stimulus combinations were piloted (not using VR) with users to determine "memorability" to inform final selection of stimuli that is being used in the formal VR test. Informal exploration of image-based stimuli for later development of a pure object-based visual stimulus test has occurred concurrently with verbal tests, using pictures of objects similar to the language stimuli.

VR Interface and Task Training Phase – After users are given the three one-minute trials to "memorize" the stimuli, a brief "interface training" period then occurs in which users become familiar with their objective, the controls of the game pad navigation interface and head-mounted display (HMD). The task is read aloud by the investigator and contains specific instructions for how to proceed through the virtual environment (VE) and how to record images of each target object. Users are told that they will need to go to each target zone in sequence, and at each zone, two of the items that they had memorized previously will be present somewhere in the environment from that vantage point. Upon finding the items, they should align the cross hairs with that object and press the response button to record (or "collect") them. Users have one minute to spend within each target zone and scan for the relevant memorized target items. If they find the target items in less than the one-minute period, they must wait for time to expire and follow their guide to the next zone. If the user does not find both objects in a target zone by the time that the one-minute period has elapsed, an alarm sounds and a voice tells the user to move to the next zone and seek out the two objects located there. To minimize guessing by subjects that hit the response button on all possible target objects, subjects are told that they have a limit of two button presses per zone.

The VE is designed to resemble a city and the location of this task training phase also serves as the starting point for the users. The environment contains people (of various ages and gender) dressed in culturally appropriate clothing, a market place, avatars, various moving and parked vehicles, animals, buildings and street signs and a host of other objects (i.e., wooden barrels, crates, containers, etc.). Users are given as much time as needed to explore a limited area of the environment. This exploration area is determined by the experimenter. During this phase, the investigator can informally present verbal guidance to the users in order to help them to become familiar with the interface navigation, response button and HMD viewing parameters. This phase is designed to teach the interface controls to the user, so that performance on the VE navigation and object selection interaction tasks are minimally influenced or distracted away from the resulting memory assessment in the retrieval phase that follows.

Retrieval Phase – Once users indicate that they are comfortable within the VE and can demonstrate comprehension of the navigation interface and targeting procedure, the investigator asks if there are any questions. If so, clarification and coaching occur until the user can fully comprehend the task.

Debriefing Phase – During this phase, users are asked to recall the original list of stimuli and at which target zones they were found. The performance measures that are derived from this test include: number of correct hits, false hits, time to successfully complete per target zone, time to complete overall. A trained research assistant administered all psychometric tests. The Simulator Sickness Questionnaire (Kennedy et al., 1992; SSQ) was used to determine whether the participant felt sick as a result of the VR experience.

DATA ANALYTICS

All data were analyzed using SAS version 9.1 (SAS Institute Inc, Cary, NC, 2003). Descriptive statistics were calculated for participant demographics, and for results of the VRCPAT and the criterion neuropsychological tests. Missing data were imputed by either "mean substitution" or "last case carried forward." Two types of analyses were performed. The first involved computing basic correlations between VRCPAT measures and traditional neuropsychological measures assessing learning and memory. Two-tailed Pearson correlations were used. To make the results for continuous tests comparable, the test scores were converted to standard scores with a mean of zero and standard deviation of one (z-score transformation). The second series of analyses involved computing basic correlations between VRCPAT measures and traditional neuropsychological measures that assess domains that have traditionally been understood to be other than learning and memory. Two-tailed Pearson correlations were used. To make the results for continuous tests comparable, the test scores were converted to standard scores with a mean of zero and standard deviation of one (z-score transformation). It was expected that while VRCPAT Learning and Memory scores would be highly correlated with standard neuropsychological measures of learning and memory, VRCPAT Learning and Memory scores would not be significantly correlated with neuropsychological measures of domains other than memory.

RESULTS

Given the similarity of participants in terms of age, sex, education, immersiveness, and ethnicity, no correction for these variables was employed. Notably, none of the participants reported simulator sickness following VR exposure as measured by the SSQ. Table 1 shows correlations between traditional test cognitive domain scores and VRCPAT scores.

To provide preliminary data to support the validity of the VRCPAT as a measure of learning and memory, recall indices from the VRCPAT and traditional neuropsychological tests were correlated. Indices were developed from linear composites derived from z-score transformations. Specifically, Pearson correlation analyses were used to compare recall from the VRCPAT with linear composites derived from traditional neuropsychological measures.

Convergent Validity Tests: Whilst the VRCPAT Total Memory Score was significantly correlated with composites derived from established measures of learning and memory, it did not correlate with possibly confounded variables (i.e., Executive Functions; Attention; and Processing Speed) drawn from traditional neuropsychological measures that are not assessments of learning and memory (see Table 1). Hence, the results indicated that the VRCPAT correlated significantly with the traditional neuropsychological Learning Composite (HVLT Trials 1-3; and BVMT Trials 1-3) $r = 0.68$, $p < 0.001$), with 46% variance shared between the two indices. The results indicated that the VRCPAT also correlated significantly with the traditional neuropsychological Memory Composite (HVLT Total Recall after a Delay; and BVMT Total Recall after a Delay) $r = 0.67$, $p < 0.001$), with 45% variance shared between the two indices.

Discriminant Validity Tests: As expected, there were no significant correlations between VRCPAT measures and the following neuropsychology test composites: Executive Functions Composite; Attention Composite; or Processing Speed Composite. Hence, each of the discriminant validity significance tests were as predicted, that is, did not correlate with theoretically unrelated abilities (Table 2).

Although validity coefficients drawn from composites may not meet validity expectations it may still be the case that individual measures account for some of the trait variance. Therefore, we assessed the measures both as composites and individually. As such, we compared the VRCPAT with the actual neuropsychological tests (used to derive the Learning Composite and the Memory Composite). Analysis of the relations between the VRCPAT Total Memory Score and the actual learning and memory tests revealed significant correlations for each of the convergent validity significance tests, in accordance with prediction (Table 2).

For correlations between the VRCPAT and traditional psychometric measures we only consider

Table 1: Correlations between traditional test cognitive domain scores and VRCPAT scores

	VR Learning		VR Recognition		VR Speed		VR Memory	
	R	P	R	p	r	p	R	p
Learning	0.68	*	0.72	*	0.39	*	0.70	*
Retrospective Memory	0.69	*	0.67	*	0.29		0.65	*
Executive Functions	-0.14		-0.25		0.19		-0.05	
Attention	0.25		0.25		0.16		0.18	
Processing Speed	-0.17		-0.19		-0.01		-0.20	
Lexical-Semantic Memory	0.67	*	0.31		0.13		0.51	*

Note: N=20 for all analyses. VR = Virtual Reality.
** P < 0.05*

Table 2: Correlations between traditional neurocognitive test scores and VRCPAT total memory score

	R	* P
Learning		
HVLT Trials 1–3	0.59	< 0.05
BVMT-R Trials 1–3	0.43	< 0.05
Retrospective Memory		
HVLT Recognition	0.57	< 0.05
BVMT-R Recognition	0.36	< 0.05
Executive Functions		
Trails B	-0.10	ns
Stroop Interference	0.01	ns
Attention		
Letter Number Sequencing	0.21	ns
Digit Span Forward	0.10	ns
Digit Span Backward	0.10	ns
Processing Speed		
Trails A	-0.13	ns
Digit Coding	-0.09	ns
Lexical-Semantic Memory		
Animals	0.46	< 0.05
Letter Fluency	0.27	p=.171

Note: N=20 for all analyses.

ered those correlations that met the criterion of $p < .05$ to be meaningful. Given our small sample size we kept *P* at this level, despite the risk of Type I error with multiple correlations. All of our significant correlations were associated with at least moderate effect sizes.

DISCUSSION

The results of this study indicate that: (1) VRCPAT memory measures correlated significantly with scores from the memory measures drawn from the traditional neuropsychological test battery; (2) VRCPAT memory scores did not correlate with non-memory measures drawn from the traditional neuropsychological test battery. Additionally, no negative side effects were associated with use of the VRCPAT. The establishment that the VRCPAT's memory measures correlated significantly with scores from the memory measures drawn from the traditional neuropsychological test battery but not with non-memory measures removed the possibility that results reflected correlates of the non-target construct (i.e. processing speed; executive function).

Our findings should be understood in the context of some limitations. These findings are based on a fairly small sample size. As a necessary next step, the reliability and validity of the test needs to be established using a larger sample of participants. This will ensure that the current findings are not an anomaly due to sample size. Additionally, as indicated above, the diagnostic utility of this VRCPAT assessment tool must be determined. The ability of the VRCPAT to accurately classify participants into memory impaired and non-impaired groups based on carefully established critical values must be evaluated. This will involve the generation of specific cut-off points for classifying a positive (memory impaired likely) or negative (memory impaired unlikely) finding. The VRCPAT's prediction of memory impairment will need to be evaluated by the performance indices of sensitivity, specificity, predictive value of a positive test, and predictive value of a negative test. Even though reliability is considered to be a unique asset of testing in computer-generated VEs, issues of test–retest reliability need to be addressed.

Our goal was to conduct an initial pilot study of a VRCPAT that employs a standard neuropsychological battery for the assessment of normal participants. We believe that this goal was met. We recognize, however, that the current findings are only a first step in the development this tool. Many more steps need to be taken in order to continue the process of test development and to fully establish the VRCPAT as a measure that contributes to existing assessment procedures for the diagnosis of memory decline. Whilst the VRCPAT as a measure needs to be fully validated, current findings provide preliminary data regarding the validity of the virtual environment as a memory measure. The VRCPAT was correlated with widely used memory assessment tools. Nevertheless, the fairly small sample size requires that the reliability and validity of the VRCPAT be established using a larger sample of well-matched participants. This will ensure that current findings are not a sample size related anomaly. Finally, the ability of the VRCPAT to accurately classify participants not involved in the initial validation study will need to be examined for cross-validation purposes.

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Handheld Computerized Neuropsychological Assessment in a Virtual Reality Treatment Protocol for Combat PTSD

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Abstract: *In this paper we introduce a new handheld computerized neuropsychological assessment system, i.e., BrainCheckers. This test system includes the Mental Efficiency and Workload Test (MEWT) designed for Primary Care and Pharmaceutical research, a Concussion Toolbox, and our Combat Stress Assessment (CSA). Focus will be on the CSA. It has been designed for assessment of injuries such as concussion due to blast exposure and/or Post Traumatic Stress Disorder (PTSD). It is presently being implemented as a key assessment instrument by the Virtual Reality Medical Center, San Diego, CA in a Virtual Reality (VR) treatment program for veterans from Iraq who have been diagnosed with PTSD.*

BrainCheckers runs on handheld Palm® personal digital assistants (PDA). It includes a library of 20 tests that have been modeled after the Automated Neuropsychological Assessment Metrics (ANAM). Tests assess attention and concentration, working memory, mental flexibility, spatial processing, cognitive processing efficiency, memory recall, mood, and fatigue. It includes norms, and new tests such as an Emotional Stoop (E-Stroop). Our E-Stroop has been designed specifically for repeated assessment of PTSD treatment outcomes for veterans who have experienced psychological combat trauma in Iraq.

This system is presently being used in a variety of medical settings including military and Veterans Administration medical hospitals where efficient, cost-effective, and repeated assessments are essential.

Keywords*: Neuropsychological assessment, Palm OS; ANAM; ARES; PTSD; Virtual Reality; Concussion; Combat; Stress*

INTRODUCTION

Computerized neuropsychological testing has predominantly used desktop or laptop computers and/or the Internet to administer tests. Such systems are suited for controlled research and clinical environments, but are impractical in operational medicine settings such as an Emergency Room, a desert field environment such as Iraq, or in general medical clinics/exam rooms. Further, very few systems have been designed for reliable serial assessment as is required in tracking treatment effects and recovery of patients with concussion and/or PTSD. Our solution has been a re-engineering of a validated computerized test system, i.e., the Automated Neuropsychological Assessment Metrics (ANAM) (Reeves, et. al., 2007), for use on handheld computers. The latest generation of development in this line is BrainCheckers. It includes a library of test modules that have been configured into standardized batteries for three specific product lines. They are: 1) a diagnostic Concussion Toolkit for assessments in Sports Medicine and of Blast Concussion; 2) a Mental Efficiency and Workload Test (MEWT) for primary care and pharmaceutical research; 3) and a Combat Stress Assessment (CSA) that includes a brief neuropsychological screen and PTSD assessment metric.

The BrainCheckers system is designed to provide precise measurement of cognitive processing efficiency in a variety of contexts. A prototype of BrainCheckers (i.e., ANAM Readiness Evaluation System, ARES), (Elsmore et. al., 2007), was tested in a field medical unit in 2003 in Iraq. It proved well suited for use in that hos-

tile and sandstorm environment. Since then, hardware and software engineering has been completed along with concurrent validity research and development of a normative database.

Technical Information.
BrainCheckers includes a library of 20 ANAM tests that have been adapted for the Palm OS version of the C++ programming language. It runs only on Palm® handheld (PDA) computers. It requires Palm® OS, Version 4.1 or higher. The system is designed to run tests in flexible batteries to meet specific clinical, operational, and research goals. BrainCheckers operates on a wide range of color Palm OS PDAs; the Tungsten/E2 is our recommended full-featured unit. The system includes a Windows support program for communication between Windows PCs and the PDAs for data downloading, viewing, and archiving of data. Communication between PDA and desktop can be via direct serial link, USB, or landline and wireless modems. At the end of each test session, data are stored on the PDA in a Palm® database. Additionally, this includes a Microsoft® ".mdb" Access database file. All input for BrainCheckers CSA requires a PDA stylus.

History of BrainCheckers.

For decades the Department of Defense has been involved in the development of cognitive tests to assess and monitor changes in neurocognitive status of the war-fighter. The desktop PC version of ANAM has been the most prominent outgrowth of the Military-sponsored neurocognitive assessment systems. BrainCheckers development stemmed from a need for a portable automated neurocognitive testing system that could be used in field medical settings such as Iraq and Bosnia (Proctor, et al., 2002; Proctor, et al., 2003).

The first version of the Palm based ANAM was developed in the context of migraine research (Farmer et al., 2000). A small subset of tests was developed for the PDA and proved useful in assessing efficacy of treatment interventions for migraine. This instrument was named the Migraine Early Warning Tool (MEWT) (Farmer et al., 2001; Farmer et al., 2003). The MEWT could be administered in about five minutes to provide immediate feedback to the patient regarding possible onset of a migraine attack. This research demonstrated the sensitivity of the system to changes in the CNS and the practicality for use of a portable cognitive assessment system in clinical medicine. The second generation was developed for the military and field operation medicine. This system was called the ANAM Readiness Evaluation System (ARES). That system underwent a steady evolution and expansion and is now BrainCheckers.

The current system includes a multi-level set of batteries designed at the upper end to assess Fitness for Duty in high functioning patients, such as pilots, and at the lower end to assess and track patients with progressive dementia such as Alzheimer's disease. The development has been guided through direct user feedback in clinical settings including medical centers such as the National Naval Medical Center, Bethesda, MD, the University of Maryland Medical Center's Shock Trauma unit, National Center for PTSD, Menlo Park, CA, and the Naval Medical Center in San Diego. As a result, BrainCheckers modules have been "fine-tuned" for clinical use with modifications guided by patients' limitations and examiners' needs for flexibility in administration and ease of data management. Technical improvements have resulted in a mature, stable and reliable set of software modules.

BrainCheckers Combat Stress Assessment

The BrainCheckers Combat Stress Assessment is a neuropsychological test system designed for use in operational and clinical military medical settings. It has been designed for pre and

BrainCheckers CSA includes five tests:

1. Sleep scale
2. Simple Reaction Time
3. Go-no-Go Reaction Time
4. Procedural Reaction Time
5. Matching to Sample
6. Mood Scale
7. OIF E-Stroop

Table 1. BrainCheckers Combat Stress Assessment	
Test	Neuropsychological Measure
1. Sleep Scale	Subjective assessment of energy/fatigue level
2. Simple Reaction Time	Visual-response time---psychomotor reaction time
3. Go-no-GO Reaction Time	Response inhibition
4. Procedural Reaction Time	Sustained attention & mental flexibility
5. Matching to Sample	Spatial working memory
6. Mood Scale	7 subscales assessing emotion/affect/physical state
7. ARS E-Stroop (OIF)	Cognitive & Emotional response & inhibition reaction time

post deployment neurocognitive/TBI/and PTSD, and repeated rehabilitative progress assessments.

Table 1 presents a listing of the test menu along with a listing of cognitive and emotional constructs associated with individual tests. Descriptions and illustrations of the component tests are presented in Appendix A.

The CSA was designed for repeated assessment of neurocognitive function, emotional status and hyper-reactivity. We included modules that have established validity and reliability (Bleiberg et. al., 2001; Elsmore et. al., 2007). Another consideration was to include measures of memory and executive function that are known to be impaired in individuals with mild traumatic brain injury and PTSD (Vasterling and Brewin, 2005).

BrainCheckers and VR treatment for PTSD.

At present, the Virtual Reality Medical Center (VRMC) is conducting a VR Treatment program for active duty personnel who have served in Iraq and who have PTSD. This program is funded by the Office of Naval Research (ONR) and is comparing the effects of Virtual Reality Graded Exposure Therapy (VRGET) with Cognitive Behavioral Group therapy on active-duty personnel. The BrainCheckers CSA is being implemented in this program as an objective index of emotional reactivity and cognitive processing efficacy. Within this program, we have developed an Emotional Stroop specifically for Operation Iraqi Freedom veterans.

Preliminary results from the project are presented in the tables below. The data in these tables were derived from 15 subjects who are presently undergoing treatment. These results are from our pre-treatment baseline assessment and provide a profile of the negative impact that PTSD has on cognitive processing efficiency and executive functions.

Table 2 presents results from the Sleep Scale. The sleep scale is a subjective assessment that requires the subject to select a statement that describes their level of alertness. Scores range for 1 to 7, with 1 defined as “active, vital and alert”, and 7 defined as “very sleepy, falling asleep”. As seen in Table 2 the group mean sleep score is 3, which is defined as “relaxed, not fully alert” and indicates that our subjects were adequately alert to proceed with the remainder of the test.

Table 2. Sleep scale results	
Score	RT (sec)
3	21.6

Table 3 presents results from the Mood Scale. Scores represent the strength of emotion the individual is experiencing in each of the seven categories. Scores range from 0 to 100%. Additionally, the response time to each adjective presented in this test is recorded which provides a perspective on emotion and affect available only in our scale. Results reflect general euthymia and an almost dampened affect with none of the scores exceeding 50%. The response scores indicate the subjects took time to think about their responses and response times are balanced across categories.

Table 3. Mood Scale results

Mood Scale	Vigor	Happiness	Depression	Anger	Fatigue	Anxiety	Restless
Score %	44	43	35	36	38	45	49
Response Time	2.86	2.97	2.68	2.09	2.29	2.00	2.37

Results shown in Table 4 are from our traditional Stroop test, which provides a measure of the ability for response inhibition. This test is the first computerized version of the Stroop developed for use on the PDA. It has been modeled after a well validated and standardized clinical version (Golden, 1978). There are two subsets, congruent and incongruent. In the congruent subset the words red, blue and green are presented in congruent colors and the subject taps on a block at the bottom of the screen that represents the color of the letters. In the incongruent subset the words are presented in incongruent colors. For example the word red might be displayed in green letters. Here again the subject is requested to tap the block that corresponds to the color of the letters. There is a strong tendency for the subject to want to read the word and tap on the block that represents the meaning of the word instead of the color of the letters. This is the "stroop" effect" and requires the ability to inhibit the response tendency to produce a correct response. Results in Table 4 clearly reveal this effect across all scores by comparing the congruent with incongruent test results.

Our study also includes a variation of the traditional Stroop paradigm, i.e., the Emotional Stroop (E-Stroop) (Beck, et. al., 2001 and Constans, et. al., 2004). Our version is unique and the first to be specifically designed for use in the assessment of PTSD in veterans from Iraq. The test is presently in the early stage of validation in this study. It is described in Appendix A.

Table 5 presents results from response time tests. In this table, test results from our subjects are compared to normative values. Scores include mean response time, median response time, throughput (number of correct responses per minute) and the percent correct. Simple Reaction Time is as the name implies a simple input/output visual response time test that requires the subject to tap on an asterisk each time it appears on the screen. The Procedural Reaction Time Test presents the numbers 2, 3, 4, or 5 rapidly on the screen. When the 2 or 3 appears the subjects taps on a block labeled **2, 3**. The subject is instructed to tap on the block that is labeled **4, 5** when the 4 or 5 is flashed on the screen. This test is forced paced and is a very good measure of mental flexibility and sustained concentration. Results in our study reveal an almost universal cognitive and psychomotor slowing in our subjects' scores as compared to normative scores for 18-33 year-old subjects (*shown in parentheses*).

CONCLUSIONS

BrainCheckers is a handheld version of the ANAM, a widely utilized neuropsychological assessment instrument that has been undergone over 15 years of development. Its validity and reliability have been well established (Reeves, et. al., 2007). The CSA has been specifically tailored for assessing the impact of PTSD and treatment outcomes within a research protocol that is directed at creating an effective VR treatment for combat PTSD. In the VR laboratory, the CSA has been proven to be a practical instrument for measuring to emotional and neurocognitive changes over repeated trials. Through our current research, our hope is that the BrainCheckers CSA will also prove useful in detecting early signs of PTSD, and a combatant's readiness to return to duty.

Table 4. Traditional stroop results

test name	meanCorRT	medCorRT	tput	% correct
Stroop Congruent	.89	.82	75	97
Stroop Incongruent	1.14	1.04	58	91

Table 5.Response Time Tests				
test name	Mean RT	Median RT	Throughput	% correct
Simple RT	.42 (*.26*)	.39 (*.25*)	163 (*236*)	Na
Procedural RT	.65 (*.54*)	.63 (*.53*)	86 (*108*)	95 (*98*)

The CSA is being developed as a screening and brief assessment instrument, and to augment, not replace, traditional neuropsychological batteries such as Halstad-Raitan neuropsychological test battery. It provides an adaptable and efficient tool for use in a variety of environments, in this case the VR laboratory. It includes an automated cognitive status report that compares a patient against his or her own norm, as well as standardized norms based on various populations. This unique aspect of the system allows for use as a screening and serial testing instrument.

Future applications will involve testing its use in studies that involve medics and corpsmen in combat settings. Its application for detecting mild concussion due to mechanical and blast injuries, onset of PTSD symptoms, and the readiness of troops to return to combat will be an important extension from its in-vitro clinical laboratory into the combat in-vivo environment.

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Science Learning by Blind Children through Audio-Based Interactive Software

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Abstract: *In this research we evaluated the impact of AudioLink, interactive audio-based multimedia software for children with visual disabilities, on science learning when used jointly with cognitive tasks. We present main results obtained when using this software during a six-month field study. Children were able to learn and practice scientific method processes and enjoy learning new topics by widening and enhancing their theoretical conceptualizations and acoustic perception. There were manifest physics learning gains; analytical cognitive skills were enhanced between pretest and post-test measures. In some participants these gains meant significant achievement. Children were also able to map, use and understand a game with a complex dynamic and interaction, and solved complicated science problems. We concluded that the use of AudioLink, combined with cognitive tasks, promotes scientific content learning and also enhances problem-solving skills during experimentation conveyed through the application of the scientific enquiry method.*

Keywords: *Blind children, cognitive evaluation, science learning, interactive software, virtual environments.*

INTRODUCTION

Most children have difficulties in learning science, no matter their origin. The situation of children with visual impairments is poorer, since they have many difficulties accessing information, and science learning methods are designed mainly to take advantage of visual channels. A growing line of research on designing educational software for children with visual disabilities is using audio as the chief sensory channel to assist the construction of knowledge and meaning making (Kurniawan, et al., 2004; Sánchez & Flores, 2004). Although there are some software titles that support the development of mathematics learning and problem-solving skills (Shaftel et al. 2005) with significant gain for blind children (Eriksson & Gärdenfors, 2004; Mastropieri & Scruggs, 1992; Sánchez & Sáenz, 2006), no relevant work using audio-based science software to enhance science learning in blind children has been described in the literature.

The key issue in this research was the fact that teaching of science is tightly related to observation using the vision channel. Cognitive abilities for discriminating, classifying, sorting and recognizing objects, facts or phenomena contribute to prepare children to solve problems in real life. But traditional science teaching always uses vision as the chief channel to convey information, overlooking the remaining senses, which can actually produce more meaningful learning.

It should be said that at a motor level there are some setbacks in the development of basic skills in blind children (body knowledge, imitative behavior). However, at a cognitive level, they are absolutely normal, developing different perception channels, relaying more on the audio and tactile-kinestesic than sighted children.

The main purpose of this research was to evaluate the impact of *AudioLink* (Sánchez & Elías, 2006), an interactive audio-based multimedia software for children with visual disabilities, on science learning. The underlying questions of this study were: Can we develop scientific inquiry thinking (observation, stating a hypothesis, and doing experimentation) in blind children through audio-based multimedia software? Does this type of software assist the learning of science content? Can the use of interactive audio-based multimedia software enhance cognitive skills, both analytical (classify, relate, analyze and compare) and critical (evaluate, discern), as well as problem-solving skills?

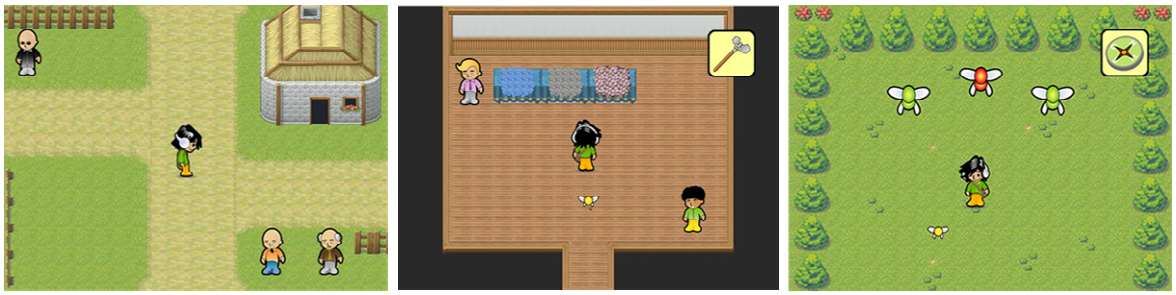

Figure 1. Main views of AudioLink

We present the main results obtained when using *AudioLink* in a field study during a six-month period, combined with the utilization of concrete materials and cognitive tasks to learn and practice scientific method processes and science topics.

INTERACTIVE SOFTWARE

AudioLink is an action-platform role-playing game (RPG). When playing the game, the user controls a main character in a treasure hunt (see figure 1). The character navigates through a chain of connected stages that represents a fictitious world with streets, houses, and cities. He or she interacts with elements and characters that provide the quests to be accomplished and the clues needed to fulfill them. There are also side-quests that involve additional rewards. Hence, it is possible to incorporate different science concepts in a quest in such a way that each of these adventures considers the learning of one or more concepts. The game provides sequential, parallel, optional, and alternative stories, and the accomplishment of side-quests ends up with different game-endings.

METHODOLOGY

This study was divided in two stages. In the first stage, a usability evaluation was implemented to ensure that the product was usable for blind end-users. End-user and heuristic usability evaluations were applied; concluding that the product developed could be utilized by blind users independently. It was also verified that *AudioLink* is appealing, encouraging and challenging software that stimulates interaction. In this first stage a preliminary cognitive evaluation took place for the purpose of verifying whether the interaction of children with *Audiolink* implied a greater science understanding and application of the scientific method to analyze and solve problems. Two instruments were used: logging of user's actions as recorded by the software and an open-question questionnaire. The results obtained indicated that users were able to perform most interactions embedded in the software and learners became highly motivated during interaction. *AudioLink* favors (in a game-based entertaining fashion) the development of skills related to the scientific method. Users were able to clearly identify the problems, understood that information was distributed in different zones, and explored the virtual world in order to retrieve it. Users mentioned that they enjoyed playing, faced different challenges and solved problems after planning and executing strategies. A complete review of *AudioLink*, usability evaluation results, and preliminary cognitive evaluation (scenario, sample) is discussed in Sánchez & Elías, 2006.

In the second stage of the study, which is the focus of this article, a complete and thorough cognitive evaluation was implemented. This evaluation consisted of a field study during a six-month period, combined with the utilization of concrete materials and cognitive tasks to learn and practice scientific method processes and science topics. This evaluation was comprised of three processes: software exploration, knowledge construction, and application. In the first process, children interacted with *AudioLink*, learned the functionalities, and began to realize the main purpose of the game. In the Knowledge construction process, children built pieces of knowledge by interacting with *AudioLink*. They learned the embedded concepts (physics and general science, see table 1) and also specific content of the game (characters, missions). Lastly, they applied what was learned, working with the cognitive tasks as part of the AudioLink scenarios.

Table 1: *Physics and Science concepts embedded in AudioLink.*		
Physics	Cardinal directions	N, NE, E, SE, S, SW, W, NW
	States of matter	Phases, states.
	Weight	Weight, mass, volume.
	Force	Direction, velocity, kinematics
	Energy	Thermal and light energies.
Science	Economic Activities	Natural resources.

COGNITIVE IMPACT

Purpose

The main goal of this study was to develop scientific inquiry thinking skills (observation, classification and experimentation abilities) in children with visual disabilities to analyze and solve scientific problems through interaction with audio-based multimedia software. Furthermore, we evaluated whether *AudioLink* combined with the cognitive tasks applied afterwards promotes learning physics and science concepts and the execution of necessary actions to solve problems during experimentation.

Scenario

All software evaluations were carried out at the "Santa Lucía" school for the blind, located in Santiago, Chile. Two special education teachers expert in vision disorders participated in the evaluations.

Sample

The sample consisted of 7 blind students, ages 8 to 14 years old (10 years old in average). One of them was totally blind, the others had residual vision. Three of them were female and 4 were male. All of them were legally blind, according to Chilean laws that state that "*an eye is blind when its corrected visual accuracy is 1/10, or when the sight field is reduced to 20 degrees*". This means that a legally blind person is able to see at one meter (3.2 feet) what a sighted one can see at 10 meters (32 feet). They were familiar with computer interaction through a keyboard. All of them also had attained expressive and comprehensive language skills and could utilize reading and writing systems (Braille or Macro-type). The sample had an IQ score higher than 70. We did not intend to have a larger sample because this was a case-study to provide in-depth data and information about science learning through audio-based interactive software.

Time Schedule

Cognitive evaluations took place from April to October, 2006. Until July the evaluations were scheduled twice a week and were 1.45 hrs per session. From August to October evaluations took place once a week with a 3.5 hr. duration.

Cognitive Tasks

Task 1: Little Researchers

The purpose of this task was to develop scientific thinking skills through observation, classification and experimentation, allowing learners to analyze and solve scientific problems. In addition to these cognitive abilities, learning content was promoted. Cognitive requirements for this task were: spatial orientation notions, tempo relationships and sensorial integration.

The task was implemented with a board game specially designed for this activity (see figure 2). The board had 98 spaces with six groups of questions or situations, which compelled children to apply scientific thinking and problem-solving skills. Two teams were formed and took turns to roll a special dice (with Braille labels on each side). The dynamic of the game follows the model of *Monopoly*; thus according to the number obtained, the current player of the team in turn moves a playing piece to land in the corresponding space, and then the facilitator reads a card of the same color of the space. The six colors correspond to: problem-solving questions; chance cards (good and bad); content-related questions; *AudioLink* related questions; and special spaces that, for instance, can make a player lose his or her turn or get an extra one. Each team can earn points for every correct answer provided, more points are obtained if

Figure 2. Game board designed for the first cognitive task

the current player answers without the support of their teammates. The game ends when one team reaches the central space, and the team that got more points is the winning team. Three sessions of this game were implemented in the study.

Task 2: Going for Scientific Thinking

The purpose of this task was to develop scientific thinking skills through observation, classification and experimentation allowing learners to analyze and solve scientific problems. Another goal was that learners solved problems through experimentation. The cognitive requirements for this task were the same as in Task 1. Two teams were formed pursuing the goal of rebuilding the relief puzzle of the world embedded in *AudioLink* by using concrete materials (figure 3-F). Nine pieces were provided to each team, and they were encouraged to finish the puzzle in the shortest time possible to win the game. To obtain the puzzle's pieces, teams had to solve practical problems concerning the application of scientific knowledge and contents embedded in the software.

Instruments

WISC-R

The Wechsler Intelligence Scale for Children-Revised (WISC-R) is a general test of intelligence, which Wechsler defined as *"...the global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment"* (Wechsler, 1944). This scale consists of 13 subtests divided into two parts, verbal and performance. The test helps to deter-

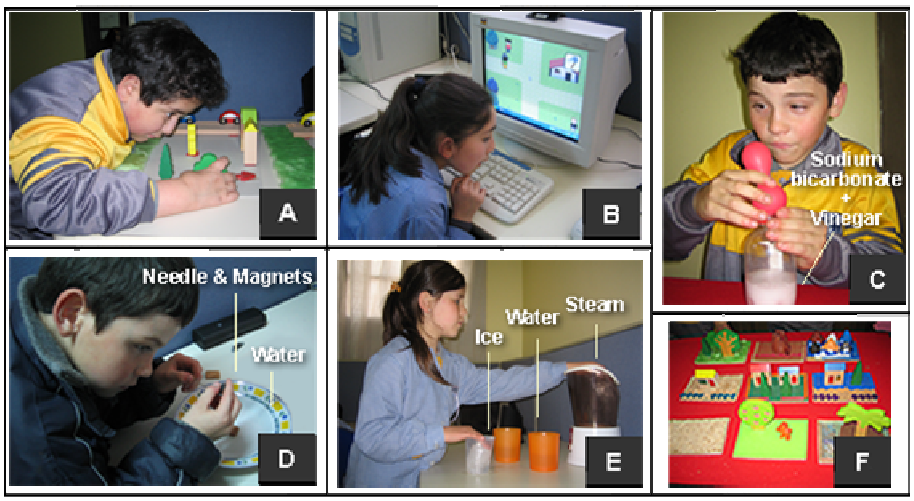

Figure 3. Activities of the cognitive task: (A) Completing the puzzle, (B) Interacting with *AudioLink*, (C) Experimenting chemical reactions, using sodium bicarbonate inside a balloon, and a bottle with vinegar, (D) Creating a compass (using a cork over water and a magnetized needle), (E) Experimenting with states of matter using ice cubes, glass of water and facial steamer, and (F) the completed puzzle

mine the child's ability to use practical judgments in social situations of everyday life. Each answer provided by the child has a score depending on whether it is appropriate and complete.

Procedure

To evaluate the cognitive contribution of *AudioLink* when used in combination with the cognitive tasks described above, we designed the following activities: First, a pretest evaluation was taken to measure the children's abilities. For this evaluation, the WISC-R test was applied. Next, children interacted with *AudioLink* and solved cognitive tasks. The complete sequence of activities of this stage was: interaction with *AudioLink*, presentation of concrete materials for each task, team formation, setting ground rules, application and evaluation of the cognitive task. The order of the tasks was first Task 1 *Little Researchers* and then Task 2 *Going for Scientific Thinking*. Finally, a posttest evaluation was taken to measure the children's abilities after the intervention. For this evaluation, the WISC-R test was applied. Likewise, to gather qualitative and quantitative data at the cognitive evaluation, questionnaires and photographic records were also utilized.

RESULTS

The small number of students did not permit extensive statistical analysis of the results. However, a case-study approach showed us that in the pretest, on average, students initially had a rather low performance, presenting poor skills in gathering and processing information about the local and more general social environment they deal with everyday. Many times they mentioned that "they would ask for adults to help" to solve a problem, evidencing that they have a strong dependence on others to make decisions. There was also a lack of ability to search, choose and utilize effective solutions to logic and everyday problems. The highest score obtained in the pretest was 22 (out of 34), which translates into an achievement level (AL) of 64.70%. The lowest score was 8 (23.52% AL) and the average score of this group was 13.14 (38.64% AL).

When contrasting pretest/posttest results, children clearly improved their performance (see figure 4). Many times children answered "I don't

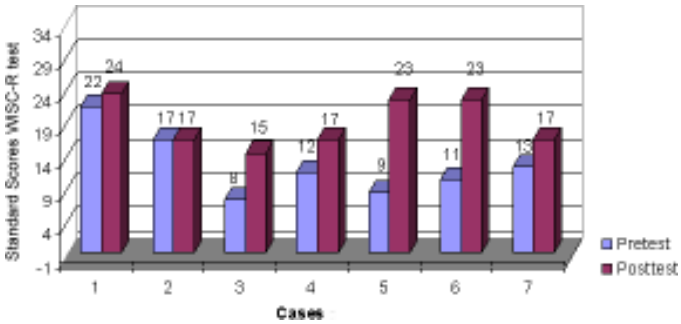

Figure 4. Pretest and posttest WISC-R test results

know" in pretest questions or gave only one possible answer for each question. However, there was a clear gain in the number of posttest answers provided by children being even more appropriate and correct for the problems presented. They were also able to come up with more than one solution to each problem and verbalize it in a more elaborated way. This showed a new approach to problems by student, considering a more elaborated processing and selection of information. The highest score obtained was 24 (out of 34), which translates to an achievement level of 70.58%. The lowest score was 17 (50% AL) and the average score of this group was of 19.42 (57.11% AL). These results also show that the majority of students (with the exception of one of them who maintained the same pretest score) improved their performance, both individually and as a group. On average, there was an increment of 6.28 points in the standard score (18.47% AL). Also, the pretest standard deviation was 4.9, while in the posttest it was 3.7. This indicates that after using *AudioLink* and fulfilling the cognitive tasks children, as a group, became more even, especially those students with lower scores in the pretest performed significantly better in the posttest. It is important to notice that student number 3 (the totally blind participant) increased his achievement level by 20.6%, almost doubling his standard score and student number 5, with low vision, almost tripled his score.

DISCUSSION

This study shows that by utilizing *AudioLink* with the cognitive tasks, blind students faced a new way of gathering science-related information. Furthermore, they participated in several activities that motivated them to process, select,

and use information purposefully. It is important to acknowledge the significant affect of these activities on most participants, some of them doubled and tripled their performance during posttest evaluation. Blind children learned to identify, select and apply different information to solve a given problem. There was a manifest increase in the number of answers/ideas provided as well as their correctness (score). Learners learned scientific facts and processes in a playful way, developing analytical skills such as classifying, relating, analyzing and comparing, and critical skills such as evaluating and discerning.

Cognitive tasks exercised attention, promoted the development of scientific thinking skills and favored the learners' verbal abilities. The technology utilized facilitated the learning process and favored analysis and solving scientific problems by blind children. Children also showed a new way of interacting with *AudioLink*, searching for specific information to meet specific ends and hearing what each character told them, some of them even tended to stop the character's dialogs after a few seconds. Although the activities required executing strategies independently, learners also interacted with each other to solve specific problems in teams.

In the psychomotor area there was an improvement in the way learners explored and manipulated concrete materials. In the cognitive area they showed an appropriate degree of comprehension of the game structure and rules. Also, there was an improvement in how the students recognized information and how they applied knowledge using *AudioLink* and their short-term and long-term memory. In the affective area, students appeared encouraged and willing to participate in the process, being aware of their errors and asking for help when needed. Finally, regarding scientific thinking, students applied process skills such as observation, classification, verification and reflective thinking.
Each learner worked at his or her own pace, which allowed superficial and deep interaction with the software. Students were able to realize what part of the game is crucial to solve the current problem. The contents embedded in *AudioLink* combined with practical activities, provided learners the opportunity to challenge themselves by stating problems, hypothesis, and experimenting with problem-solving strategies, which ultimately led to accepting or rejecting their own hypothesis.

According to the results obtained, *AudioLink*, as a multimedia audio-based tool, combined with cognitive activities, can be utilized to support the development of some of the core scientific method processes. These include observation (auditory observation) to get scientific meaning of what they hear and thus increase their knowledge; experimentation by gathering several objects throughout the game learners have the opportunity of experiencing the consequences of using one or more items in different contexts and use several strategies to get a new item, enter a new zone or solve any problems during the game; and stating, hypothesis by picking items to be used sometime for some purpose and once learners have a new item, questioning themselves about what to do with it and how it can affect the plot of the story during the game.

Finally, the results of this study revealed that the use of *AudioLink* promotes scientific content learning (particularly physics) and enhances problem solving skills through experimentation by the use of the scientific method. These results also validate the use of this software as an attractive, challenging and effective way to learn science content and to develop scientific thinking skills, thus helping to close the gap in science learning opportunities between sighted and blind children.

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Stress Assessment and Management while Medics Take Care of the VR Wounded

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Abstract: *"Stress Inoculation Training (SIT)" is designed to mitigate the potential negative effects of stressors in healthy individuals. As a cognitive-behavioral therapy technique, SIT is applied in a gradual, controlled, monitored, and repeated manner with the goal of desensitizing individuals to stressful stimuli. Prior simulated exposure can help prevent a fight/flight/freeze stress-response allowing individuals to accomplish tasks at hand. In our study, Soldiers (e.g., first responders or "medics") navigate through virtual reality (VR) applied to SIT ("VR-SIT") while performing tasks, such as putting a tourniquet on a casualty, in a stressful, but controlled, simulated combat casualty environment. Participants receive feedback on their psychological, physiological, and bio-chemical stress levels and practice coping strategies (i.e., combat breathing). We predict that this approach will not only improve Soldiers' performance on real tasks, but also increase their stress resilience and hopefully prevent chronic psychological decompensation (e.g., post-traumatic stress disorder). Preliminary findings with a sample of 25 medics, suggest that those who learned coping techniques during the VR training, exhibited lower levels of stress than what was seen in the control group.*

INTRODUCTION

Psychological Stress in the Battlefield.

Warfighters face a myriad of stressors when deployed to the battlefield. Some of these stressors are sleep deprivation, information overload, exposure to injuries/dead bodies, and anxiety for the welfare of fellow warfighters and family left behind (Lukey, Stetz, Romano, 2005). Hoge et al. (2004) have reported that approximately 18% of Warfighters returning from Iraq and 11% returning from Afghanistan (n = 6, 201) screened positive on stress-related measures (i.e., Post Traumatic Stress Disorder (PTSD)). He later added that 1 in 10 U.S. Iraq-War veterans suffer some type of stress disorder (Hoge, Auchterloni, Milliken, 2006). Interestingly, Stetz et al. (2006) have also found that, in 2003, about 7% (21 out of 282) of medical evacuations in Operation Enduring Freedom and 6% (365 out of 5,389) of those in Operation Iraqi Freedom were due to psychiatric illness. Stetz et al. (2007) also reported that 21% of those evacuated had prior psychiatric histories before deploying to the theater of operations. Most prior histories were either related to stress (i.e., PTSD, n = 33, 31%) or to depression, (n = 72, 66%).

Anxiety and depression are two of the most common types of mental disorders in the United States. The National Institute of Mental Health reports that 19 million Americans ages 18 to 54, or 13% of adults, are afflicted by these illnesses (Narrow et al., 1998). Stress reactions can be manifested in a range from Acute Stress Disorder (ASD) to Post Traumatic Stress Disorder (Bryant & Harvey, 2000). ASD symptoms are relatively short lived and generally dissipate in less than a month. On the other hand, PTSD symptoms must be present for more than one month (to rule out Acute Stress Disorder) and the disturbance must cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Stress Inoculation via Training.

Stress Inoculation [exposure] Training (SIT) is a prevention strategy that aims to mitigate the negative effects of psychological stressors in healthy individuals. Its foundation dates back to Wolpe's work on cognitive/behavioral stress-coping training in the early 1970's. The cognitive-behavioral preventive approach, which is central to SIT, has been implemented in military, medical, and other settings. SIT attempts

to immunize an individual from reacting negatively to stress exposure (Abramson, Metalsky, Alloy, 1989). The individual and the stressful condition must be identified *a priori* (Adams, 2005). Gradual and repeated stress exposure is thought to desensitize individuals to stimuli that may impede performance and produce psychological trauma (Wiederhold, Bullinger, Wiederhold, 2006), decreasing the probability of later negative responses (Driskell, Johnston, 1998). That is, through successive approximations, individuals build a sense of expectancy that is integrated into positive cognitive appraisal providing a greater sense of mastery and confidence or "self-efficacy." The rationale for stress reduction is based on the premise that the availability of information or pre-exposure to the stress reduces the novelty of stressful tasks. This exposure then increases the sense of predictability and control and the likelihood that individuals will react more positively and exhibit fewer negative physiological and emotional responses to future stressful events.

Saunders et al. (1996) offer the following findings regarding the effectiveness of SIT: 1) the greater the number of training sessions the better; 2) results from both field and laboratory studies seem to be somewhat comparable; 3) SIT is more effective for state anxiety if used with small groups; and finally 4) SIT programs using imagery components are more effective at reducing performance anxiety than those that do not use imagery unless the latter uses behavioral practice in coping. They also state that SIT's success depends upon employing stress-coping training-features, and instructional design. Adaptive coping strategies and their associated appraisals could act as a moderating buffer against stress-induced impairment.

Coping skills, such as combat breathing, can first be taught in a safe environment. After the basic skill is taught, the individual can be asked to perform the skill in a more vivid environment. Vividness is an important component of the SIT approach and it must be controlled, allowing individuals to gradually adapt to stressors and learn how to cope. With recent advances in virtual reality (VR), VR lends itself quite well to SIT. That is, in a virtual world, stressors can be systematically added to scenarios until the individual habituates to these stressors. Military personnel can train in virtual environments (i.e., Iraqi village, a shoot house, or a ship) where simulations can be viewed on desktops, laptops, through a head-mounted display, or as a 1 or 3-wall CAVE projection system. The training can then transferred to real-world exercises in structures designed specifically for tactical training. Here, VR-SIT is particularly useful as it can be easily integrated and embedded in training in warfighters' systems.

To address problems related to the potential for combat power loss which can result from psychological decompensation, the United States Army Aeromedical Research Laboratory (USAARL) is currently conducting a study with the goal to harden Soldiers against stress. Specifically, the objective of this study is to evaluate the utility of Virtual Reality Stress Inoculation Training (VR-SIT) to inoculate (e.g., habituate, harden, protect) against harmful stress and help maintain or increase the performance of Soldiers undergoing rigorous field-relevant medical training. We believe that those medics training with VR scenarios and receiving coping training will show lower stress levels, with time, than those that do not get this opportunity.

METHODS

Participants and Research Design.

For the present paper, we are reporting part of the obtained sample-to-date (n = 25) attending the Flight Medic Course in Fort Rucker, Alabama (Sub-sample #1) and medics working at the medical clinic at Fort Rucker (Sub-sample #2).

Our present study started in January, 2007 and will end in June (2007). Therefore, we use present tense to describe our research design. We are using a criterion for significance (alpha) set at .05 and an effect size (f) of .40 to yield a power of .80. After the USAARL research team coordinates with the participants' units/schools, they visit with and brief Soldiers on the purpose of the study. Once volunteers sign informed consents and undergo screening procedures (e.g., vitals and "PTSD Checklist- Military Version," Weathers, Huska, & Keane, 1991), the Principal Investigator (PI) assigns qualified volunteers to the experimental phase. We also post-screen participants before they leave our laboratory by checking for potential

"cybersickness" via the "Simulator Sickness Questionnaire" (Kennedy et al., 1993).

Participants (n = 63-75) are matched as closely as possible based on factors thought to affect VR-SIT efficacy such as gender, age, prior gaming experience, and deployment history. Previous work conducted by Wiederhold at the Virtual Reality Medical Center, suggests that to assess the efficacy of a virtual reality exposure, more than one session is required. Each participant is assigned to one of the groups as defined below:

- "Control Group" does not do undergo any VR or coping training (CT), only vital signs are measured.
- "Group 1" gets 2 (or 4) VR game play sessions, but no CT.
- "Group 2" gets 2 (or 4) CT sessions, but no VR sessions.
- "Group 3" gets VR + CT training during 2 (or 4) sessions of game play.

Assessment Tools and Technology.
We do not only measure the experience of the participant in our VR world but also measure some of their stress levels.

Presence has been defined as the subjective experience of being in one place or environment, 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. The Presence Questionnaire (PQ) is administered after each VR session. There is no weighting of items or subscales. Administration time for the PQ is about 3 minutes.

Psychological Stress. We use the "Multiple Affect Adjective Check List-Revised" (MAACL-R, Zuckerman & Lubin, 1985) to measure five components of subjective trait characteristics that affect changes in response to stressful situations. Specifically, this instrument measures anxiety, depression, and hostility. Participants must choose (i.e., by checking a box) which adjectives (out of 132 potential descriptors) best describes how they feel before and after each session. This questionnaire is presented to the participant before and after each session. It is scored using a scoring guidance developed by the Army Research Laboratory (ARL)- Engineering Directorate. Administration time for the MAACL-R is about 2 minutes long.
Bio-chemical Stress. We utilize a salivary amylase test as a measure of biochemical stress. Amylase is an enzyme that hydrolyzes starch to oligosaccharides and then slowly to maltose and glucose. Salivary amylase concentrations are predictive of plasma catecholamine levels and can be used as a measure of stress. Studies conducted by ARL in collaboration with the Northwestern University report a positive correlation between cortisol and amylase (Chatterton et al., 1996). The "Salivary Amylase Kit" is self-contained and in this study, salivary amylase is collected before and after each exposure. Amylase levels are quantified using tabled values of time for color change and ambient temperature recording. Measurement of amylase concentration in saliva involves simple observation of chemical color changes according to standard photometric procedures. Saliva samples for amylase assay are obtained from participants by asking them to "spit in a cup." A 50ul of that dilution is then added to a pre-measured reagent, and the time for color change is recorded. We use the recorded time of this transformation as an additional measure of stress.

Physiological Stress. We also monitor objective physiological stress indices from participants in this study using a "PhysioLab." The Physiolab is a device that captures (among other parameters), peripheral body temperature, breathing rate, and pulse rate. Some sensors are placed on the participant's wrists to capture heart rate, on fingers to capture peripheral body temperature, and around the chest to capture breathing rate. The research team visually monitors graphical displays of these markers from a remote location using the PhysioLab software and note when levels fluctuate in response to stressors presented and/or in response to employment of the participants' stress coping strategies.

Virtual reality scenarios and rest of the equipment used. The scenarios used for the VR testing portion of this study have been developed by the Virtual Reality Medical Center (VRMC). Our participants are able to navigate (e.g., "walk" or "fly") through Iraqi or Afghan VR combat scenarios. The "Combat Medic" and the

"Flight Medic" scenarios we utilize are displayed using a laptop computer with imagery presented via a Z800 3D Visor head mounted display (HMD). In the Combat Medic Scenario, participants are able to perform the following tasks: 1. Move casualty to cover; 2. Asses and stop life threatening bleeding (applies tourniquet) 3. Request additional help/employs all personnel available if necessary; 4. Asses airway; 5. Breathing (Asherman chest seal/Needle decompression); 6. Check for additional wounds; and 7. Administer pain medication. In the Flight Medic module, participants can: 1. Asses and stop life threatening bleeding (applies tourniquet); 2. Request additional help/ employs all personnel available if necessary; 3. Asses airway; 4. Breathing (Asherman chest seal/ Needle decompression); 5. Check for additional wounds; and 6. Administer pain medication.

Our visor system combines two OLED micro-displays with stereovision 3D capabilities, stereo audio, a noise-canceling microphone, and an integrated head tracker. Its high-speed head tracker enables full 360-degree virtual-surround viewing. This HMD also helps participants "walk/drive/fly" inside the VR scenarios with additional help from a dual action Logitech joypad. To enhance the experience while navigating these scenarios, we also add display synched vibrations using a low frequency effects (LFE) speaker. The "ButtKicker" LFE is a type of "noiseless speaker" that accurately reproduces the "feeling" range of many natural and man-made low frequency sounds such as earthquakes, thunderstorms, rocket launches, waves, explosions, tornadoes, volcanoes, etc. Another device used to enhance the realism of the experience is the "ScentPalette"™. This is a computer-controlled, 8-cartridge scent machine that uses puffs of air to project different scents (gunpowder, body odor, blood, vomit, burning trash, etc…) on cue for a predetermined time. When it is connected to a computer, it can provide up to 64 scents on cue precisely synched to the computer's visuals to present associated odors. Odors are interspersed with bursts of unscented air in between smells to clear for the next scent, thus eliminating cross bleed/mixing problems. Additionally, we have cameras in the VR booth to capture participants' facial expressions and gestures (i.e., fidgeting) while navigating the scenarios. See Figure 1 for a photo of the quad-splitter used to capture all images.

RESULTS

Preliminary data. Table 1 presents the specific demographic breakdown of our present sample. In general, it was composed of largely Caucasian males, between the ages of 21 to 42 years old. They hold high school diplomas and enlisted (e.g., E-4) military ranks. The tenure in the Army of a majority of participants with less than 5 years, and most planned to remain in the service. The great majority reported having at least some VR or video-game experience.

Figure 1. Photo of simultaneous images taken to monitor each participant during the data collection at USAARL.

Table 1. Descriptive demographical analysis of our present sample.

Sub-sample Number	Sub-sample #1	Sub-sample #2
Sample Size	13	12
Race	Caucasian (10, 77%)	Caucasian (7, 58%)
Years in the Army	Less than 5 (7, 54%)	Less than 5 (7, 58%)
Marital Status	Single (11, 85%)	Married (10, 83%)
Gender	Male (13, 100%)	Male (9, 82%)
Rank	E-4 (6, 46%)	E-4 (6, 55%)
Age Range	21-39 years old	21-42 years old
Kids	None (11, 85%)	0-1 (6, 60%)
Level Education	High School (12, 92%)	High School (8, 67%)
Military Component	Reserve (10, 77%)	Active (12, 100%)
Previous Deployment	Yes (10, 77%)	No (7, 58%)
Deploying Soon	Yes (8, 73%)	No (8, 67%)
Staying in the Army	Yes (12, 92%)	Yes (10, 91%)
VR/Video Experience	Yes (12, 92%)	Yes (8, 67%)

As mentioned earlier, at the beginning of our study, we screened participants for Post Traumatic Stress Disorder using the PTSD Checklist (Weathers, Huska, and Keane, 1991). Our participants obtained a overall composite, PTSD checklist mean score of 15 (s.d., 11; Range: 0 to 37). This is well below the threshold of 50 which generally indicates the presence of PTSD (Weathers, et al., 1994). In addition, participants scored well below a 4 on our 5 point scale providing further evidence that PTSD was not present. Hence, we are confident that none of our participants were suffering from PTSD.

We also examined the perceived realism of our VR environment using several scales developed from the Presence Questionnaire (Witmer and Singer, 1998). The presence questionnaire is designed to measure the amount of involvement and immersion that an individual experiences in a VR environment. The questionnaire measures several dimensions of an individual's immersion in the VR environment including: the amount of perceived control they possess in the environment (i.e., involvement/control dimension), their perception that their interaction with and within the environment is "natural" (i.e., natural level of interaction dimension), and the overall quality of the VR interface (interface quality dimension). The results we obtained indicate that participants maintained a moderate level of immersion in our VR environment. Specifically, on our 7-point scale, participants rated our VR environment 3.7 (s.d., .78) on the "involvement/control" dimension, 3.2 (s.d., 1.3) on the "natural level of interaction" dimension, and 3.3 (s.d., 0.9) on the "interface quality" dimension.

In Figures 2-3, we present results of our inferential analyses. Specifically, we performed a two-way multivariate analysis of variance (condition x inoculation) to determine if there were differences between the experimental group and inoculation conditions across measures of anxiety, depression, hostility, and "dysphoria" (a composite measure of anxiety, depression and hostility), and amount of time required for salivary amylase transformation. Tests of the overall model indicated that results obtained across conditions were trending in the hypothesized direction and approaching significance (Wilk's Lambda = $F(35, 2) = .492$; $p < .08$).

Tests of Between Subjects Effects indicates that condition affects levels of post-treatment anxiety ($F(35, 2) = 4.16$, $p < .05$) and post-treatment dysphoria ($F(35, 2) = 3.53$, $p < .05$). The results of post hoc comparisons using t-test procedures indicate that participants in the VR-Only (Mean = 60, s.d. = 20; $p < .05$) condition experienced a greater level of post-treatment anxiety than participants in both the combined CT + VR (Mean = 48, s.d. = 5.5) and the CT –only conditions (Mean = 45, s.d., 0). Results of post hoc comparisons also indicate that participants in the VR-Only (Mean = 64, s.d. = 28.4, $p<.10$) condition exhibited a greater level of post-treatment anxiety than participants in both the combined CT + VR (Mean = 50, s.d. = 9.1) and the CT –only conditions (Mean = 45, s.d. = 4.4). However, our conclusions on dysphoria are preliminary based on the fact that they were trending in the hypothesized direction and were approaching significance ($p<.10$).

Our results also indicate that the recorded time of salivary amylase transformation increases with the inoculations participants experience ($F(18, 2) = 4.78$, $p < .05$). Results of post-hoc comparisons using t-test procedures indicate that participants exhibited more stress in the second inoculation (Mean = 362, s.d., 185) than the first inoculation (Mean = 250, s.d., 106). Finally, analysis of the breathing pattern (diaphragm expansion) of our participants (see Figure 4) suggests a slight increase for both of the groups receiving CT. However, firm conclusions can not be drawn from this preliminary data.

CONCLUSION

Many warfighters are coming back home from deployments with stress-related problems. USAARL is trying to help the cause by hardening medics, who must treat the wounded while pulling security, against stress.

Preliminary findings from our ongoing study show that most of the medics in our sample were single Caucasian enlisted young males with some VR/ video-game experience. During the screening process, we did not lose any participants due to having pre-existing PTSD symptoms. Our preliminary analyses suggest that the VR environment (e.g., presence) was very natural, that they generally enjoyed the environment, and experience minor to no discomfort while navigating within the environment. Preliminary comparative analyses also indicated that we have identified a tool and set of techniques that induce a level of stress high enough to potentially produce an "inoculation" effect. Specifically, our results indicate that our VR environment did increase levels of post-treatment anxiety and dysphoria. These measures were higher than the levels of anxiety and dysphoria experienced by participants in the CT and VR and the CT-only conditions.

It seems to be that the VR technology holds the potential to benefit our capacity to inoculate soldiers against combat stress. If this is true, this should be a powerful tool to incorporate while preparing soldiers for deployment (e.g., as marksmanship practice). However, again, these are encouraging yet preliminary findings from a study that should end around Summer of 2007.

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Perceived Anxiety and Simulator Sickness in a Virtual Grocery Store in Persons with and without Vestibular Dysfunction

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Key words: *virtual reality, anxiety, simulator sickness*

INTRODUCTION

People with vestibular disease often experience increased symptoms of dizziness and anxiety in visual environments that have complex textures and motion (e.g. grocery store). Visual motion and flow can cause patients with vestibular disorders to feel disoriented and nauseous. Anxiety is evident during virtual reality exposures with persons with vestibular disorders (Sparto, Whitney, Hodges, Furman, & Redfern, 2004; Whitney et al., 2005; Whitney et al., 2002; Whitney et al., 2006).

Patients with vestibular disorders who experience symptoms in supermarket aisles or moving visual surroundings demonstrate greater sway when exposed to full-field visual motion (Bronstein, 2004). Bronstein et al. demonstrated that five of 15 patients who had symptoms triggered in supermarket aisles or moving visual surroundings showed increased sway responses to full-field visual motion induced by a moving room. Bowman (Bowman, 2004) has also reported that persons with uncompenstated or well-compensated unilateral vestibular hypofunction experience symptoms in a grocery store environment.

People with vestibular disorders may have greater reliance on visual cues, resulting in increased sway in visual provocative situations (Whitney et al., 2005). It has been reported that patients with vestibular disorders are sensitive to optic flow (Redfern & Furman, 1994), similar to what has been reported in persons with anxiety disorders who were sensitive to body sway during full-field visual motion from an optic flow stimulus (Redfern, Furman, & Jacob, 2006). One intervention strategy to decrease sway and anxiety is to attempt to have patients focus on proprioceptive cues to enhance postural stability, thus attempting to change their sensory weighting of postural cues (Whitney et al., 2005).

Habituation exercises (typically defined as repeated movement experiences that cause dizziness) in the form of visually provocative scenes have resulted in functional changes in patients with vestibular dysfunction (Pavlou, Lingeswaran, Davies, Gresty, & Bronstein, 2004; Vitte, Semont, & Berthoz, 1994). Vitte et al. (Vitte, Semont, & Berthoz, 1994) exposed patients with vestibular disorders to moving lights from a reflective ball with 2 horizontal bars on either side that were used as reference bars by the subjects. Subjects stood and experienced pitch and yaw flow in both directions while looking forward. The optic flow experience by Vitte et al. (Vitte, Semont, & Berthoz, 1994) is a similar visual experience to what is generated during virtual reality, i.e. the perception that the world is moving past the patient as they stand in a virtual environment. There is no immersion or true sense of reality involved in the optokinetic scenes generated by Vitte et al. (Vitte, Semont, & Berthoz, 1994) and Pavlou et al. (Pavlou, Lingeswaran, Davies, Gresty, & Bronstein, 2004). Both studies suggested that postural control improved and dizziness decreased as a result of the optokinetic exposure. Suarez (Suarez, Muse, Suarez, & Arocena, 2001) has suggested the optokinetic nystagmus may be related to falling in older adults with central vestibular disorders.

The ability of persons with vestibular disorders to tolerate visual environments is critical for the success of the virtual reality intervention. Therefore, the purpose of this study was to investigate how well persons with and without vestibular dysfunction tolerated moving through a virtual grocery store while they searched for products. In order to measure tolerance of the environment, we asked subjects to rate their perceived anxiety using the Subjective Units of Discomfort (SUD) and record their simulator sickness. The SUD scale has been used to quantify the magnitude of anxiety experienced in virtual experiences on a scale of 0 (no discomfort or anxiety) to 100 (the most discomfort or anxiety that the person could imagine) (B. Rothbaum & Hodges, 1993; B. O. Rothbaum, Hodges, & Kooper, 1997; B. O. Rothbaum & Hodges, 1999; B. O. Rothbaum et al., 1995). The SUD score has been shown to decrease over time after exposure to virtual scenes (B. O. Rothbaum, Hodges, & Kooper, 1997; B. O. Rothbaum & Hodges, 1999; B. O. Rothbaum et al., 1995; Sparto, Whitney, Hodges, Furman, & Redfern, 2004; Whitney et al., 2005). Kennedy et al. (Kennedy & Lane, 1993) developed a 16-item simulator sickness questionnaire (SSQ) to determine the degree of simulator sickness experienced during virtual reality exposures. The SSQ has been used in persons with vestibular disorders to determine their level of discomfort with the virtual experience (Whitney et al., 2005; Whitney et al., 2006).

METHODS

Twenty healthy subjects with no evidence of neurological disease (10 female, mean age 45 y, range 21 to 79 y) and 10 patients with unilateral vestibular hypofunction, UVH (4 female, mean age 58 y, range 37 to 69 y) participated. All healthy subjects had undergone a neurologic screening and had a normal vestibular test battery that included electronystagmography (positional testing, calorics and oculomotor), rotational chair, and computerized dynamic posturography. Patients underwent the same test battery and all were diagnosed with unilateral peripheral vestibular hypofunction.

A single-aisle virtual grocery store was displayed in a full field-of-view CAVE-like virtual environment (2.4 m high, 2.4 m wide, 1.5 m deep, Figure 1) (Sparto, Whitney, Hodges, Furman, & Redfern, 2004). Three 2.4 m X 1.8 m (vertical X horizontal) back-projected screens are arranged as shown in Figure 1. The side screens make an included angle of 110° with the front screen. The front screen is 1.5 m from the user, and the opening of the BNAVE at the location of the subject is approximately 2.9 m. The images are displayed using Epson 810p PowerLite LCD monoscopic projectors, with a pixel resolution of 1024 X 768 for each screen. Each projector is connected to an NVIDIA GeForce4 graphics processing unit (64 MB texture memory) installed in a separate PC (Pentium, 2.2 GHz, 512 MB RAM) running Windows 2000. The movement of the images on the three PCs is synchronized and controlled by a server via a local area network. The update rate of the images is consistently at least 30 frames per second. Perspective was not updated based on head location.

On each of 2 separate visits, subjects navigated down the aisle by: a) standing and pushing forward on a joystick, or b) walking on a custom-made treadmill placed within the environment. Subjects performed 6 trials divided into 2 blocks: a walking block and a standing block of trials; the order was counterbalanced across visits. During two of the 6 trials (i.e. one in each block), subjects were asked to search for common cereal boxes (Frosted Flakes and Cheerios) that had been pseudo-randomly placed 20 times along the length of a 120 m aisle. The aisle was a repeating pattern of shelves that were 5 m long with a 2 m inter-shelf break. The other parts of the aisle were completely filled with 30 other brands of products. The ratio of the number of “target” products to the number of “distractor” products was approximately 8% (Search Full condition). During two more of the trials, subjects again searched for the 2 target products, but half of the shelf space was empty, resulting in a target-to-distractor product ratio of approximately 16% (Search Half condition). On the other 2 trials, subjects locomoted down the aisle without searching for any products (No Search condition).

Prior to the testing on each visit, products were displayed on a standard computer screen to ensure that the subjects would be able to recognize the products in the virtual grocery store.

Once the investigator was comfortable that the subjects could recognize the targets, subjects were trained how to move through the store using the treadmill and joystick.

The speed of the treadmill was controlled by the amount of force subjects exerted on an instrumented shopping cart. The speed of movement through the store was matched to the treadmill speed during the walking trials. During the standing trials, the speed of movement was controlled by pushing forward on the joystick. The maximum speed of movement on the treadmill and in the store was 1.2 m/s. Each visit, subjects underwent several practice trials to ensure that they were comfortable with the equipment and procedures. All subjects were secured to an overhead harness to ensure that they were safe on the treadmill.

Perceived anxiety was measured prior to testing and after each trial using the SUD scale, in which 0 corresponded to no anxiety and 100 to the worst-possible anxiety. In addition, prior to testing and after each trial, subjects completed the Kennedy Simulator Sickness Questionnaire (SSQ), in which subjects rated the intensity of 16 symptoms from 0 (none) to 3 (severe). The number of symptoms that had an intensity greater than 0 for the SSQ was computed for each trial.

The scores from both measures were not normally distributed; in particular, there were a large number of trials in which the SUD was 0, and no symptoms were reported on the SSQ. Therefore, differences in SUD and SSQ between healthy controls and subjects with UVH were examined with the non-parametric Mann-Whitney U test, using the median of each subject's scores as the estimate of central tendency. Between-visit and between-trial differences were tested using the non-parametric Friedman test, again using the median of each subject's scores.

RESULTS

SUD

The prevalence of SUD ratings that were greater than zero during the testing demonstrate a large difference between controls and subjects with UVH (Table 1). After 81% of the trials, subjects with UVH had a SUD score greater than zero, compared with 39% of the trials in controls.

Subjects with UVH had greater median SUD scores compared with controls during both the pre-test assessment and virtual reality exposure (Table 2, $p = 0.002$). However, there was no difference in the change in SUD from pre-test to virtual reality exposure between the two subject groups. None of the experimental factors had a

Figure 1. Subject walking through virtual grocery store while pushing on physical grocery cart instrumented with force transducers. The speed of the treadmill and movement through the store is proportional to the amount of force applied to the cart handle. Speed is limited to 1.2 m/s.

Table 1. Percentage of trials in which controls (CON) and subjects with unilateral vestibular hypofunction (UVH) reported Subjective Units of Discomfort (SUD) greater than zero, or reported at least one symptom on the Simulator Sickness Questionnaire (SSQ).

% non-zero events	SUD	SSQ
CON	39%	29%
UVH	81%	81%

Table 2. Range of median Subjective Units of Discomfort (SUD) scores reported before and during exposure to virtual grocery store. Median scores for "Pre-Test" computed from 2 trials (2 visits X 1 trial). Median scores for "Test" computed from all 12 trials (2 visits X 6 trials). SUD values from one control subject were missing.

SUD	Pre-Test	Test
CON	0 for 11 subjects 2.5, 3.5, 4, 4, 5, 9, 12.5, 30	0 for 11 subjects 1, 2.5, 4, 4, 6.5 10, 10.5, 20
UVH	0 for 1 subject 1, 9, 10.5, 12.5, 15, 25, 25, 30, 30	0 for 2 subjects 10, 11.5, 17.5, 22.5, 22.5, 27, 29, 60

significant effect on SUD score, including: visit 1 vs. visit 2, standing vs. walking, searching vs. not searching, or order of trial.

SSQ

The prevalence of SSQ ratings that were greater than zero during the testing also show group differences (Table 1). After 81% of the trials, subjects with UVH reported at least one symptom, compared with 29% of the trials in controls.

During the pre-test and exposure to the grocery store, subjects had greater number of symptoms reported on the SSQ than controls (Table 3, $p<0.002$). The range of median number of symptoms reported by the subjects with UVH was 0 to 12 out of 16. The range of median number of symptoms reported by control subjects was 0 to 2 out of 16. The change in number of SSQ symptoms reported from pre-test to virtual reality exposure did not differ between the groups. As with the SUD, no experimental factors affected the number of symptoms reported on the SSQ. For the control subjects, the median SSQ score was 0 for the Pre-Test and Test; for the subjects with UVH, the median SUD score was 14 for the Pre-Test and 20 for the Test.

Among the subjects with UVH, a significant correlation existed between the median SUD and median number of symptoms reported on the SSQ (Spearman rho = 0.850, $p = 0.002$). No such relationship existed for the control subjects (Spearman rho = -0.09, $p = 0.72$), probably due to the large number of scores equal to zero.

DISCUSSION and CONCLUSION

Subjects with and without vestibular abnormalities were able to complete all trials when navigating through a virtual grocery store, except for one patient. She was unable to complete the final trial on her second visit due to nausea. Patients with vestibular disorders reported more symptoms during the pre-test than the control subjects. These remained relatively stable over the 6 trials, suggesting that subjects in both groups tolerated exposure to the virtual grocery store. Thus future studies of the use of a virtual grocery store for rehabilitation of persons with vestibular disorders are warranted.

It was surprising that there was not an effect noted between the walking and standing trials. It had been expected that patients would have more difficulty with the standing trials because of the conflict created between the lower extremity sensation of static posture and the strong visual perception of movement. Patients and control subjects seem to be equally able to manage this somatosensory-visual conflict and resolve it, as no patients fell or reported problems with the visual scene.

Table 3. Range of median Simulator Sickness Questionnaire (SSQ) scores reported before and during exposure to virtual grocery store. Median scores for "Pre-Test" computed from 2 trials (2 visits X 1 trial). Median scores for "Test" computed from all 12 trials (2 visits X 6 trials).

SSQ	Pre-Test	Test
CON	0 for 15 subjects 0.5, 0.5, 0.5, 0.5, 1	0 for 14 subjects 0.5, 1, 1, 1, 2, 2
UVH	0 for 2 subjects 0.5, 1, 2, 4, 4.5, 6, 8, 9	0 for 2 subjects 1, 1.5, 2, 2, 4, 9, 9.5, 12

Subjective measures recorded after virtual reality exposure suggest that there were no differences between visits, making changes demonstrated from virtual reality exposure more likely to be a change in perceived health status versus learning of the virtual reality task. These data suggest that subjective measures recorded after exposure to the virtual reality grocery store are stable over time.

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Clinical Observations

Physiology-Driven Adaptive VR System: Technology and Rationale for PTSD Treatment

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Abstract: *The design and development of a system for automated adaptation of virtual reality based scenarios driven by the subject's physiology is presented, with a rationale regarding application of the system in PTSD treatment. The system functions in two operating modes corresponding to the major phases of the treatment protocol. In the initial testing mode, the patient's general psychophysiological characteristics are identified and the audiovisual content of the later exposure sessions is customized to the patient. In the adaptive control mode, the therapist conducts exposure sessions, and the system strives to optimally individualize therapy according to the patient's psychophysiological profile and degree of sensitivity to various stimuli. Future evaluation of the system is discussed in the closing section.*

INTRODUCTION

Physiology-Driven Adaptive VR System: Technology and Rationale for PTSD Treatment

Large peacekeeping operations including hundreds of thousands of deployed soldiers, even with a conservative 10% prevalence estimate of posttraumatic stress disorder (PTSD), make PTSD a considerable problem in modern societies. Therefore, more innovative research is needed concerning new ways of battling PTSD from various aspects, such as diagnosis, treatment, prediction, and prevention.

The focus of the research presented in this paper is the design and development of a system for automated adaptation of virtual reality (VR) based scenarios driven by the subject's physiology and modulated by other components of the psychophysiological response, like subjective units of discomfort (SUDs). The intended application domain of the system is prompt PTSD treatment. The significance and importance of prompt PTSD treatment stem from the difficulties of treating long lasting combat-related PTSD. Among the most effective pharmacotherapy and psychotherapy methods (Foa, Davidson, & Frances, 1999; VA & DoD, 2004), which are generally considered comparably effective (Van Etten & Taylor, 1998), there is still no "silver bullet" for long-lasting combat-related PTSD. A recent extension of exposure therapy, VR exposure therapy, may also have better outcomes when applied promptly, as seen in 9/11 survivors (Difede & Hoffman, 2002), than with the long-lasting PTSD cases, as in Vietnam veterans (Hodges, Anderson, Burdea, Hoffman, & Rothbaum, 2001; Rothbaum et al., 1999).

VR exposure therapy for PTSD has been proposed as an alternative to imaginal exposure therapy (Rothbaum et al., 1999), which is regarded as the standard of care for PTSD (Difede & Hoffman, 2002). Difede and Hoffman (2002) mention that VR in comparison with imagination improves the patients' emotional engagement during retelling of their trauma, which is a predictor of positive treatment outcomes (Jaycox, Foa, & Morral, 1998). VR achieves better emotional engagement by confronting the patients with interactive three-dimensional synthetic environments that visually and aurally resemble their traumas.

The physiology-driven adaptive VR system for PTSD treatment strives to improve the advantages of VR exposure therapy. The system intends to provide the therapist with more comprehensive information about the patient's emotional reactions, and to relieve the therapist of

technical and administrative issues that occur in VR exposure. With such additional assistance from the VR system, the therapists can increase their focus on the treatment and conduct more innovative and creative therapy. The expected final result is significantly more effective PTSD treatment.

To this end, the treatment protocol with the physiology-driven adaptive VR system mostly follows the established protocol of VR exposure therapy. The protocol consists of approximately 9–14 weekly or biweekly sessions, each lasting 45–90 minutes (Difede & Hoffman, 2002; Rothbaum et al., 1999).

The Concept of Control System Design

The physiology-driven adaptive VR system presented in the paper functions in two different operating modes, as explained in the remainder of the section. The modes correspond to the major phases of the treatment protocol.

Initial Testing

The initial open loop testing (Figure 1) is similar to conventional VR exposure therapy (Rizzo et al., 2004), where the therapist operates a user-friendly keyboard and mouse interface to select the desired stimuli. The initial testing corresponds to the first session of the treatment protocol (Rothbaum et al., 1999), which is devoted to the information gathering interview with the patient, familiarizing the patient with the VR technology, and relaxation training, as well as the initial identification of the patient's general psychophysiological characteristics.

While interviewing the patient, the therapist screens the description of the patient's traumatic event, in order to customize the audiovisual content of the later exposures to traumatic stimuli. By entering keywords via the Graphical Interface, customization is performed in line with the patient's trauma profile and in line with the stimulation capabilities of the system.

Identification of the patient's psychophysiological characteristics is necessary for configuration of the physiology-driven adaptive VR system. Here, the patient is exposed to various generic stimuli unrelated to the patient's trauma—neutral stimuli, relaxing stimuli, flashes, noise sounds etc.—in order to identify the general psychophysiological characteristics of the patient such as time constants, baseline values, and fluctuations of various physiological signals. The therapist sets up audiovisual content of the identification in the same way as for the

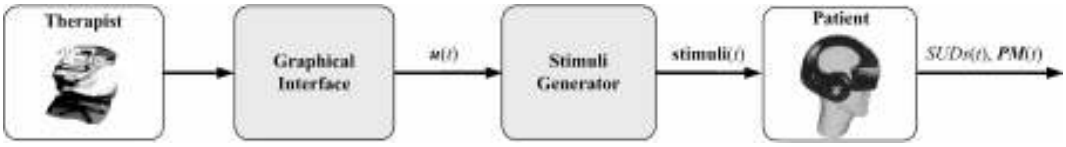

Figure 1. Initial testing.

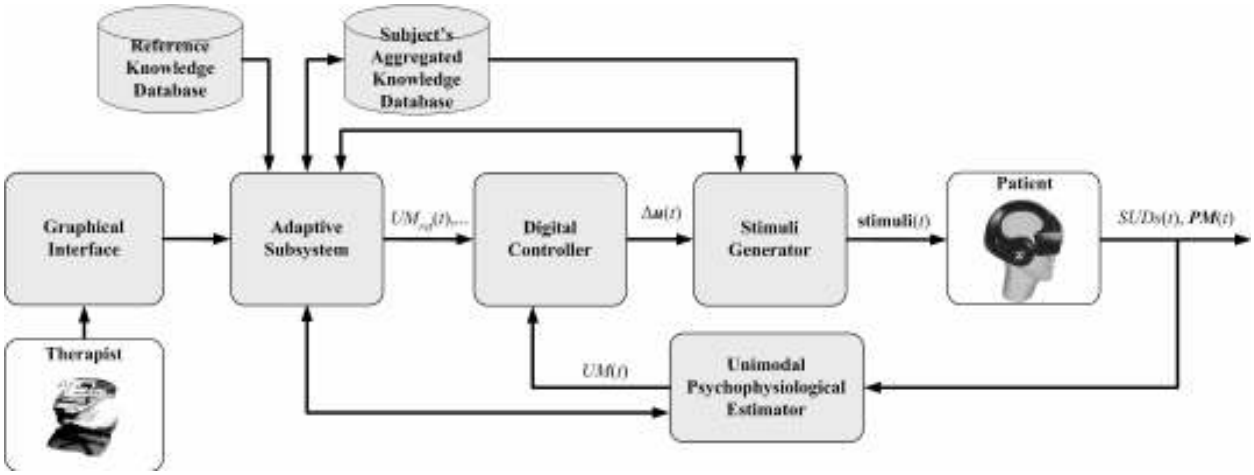

Figure 2. Adaptive control.

exposure to traumatic stimuli; however, this setup need not be done per patient, but only once for a universal session that will apply to all patients.

Adaptive Control

VR exposure sessions are conducted in the adaptive control mode (Figure 2). Each exposure session includes gradual display of VR stimuli that are hierarchically organized from the least to the most traumatic for the individual patient. When exposure to traumatic stimuli starts, the system relies on the initial testing, including customization of the audiovisual content and the gathered knowledge about the patient's general psychophysiological characteristics, in order to display appropriate stimuli at appropriate times. Knowledge about the patient's psychophysiological characteristics is continually updated from measurements acquired during each exposure session. The therapist talks with the patient, observes the patient's behavior and aggregated patient's psychophysiological information, to achieve the most effective resolution of the patient's symptoms. The adaptive control mode thus enables optimally individualized treatment according to the patient's psychophysiological profile and degree of sensitivity to various stimuli.

The Adaptive Subsystem achieves appropriate patient excitation during the session by setting the unimodal psychophysiological reference input signal $UM_{ref}(t)$ to the Digital Controller. The Digital Controller computes required changes in valence and arousal of stimuli, in order to make the patient's unimodal psychophysiological measure $UM(t)$ track the reference input. Computed changes, as a control vector $\Delta\boldsymbol{u}(t)$, are then mapped by the Stimuli Generator to the corresponding audiovisual stimuli. The Subject's Aggregated Knowledge Database stores a patient's relevant parameters in the course of the treatment. Reference Knowledge Database is based on relevant data from literature, or integrates Subject's Aggregated Knowledge Databases of the previous patients.

Stimuli Generator

Stimuli Generator transforms the control signals into audiovisual stimuli, using realistic live video and audio in combination with a synthetic three-dimensional scene. Inclusion of a live scene is mainly based on expectations of its potential to cause more intense emotional response than a synthetic one due to its authenticity. Appropriate combining of the live and synthetic scene may maximize advantages and minimize disadvantages of both media.

One way of combining live and synthetic scenes in the context of the PTSD therapy has been described recently (Alcaniz, Juan, Rey, & Lozano, 2006; Botella et al., 2006). The authors use virtual environment as an external non-traumatic world in which the patient may review the videos related to the trauma, as well as images, sounds etc. The therapist may adjust some aspects of the virtual environment, like landscape, weather, time of day etc., in order to match the patient's emotional state. This is the "video within synthetic scene" approach.

Another approach, "synthetic elements within video", involves using synthetic elements to enhance and personalize the traumatic content of the video that resembles some aspect of the patient's trauma. For example, the video resembling a traumatic event that involved the patient and his comrades may be enhanced with synthetic animated characters having texture-mapped faces of the patient's comrades. Experimentation with these approaches is planned during further research and development of the physiology-driven adaptive VR system.

Control Signal Structure

In the discrete emotion view, emotions are classified by type (Bradley, 2000), such as joy, sadness, fear, anger, surprise, and disgust, which are primary emotions per (Damasio, 1999). The problem with such classification is related to the unclear relationship between physiological response patterns and discrete emotions (Bradley, 2000). To overcome this problem, valence and arousal concept has been used. The evidence shows there are physiological patterns associated with changes along the axes of valence and arousal, e.g. for heart rate, skin conductance etc. (Bradley, 2000). However, while valence and arousal are the principal components in classifying emotional stimuli, there is generally some loss of information when projecting discrete emotion space into valence-arousal space (Figure 3).

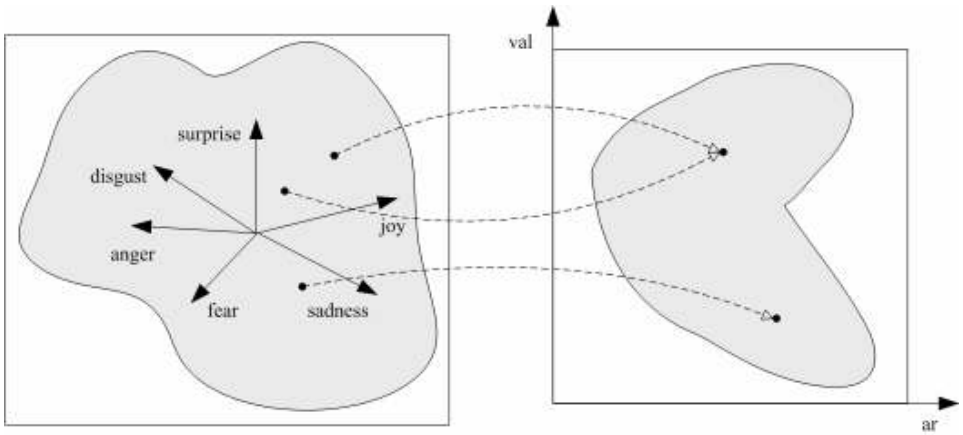

Figure 3. Conceptual mapping of the discrete emotion space based on Damasio's primary emotions to the valence-arousal space. Shaded areas represent distribution of stimuli; distribution in discrete emotion space is randomly drawn, and "boomerang" shape in valence-arousal space is based on (Bradley, 2000).

The control signal structure, illustrated by Figure 4, is designed to permit control over the major emotionally relevant features of the stimuli. The first distinction being made is between reflex stimuli, like loud brief noise or flash, and cortical stimuli, which include typical pictures, films, synthetic scene etc (cf. "stimType" on Figure 4). Less variability in reflex stimuli accounts for simpler structure of the associated control signals. Control signals for reflex stimuli specify separate arousal values for visual and auditory components. Control signals for cortical stimuli, with more degrees of freedom, first specify the targeted discrete emotion (cf. "dscrEm" on Figure 4). Due to the context of use, control signals need to be able to specify at least fear-eliciting stimuli, relaxing pleasant stimuli and neutral stimuli. According to Bradley (2000), sensory modality and media of presentation of the stimulus may both have impact on physiology. Therefore, the signals may target separately visual and auditory senses, but also allow delivery of congruent audiovisual scenery (cf. "sensMod" on Figure 4). Structurally valid control signals may also be those that specify incongruent visual and auditory stimuli; however, they may not be relevant to treatment. To control media of visual presentation, the control signals determine whether live video or synthetic three-dimensional visual stimuli are used, or perhaps their combination (cf. "visMed" on Figure 4). For successful automated physiology-driven adaptation, certain components of control signals need to be related to the resulting physiological response; therefore, the control signals also specify valence-arousal values for the stimuli (cf. "valAr" on Figure 4).

Valid control signals are those and only those obtained with a specific kind of depth-first traversal that extracts sequences of round nodes of the tree in Figure 4. The traversal starts at the topmost node and recursively follows branches, visiting successively each subnode of an encountered composite node and visiting exactly one branch of a branching or round node. Example control vectors obtained in this manner are shown in Table 1. Values "undef" and "real" represent the absence of a particular stimulus, and a real number from segment [0, 100], respectively. As real numbers are used for valence and arousal only, pleasure of the stimulus increases as valence goes from 0 to 100, with totally neutral stimuli (neither pleasant nor unpleasant) having valence of 50; arousal increases from 0 to 100, with 0 denoting no arousal. Part of the signal before the valence-arousal specifications is a descriptor that specifies the *class* of the signal.

Control Signal Interpretation and Disambiguation

Interpretation of control signals enables selection of appropriate scene elements that will be displayed to the patient. Scene elements in the Stimuli Generator's database are annotated in

advance with values complying with the control signal structure and, during session, appropriate metric is applied to select the scene element nearest to the received signals.

Metric, which determines the distance of scene element annotations from the received control signals, can be defined in a variety of ways. Two kinds outlined here are several variants of a class centered and valence-arousal centered metrics, as illustrated in Figure 5. Class centered metric sets infinite distance for annotations that do not match the control signal in tags specifying the class of the signal. Thus, the metric definitely selects some scene element in the same class as the received control signals, when such scene elements exist. Minimization of typical Euclidean distance to the received signal, applied on valence-arousal parts of scene element annotations in the wanted class, gives the scene element that is to be displayed. Other possibilities for selection of scene elements may minimize distance of either valences or arousals. With valence-arousal centered metric, class of the signal is irrelevant. Thus, selection of the scene element for display is done by minimization of some distance to the received signal, applied on valence-arousal parts of all scene element annotations.

Figure 6 shows an example of mapping the step function (significant and sudden change in control signal) to the available stimuli within the Stimuli Generator. The control signal specifying relaxed emotional state is matched with the relaxing landscape video, and the signal specifying intense fear results in the display of traumatic improvised explosive device explosion. Hypothetical unimodal psychophysiological measure is shown, reflecting reaction to the traumatic video, and illustrating some parameters of the response (delay T_{UMd} and settling time T_{UMs}). More details on unimodal psychophysiological measure calculation are provided in the following section.

As the first step, a preliminary part of the Stimuli Generator has been developed that interprets the signals of the form (*stimulus*, *arousal*) within the class of the cortical synthetic visual stimuli. The signals are read from the 3-column file, where the signals take up second and third column. Number in the first column specifies elapsed time, from the beginning of the session, when the stimulus designated by the control signal in the same row is to be displayed. The stimuli used include plane in level flight, helicopter in level flight, and an explosion on a terrain. Disambiguation of control signals is related to determining the entry positions of the objects in the scene, as well as direction of moving for mobile objects. Disambiguation is conducted by

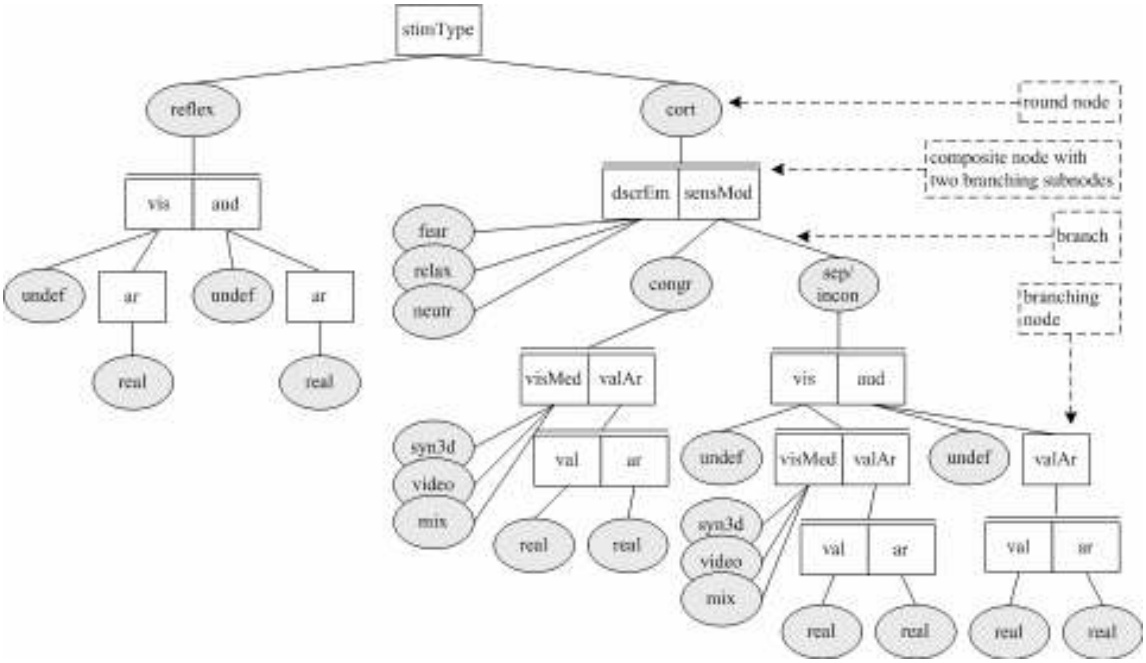

Figure 4. A tree defining the structure of the control signals.

Table 1. Examples of Control Vectors with Explanations

Signal	Explanation
(reflex, undef, 15)	Reflex stimulus, without visual component, with auditory component of arousal 15. Example is a quiet startling sound.
(reflex, 60, 80)	Reflex stimulus, with visual component of arousal 60 and auditory component of arousal 80, respectively. Example is a moderately bright and sudden flash, delivered together with a loud startling sound.
(cort, fear, congr, syn3d, 30, 70)	Cortical stimulus, eliciting fear, with congruent visual and auditory components, visual component is synthetic, valence of components is set to 30, arousal is set to 70.
(cort, neutr, sep/incon, video, 45, 10, 50, 5)	Cortical stimulus, eliciting sadness, separate or incongruent visual and auditory components, visual component is live video of valence 45 and arousal 10, auditory component has valence 50 and arousal 5.

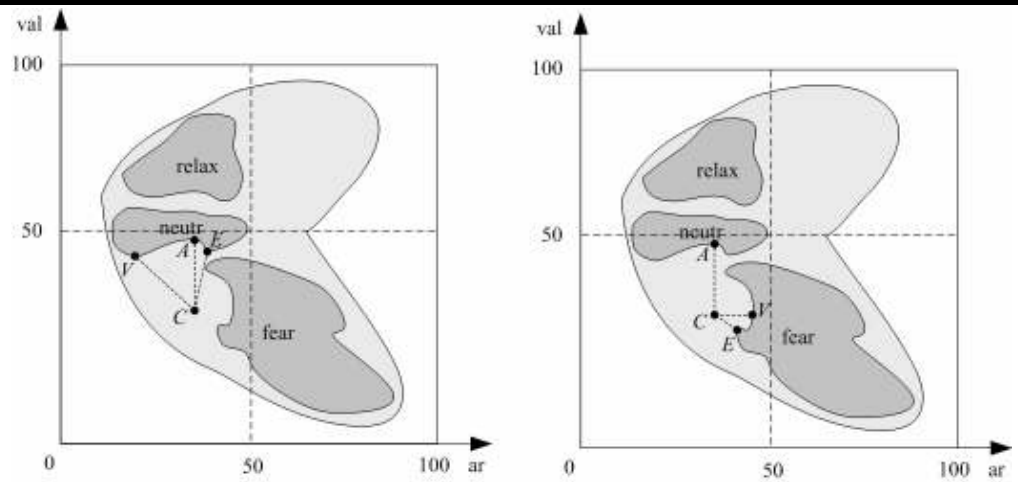

Figure 5. Using class centered (left), and valence-arousal centered (right) metric for selection of the annotated scene element that minimizes typical Euclidean distance (point *E*), valence distance (point *V*), or arousal distance (point *A*) from the control signal (point *C*). Control signal is assumed to be specified as “neutr”, and all available annotated scene elements are assumed to be represented by the shaded areas marked with “fear”, “neutr” and “relax”.

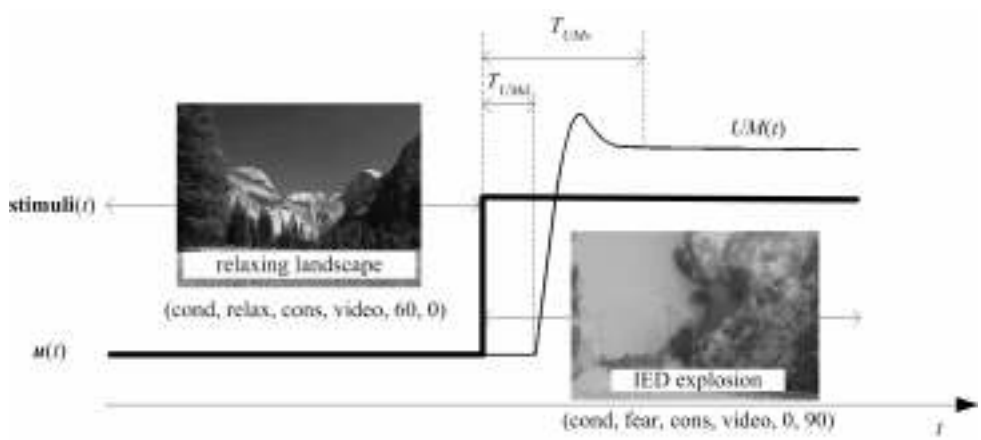

Figure 6. Step function realized in terms of control vectors, shown with the corresponding stimuli and change in unimodal psychophysiological measure. The images are courtesy of Wikipedia.

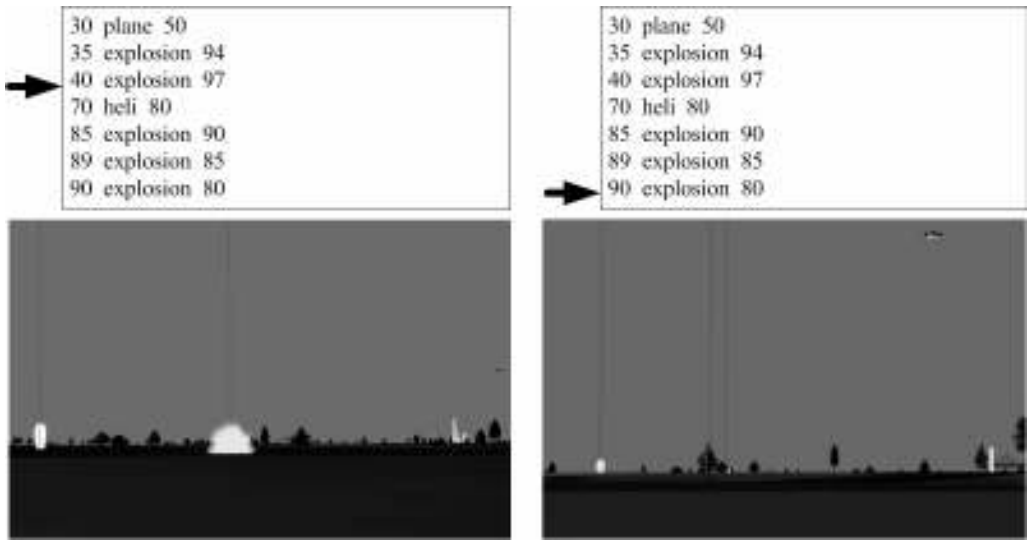

Figure 7. Two snapshots of the virtual environment just after 40 seconds (left), and just after 90 seconds (right), as designated by the arrows pointing at contents of the file with control signals. Vertical lines show the positions of the explosions and the ensuing smoke, and horizontal lines the moving directions of the plane and helicopter.

mapping the *arousal* value to the distance from the viewer, in a controlled and somewhat stochastic way, in order to ensure stimuli visibility and simulate natural unpredictability of events. Figure 7 illustrates the available stimuli, as well as differences in distances of stimuli to the viewer depending on the *arousal* values in the third column of the file.

Unimodal Psychophysiological Estimator

Unimodal Psychophysiological Estimator acquires psychophysiological response related to the patient's experiencing of emotions provoked by the audiovisual stimuli. For this reason, it utilizes various psychophysiological acquisition devices for skin conductance, heart rate, respiration rate, electromyography signals, peripheral skin temperature etc., and receives information regarding the patient's SUDs.
Unimodal psychophysiological measure, which represents the patient's arousal, has been introduced as a linear combination of differences between individual signals and their baseline values. As different physiological measures have different propagation times (Gratton, 2000), instead of momentary value a weighted average during settling time of individual physiological measure is taken. Thus, the formula for calculating the unimodal psychophysiological measure becomes:

$$UM(t) = \sum_{i=1}^{N} a_i \cdot \left(\left(\frac{1}{T_{Si}} \int_{t-T_{Si}}^{t} PM_i(\tau) d\tau \right) - PM_{Bi} \right)$$

where *UM* is the unimodal psychophysiological measure, PM_i is the *i*-th physiological measure, PM_{Bi} is the mean value of physiological measure PM_i in baseline, T_{Si} is the settling time of physiological measure PM_i, and a_i the parameter that defines measurement reliability and the relation of physiological measure PM_i and patient's arousal.

There are other possible approaches to computation of unimodal psychophysiological measure, like estimation based on fuzzy logic (Popovic, Slamic, & Cosic, 2006). Selection of the preferred approach is a matter of further experimentation.

Adaptive Subsystem

The Adaptive Subsystem is the central component for optimally individualized PTSD treatment, which selects and adjusts all relevant parameters of the system according to the individual patient's psychophysiology. Discrete-event adaptation gives reference values to the Digital Controller, Stimuli Generator, and takes as input the SUDs, Unimodal Psychophysiological Estimator output etc. The Adaptive Subsys-

tem incrementally gathers knowledge about the patient's psychophysiological profile, stores this knowledge in the Subject's Aggregated Knowledge Database, and uses this knowledge with information from the Reference Knowledge Database. During and after each session, the Adaptive Subsystem updates the patient's relevant parameters and corrects the scene element annotations to represent the patient's individual estimates of anxiety that is associated with these elements, and stores this information into the Subject's Aggregated Knowledge Database. Subsequent sessions reuse the knowledge gathered during the previous sessions. At the end of all the sessions, Subject's Aggregated Knowledge Database contains the relevant patient and other data from which the analysis across sessions may update expert rule base of the Adaptive Subsystem.

During exposure sessions, Adaptive Subsystem performs the patient's identification continuously, because the patient's psychophysiology, as an object of control, is unknown, complex, nonlinear and time variant system. Therefore, it is necessary to determine and keep up-to-date the knowledge regarding time constants, propagation times and settling times of physiological measures, baseline values of the physiological measures, values on exposure to reflex stimuli, as well as cortical stimuli representing typical signals in system identification theory (impulse, step, ramp etc.). With temporal fluctuations of the identified parameters of the patient, parameters a_i of the unimodal psychophysiological measure and the parameters of the Digital Controller can be adjusted.

Digital Controller

Digital Controller on the basis of the patient's unimodal psychophysiological measure $UM(t)$ tracks the reference unimodal psychophysiological measure $UM_{ref}(t)$. Main components of the Digital Controller are a mechanism for computation of the tracking error, controller based on fuzzy logic rules and interpreter, shown in Figure 8.

Inputs to the Fuzzy Logic Controller are the tracking error (TE) and its derivative $d/dt\ TE$, which represent the trend of the tracking error change. There are various ways of choosing the valence and arousal of the stimulus to get the same physiological response; therefore, the change of stimulation intensity ΔSI is used as the controller output. The interpreter then maps the change of stimulation intensity into the change of control signals $\Delta \boldsymbol{u}(t)$.

Input and output variables of the Fuzzy Logic Controller are represented as linguistic variables consisting of seven fuzzy sets with characteristic names, like {"negative big", "negative medium", "negative small", "zero", "positive small", "positive medium", "positive big"}. Besides deciding on the number of fuzzy sets for each linguistic variable, further degrees of freedom relate to the type and actual shape (triangular, trapezoid, Gaussian etc.) of membership functions defining the fuzzy sets. Figure 9 illustrates possible partition into fuzzy sets, for input variables TE and $d/dt\ TE$, and output variable ΔSI.

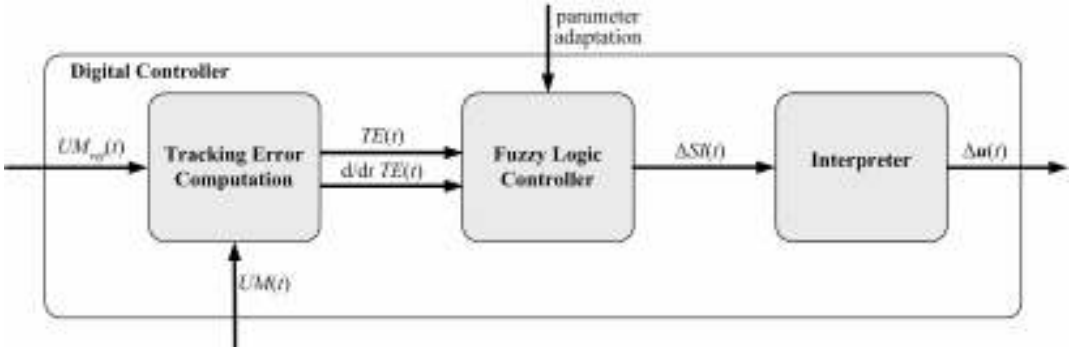

Figure 8. Structure of the Digital Controller.

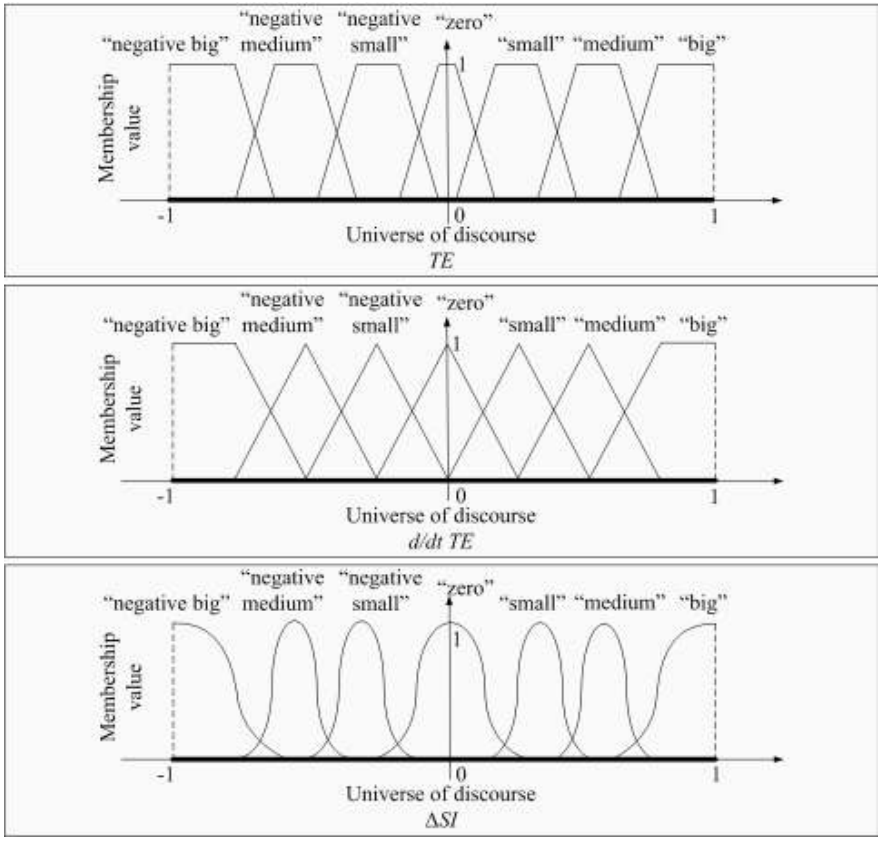

Figure 9. Input and output variables of the Fuzzy Logic Controller.

Decision making in Fuzzy Logic Controller is accomplished by fuzzy inferencing with fuzzy if-then rules. Fuzzy rule base contains a rule for every combination of the input fuzzy sets. Here, a few rules are illustrated:

- If tracking is ideal, maintain stimulation intensity,
  if (*TE* = "zero" and d/d*t TE* = "zero") then (Δ*SI* = "zero"),
- If the patient is somewhat under-aroused, give more unpleasant arousing stimulus,
  if (*TE* = "positive small" and d/d*t TE* = "positive small") then (Δ*SI* = "positive small"),
- Larger tracking error or derivative of tracking error mandate more intense stimulation,
  if (*TE* = "positive medium" and d/d*t TE* = "positive small")
  then (Δ*SI* = "positive medium"),

if (*TE* = "positive small" and d/d*t TE* = "positive large") then (Δ*SI* = "positive medium").

CONCLUSION

This paper has presented an ongoing design and development of a physiology-driven adaptive VR system for PTSD treatment, describing the clinical rationale and major components of the system. Control signals and matching scene element annotations have been analyzed. Based on stimuli content, customization from the patient's interview and suitable psychometric tests, the Stimuli Generator resolves control signals via scene element annotations into the appropriate stimuli. The unimodal psychophysiological measure has been derived from various physiological signals in order to accurately represent the patient's emotional state. An accurate representation of the patient's emotional state is crucial for the correct functioning of the automated physiology-driven changes in the patient's level of exposure.

The physiology-driven adaptive VR system for PTSD treatment described in the paper at-

tempts to build on the advantages of conventional VR exposure therapy over imaginal exposure therapy. Relieving the therapists of technical and administrative issues that occur in VR exposure and providing them with comprehensive, yet succinct, information about the patient's emotional state, may help the therapists conduct more effective PTSD therapy. However, after the working system is developed, these hypotheses need to be confirmed by experiments. Evaluation of the system against contemporary VR therapy systems according to various criteria is very important for its clinical utility. The most important and costly evaluation is a direct evaluation of treatment efficacy comparing therapists using the physiology-driven to a manually controlled VR system in a randomized controlled clinical trial. Except on the type of VR system employed, treatment efficacy depends on the patient's characteristics and the therapist's knowledge about the treatment method, so these confounding variables need to be controlled. Secondary criteria for a comparative evaluation, possibly correlated with treatment efficacy, include ease of use of the therapist's computer interface, quality of information about the patient's emotional state presented to the therapist etc. Further criteria may be measures of the system design qualities, like extensibility to account for new traumas or different hardware. After satisfactory evaluation results, the presented VR system would offer the therapists a promising tool for treating combat-related PTSD.

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War PTSD: a VR pre-trial case study

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Abstract: *As a consequence of three wars in Africa (between 1961 and 1974), there are still around 25,000 Portuguese veterans with a diagnosis of PTSD. Treatment of such patients using traditional techniques has revealed to deliver inconsistent results. Aiming to assess the ability of VR exposure to reduce PTSD symptomatology, this paper focused on a pre-trial case study with a 60-year-old war veteran who was exposed throughout seven graded sessions to a VR war scenario. Exposure, using a 295 X 225 cm Translucid Screen, took place in a Psychiatric Hospital, with therapist assistance. IES and CAPS were administered to corroborate PTSD and psychopathological comorbidity. Throughout trial sessions, EEG and ECG registers were collected, as well as video imagery. Both records showed a reduction on patient activation. During sessions, the participant assumed a combat position (arms and hands in a firearm carrying position), looking to find the enemy within the scenario. When triggers such as ambush and mine deflagration occurred, the patient tried to take cover and started simulating firing. Presence was assessed and reported (ITC-SOPI questionnaire) at the beginning and in the middle of the sessions.*

Keywords: *PTSD, VR, exposure, war veterans*

INTRODUCTION

Between 1961 and 1974, Portugal was engaged in three wars on its former colonies Angola, Mozambique and Guinea-Bissau. During this period, around one million soldiers were drafted to fight in guerrilla-type warfare. Many of them developed PTSD (Posttraumatic Stress Disorder) after returning home. Today, it is estimated that around 25,000 war veterans still meet DSM IV criteria for PTSD. The Portuguese national health system offers these veterans psychotherapy counseling services. With psychotherapy, this anxiety disorder may be reduced but not eliminated (Rothbaum et al., 1999).

In order to investigate the role of a complementary technique, a research protocol was devised by University Lusófona of Humanities and Technologies, Hospital Júlio de Matos and Military Academy to assess the opportunity of exposing war veterans with PTSD to virtual reality (VR) worlds. The clinical population consists of male subjects with the diagnosis of War PTSD according to the DSM-IV-TR (APA, 2000) that looked for treatment at Hospital Júlio de Matos in Lisbon, Portugal. They will be distributed trough 2 treatments: activate Virtual Reality Exposure (aVRE) and neutral Virtual Reality Exposure (nVRE). aVRE will be composed of the following cues: mine deflagration, mine deflagration with ambush, ambush and assisting casualties and waiting for a rescue helicopter. nVRE will consist of a walkthrough world with non-related war cues. Both groups will be using a Head Mounted Device that enables a fully immersive experience. These scenarios were developed using a video game graphics engine. It is also a goal of this study to compare different measurement procedures. To this end, CAPS, STAI, SCL-90, MCM-II and ITC-SOPI for psychometric measures and ECG, EEG and GSR for physiological measures are the evaluation procedures selected for assessing the results. Depending on the normality and homoscedasticity of the data distribution, statistical analysis will be done accordingly. A full project description is available elsewhere (Gamito, et al, 2005).

The use of VRE, despite being in its infancy, is not a novel technique within the anxiety disorder therapy milieu. In fact, for more than a decade, VR has been used to treat patients with acrophobia (Emmelkamp, et al, 2001), arachnophobia (Garcia-Palacios, et al, 2002; Carlin et

al, 1997), claustrophobia (Botella, 2000) and fear of flying (Rothbaum, et al, 2000), among other pathologies. As far as the use of VR exposure protocols for PTSD pathology is concerned, the last five years have produced some insight on this subject. Difede et al (2002) studied patients with PTSD from World Trade Center attacks, Josman et al. (2005), patients with PTSD from suicide bombing attacks in Israel, and Rizzo et al. (2006) studied soldiers that returned from Iraq.

Concerning war veterans, a decrease of 34% and of between 15% and 67% on PTSD symptoms, respectively, was found in two studies with American Vietnam combatants by Rothbaum et al. (1999, 2001). In the 1999 study, a single patient that had returned from the war 26 years prior to the study was exposed to a jungle scenario where cues such as helicopters flying, gun firing, shouts, and others were added. The same scenario was used in the 2001 study, but the number of participants was increased to 10 veterans. In both studies, results were maintained six months after the trial.

VR exposure (VRE) seems to deliver better results than the classical imagination exposure. 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. By itself, the avoidance of recalling the traumatic experience is a PTSD symptom. On the other hand, some patients are not able or not wiling to engage emotionally, which may reduce therapy success (Jaycox at al. 1998).

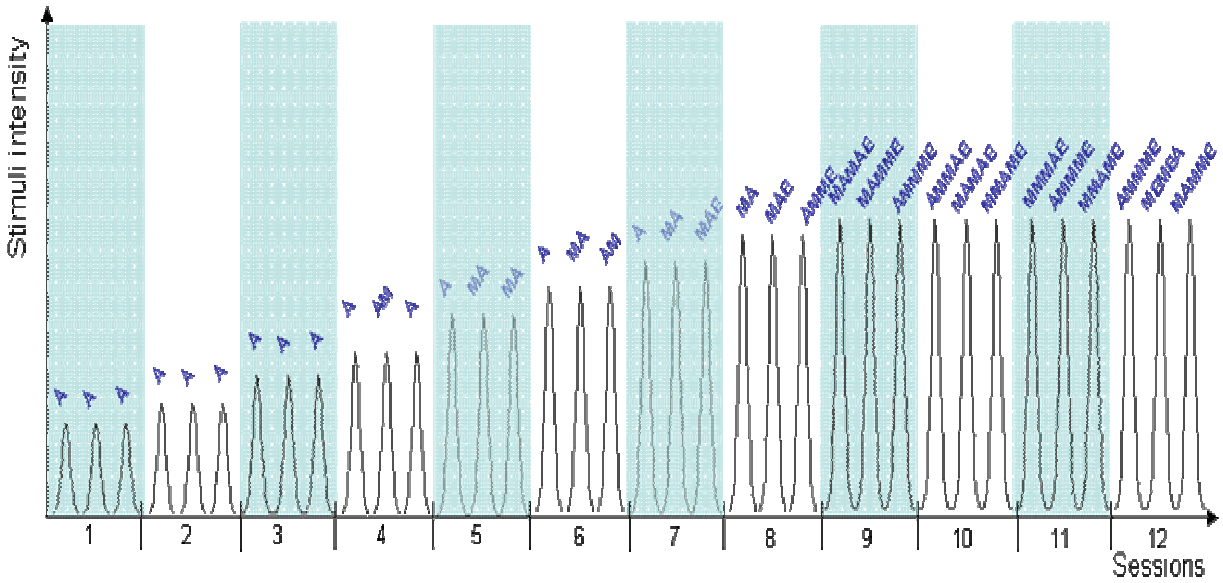
This paper reports on a pre-trial case study that was devised to assess the experimental protocol and the clinical set up that are to be used in the project mentioned above (Gamito, et al, 2005). Due to the novelty and the complexity of such a study, it was considered paramount to undertake a pre-trial study in order to assess non-clinical operational and procedure issues. As described below, this study involves two institutions and several clinical services and a transdisciplinary team. This added a new dimension of complexity that needed to be addressed before the trial began. Nevertheless, clinical and ethical matters were already established and approved by an ethical committee in order assure best practice procedures.

The main objective is therefore to undergo a clinical trial in order to produce a clinical protocol for reducing the PTSD DSM-IV associated symptoms. After this pre-trial is concluded, this protocol will be implemented in a Central Psychiatric hospital with ongoing treatment for PTSD diagnosed patients, namely the veterans of Portuguese colonial wars.

METHODOLOGY

The participant was a 60 years old war veteran that made a commission as a commando between 1972 and 1974 in Angola. He met DSM-IV (APA, 2000) criteria for PTSD and depressive disorder. Prior to trial, the participant was included in a psychotherapy group and was medicated with Sertralina, initiating with 50 mg/day and fixing the dose at 100 mg/day. No alcohol abuse was registered. Prior to enrolment, the participant gave his informed consent and was evaluated through a battery of psychological and medical tests. Evaluation was conducted by independent professionals. Exclusion criteria of cardiovascular disease, epilepsy, and absence of informed consent from the assistant psychiatrist were not met by this patient.

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. A wide lens XGA VPLPX 41 Sony projector and a Creative 5.1 surround sound system plugged into a P4 3.4 GHz with a 7800 GT graphics board were in use. The patient was sitting on a chair positioned over a platform coupled with Aura twin bass shakers. The projected VR world was developed using Valve graphic editor Hammer and consisted of a footpath ("picada") surrounded by dense vegetation ("capim"), where the participant followed a column of virtual soldiers (bots). In each of the 12 sessions three moments of activating cues were in place, as seen in Figure 1.
Being a graded exposure, stimuli intensity was increasingly raised throughout the sessions until a plateau was achieved (session 9). Once on the plateau, intensity stayed the same, however the combination of cues differed. Each cue is described as follows (Figure 2):



Legend:
A: Ambush;
M: Mortar;
E: Evacuation through helicopter.

- Ambush: sounds of gun firing (AK 47) and tracing bullets;
- Mortar: sound of a blasting plus black smoke and particles spraying;
- Evacuation: Alouette II flying in and evacuating injured soldiers.

While electrodes for EEG (Electroencephalography), GSR (Galvanic Skin Response) and ECG (Electrocardiography) where put in place, the patient was encouraged to engage in dialogue counseling with his assistant therapist. This dialogue was maintained during exposure and at the end of the session. In these two situations, the therapist also asked the patient to control his anxiety levels using anxiety management techniques learned in psychotherapy group. Besides EEG (Fp1 activity), GSR and ECG recordings, video imagery was also registered.

Along with psychophysiological records, data was also collected through clinical and self report measures, namely, the Clinician-administered PTSD Scale (CAPS; Blake et al., 1990); Impact of Events Scale (IES; Horowitz, Wilner & Alvarez, 1979); and ITC Sense of Presence Inventory (ITC-SOPI; Lessiter, Freeman, Keogh & Davidoff, 2001). Besides the self-report measures, the clinical assessment was composed of a Structured Clinical Interview for DSM-IV.

RESULTS and DISCUSSION

Concerning self-report measures, CAPS total score was 62, which reports severe symptoms

Table 1. Descriptive analyses (average) for self-report measures related to PTSD

Measure	Pre-VRE	Post-VRE
CAPS total score	62	-
Reexperiencing	15	-
Avoidance	15	-
Arousal	32	-
IES total score	59	51
Intrusion	32	27
Avoidance	27	29

related to PTSD (Weathers, 1998). The evaluation carried out by IES scale corroborates the initial diagnosis of PTSD and reported an Avoidance index of 27 and 32 for Intrusion. This assessment was taken before VRE. The second IES assessment was taken after the 7th session. On this occasion, no data was collected from CAPS.

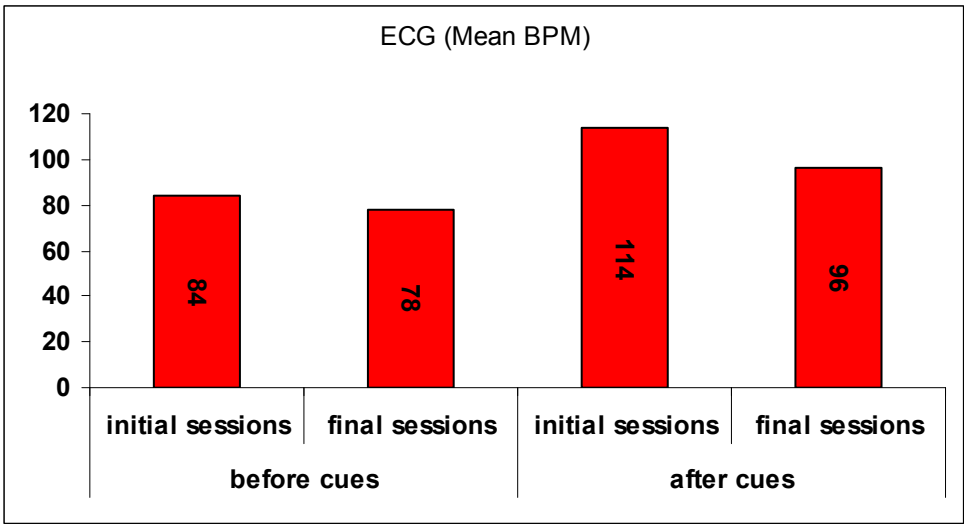
Regarding Physical Presence, ITC-SOPI scores showed an increased pattern of physical presence evaluated in two different moments (Table 2). Negative Effects of exposure decreased.

Throughout the 7 trial sessions, ECG, GSR and EEG records were collected, as well as video imagery. Data was organized in two sets: Initial Sessions (1 to 5 sessions) and Final Sessions (6 and 7 session), which correspond to two ECG and GSR different data patterns (Graph 1 and 2). These two clusters were obtained from the Hierarchical Cluster Analysis. Furthermore, subsequent K-means cluster analysis put in evidence the diverse characteristics of each cluster, where lower levels of GSR and ECG were found in cluster Initial Sessions (see Graph 1 and 2). These clusters were coincident with therapist reports on patient behaviour patterns. These reports, which resulted from therapist/ patient dialogue, showed a decrease in patient emotional reactions in the last two sessions.

Psychophysiological records showed that physiological activation was significantly different before and after cues (Table 3). In fact, for both ECG and GSR, the average score of heart rate and of Galvanic Skin Response were significantly higher in the after cues condition. In both before and after cues conditions, a decrease in the psychophysiological activation between initial and final sessions was registered. This possibly means that the patient showed lesser activation towards the aversive cues at the end of the study than at the beginning. Nevertheless, this decrease was not statistically significant. For ECG records, an interaction effect was verified between before and after cues and initial and final sessions. This possibly means that the observed decline in the after cues condition was more expressive than on the before cues condition, from initial to final sessions.

Table 2. Descriptive analyses (average) for self-report measures related to Physical Presence

Measure	Pre-VRE	Post-VRE
ITC-SOPI		
Spatial Presence	3.84	4.00
Engagement	3.23	3.53
Ecological Validity	3.80	4.00
Negative Effects	3.83	3.33

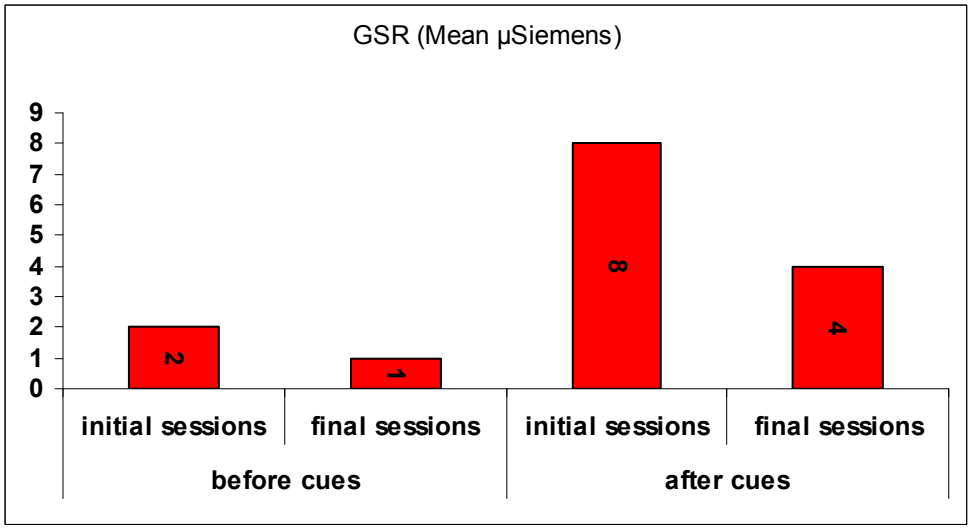


Graph 1. ECG records, before and after cues.

Concerning EEG records - see Graph 1 for EEG pattern before cues and Graph 2 for EEG pattern during cues - an increasing activation was observed during VRE cues i.e. during ambush and mine deflagration episodes (Graph 2), Fp1 (frontopariental 1) activity was augmented. However, this activation was, possibly, due to the involuntary body movements during cues (Graph 2).

In this way, it was not possible to produce a proper assessment of the neurophysiological activity in this subject. In future studies it may be relevant to engage other approaches in order to assess this activity. For example, the evaluation could focus on qualitative analyses and control of neurophysiological responses (e.g. spike activity of epileptic focuses).

Observational methods showed that after the second session, where cue intensity was raised, the participant assumed a combat position (arms and hands in a position such as if a firearm was being carried), trying to find the enemy within the scenario. When triggers such as ambush and mine deflagration occurred, the patient tried to take cover and started simulating firing. The subject maintained this behaviour pattern throughout the following sessions.
Besides self report measures and psychophysiological data, data was also collected from therapist/patient conversation. In the initial ses-



Graph 2. GSR records, before and after cues.

Table 3. ANOVA of Repeated Measures for main and interaction effects.

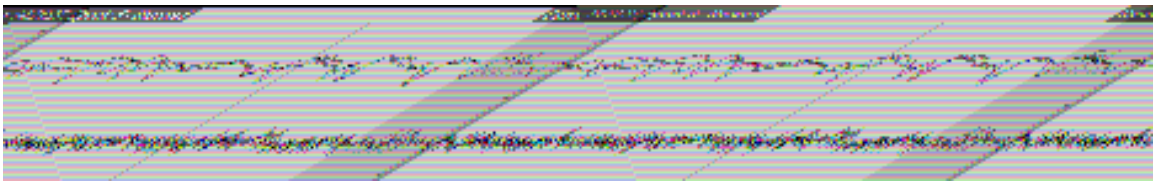
	F before and after cues	F initial and final sessions	F for interaction effect
ECG	172.192 ***	5.806	5.000*
GSR	54.454**	5.259	1.513

sions the subject evidenced exacerbated emotional reactions to VR triggers. In sessions 3 and 4 the subject presented some avoidance reactions to VRE and after these sessions the subject reported to the therapist an increase of nightmares related to war conditions. The therapist also reported a decrease in autonomic activation by observable behaviours during the last two VRE sessions.

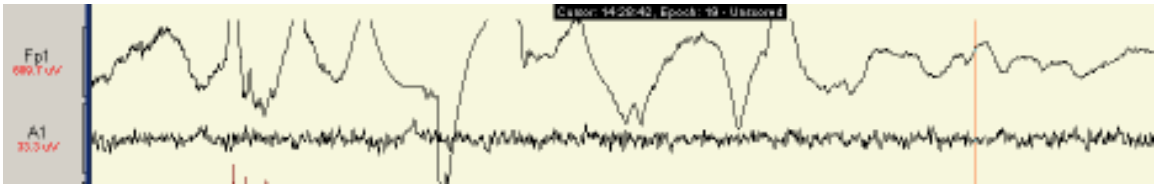
The key element of exposure, confrontation with an intense fear (Foa and Kozak, 1986), was achieved in this study. Both indirect and physiological measures showed participant activation towards the cues that were placed in the VR world. Scores for spatial presence and for engagement were higher in Post–VRE as they were for ECG and GSR in after cue moments. In fact, according to Wilhelm et al (2005, pp 272) "physiological activation is seen as a by-product of the activation of relevant fear structures during exposure therapy. This activation is believed to be advantageous for restructuring to occur".

However, confrontation with the fear stimuli is not sufficient. An adaptation to the traumatic event may need to take place (Foa and Kozak, 1986). Probably, this adaptive process happened, to a certain extent, with this patient. In fact, as cue intensity was raised from session 1 to 7, the patient reported higher presence and lower activation i.e. the patient showed some desensitization towards the activating cues. This may suggest that graded exposure to the VR war world was responsible for some restructuring. Actually, a decrease of 14% for IES Avoidance and Intrusion scores was found.

A final assessment on the 12th session, however, was not possible. This subject did not complete the full protocol. In fact, he abandoned the study on the 7th session, missing the last five. When asked the reason for leaving, the participant mentioned that on the night after the 7th session he had a flashback episode. While sleeping, he thought that was being shot at while flying in a combat helicopter. This flashback caused him a distressful situation, which forced him to abandon the protocol. Consequently, though CAPS were in use to diagnose PTSD at the beginning of the trial, it was not possible to make use of it again in the final assessment as patient dropped out. In fact, in the last assessment, which according to the initial protocol was supposed to be an interim assessment, only IES was completed.



Graph 1. EEG pattern before cues



Graph 2. EEG pattern during cues

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The use of VR exposure in the treatment of motor vehicle PTSD: A case-report

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Abstract: *Posttraumatic Stress Disorder (PTSD) is a psychiatric diagnosis with 8 – 40% prevalence in Motor Vehicle Accident (MVA) survivors. This paper reports on a case study about a subject that underwent a VR exposure program designed to reduce PTSD symptomatology that was developed after a violent MVA. The VR world consisted of a 4 lane highway setup with traffic on both ways that was displayed to the patient through a 295 X 225 cm Translucid Screen. In the 4 sessions, the participant, a 42-year-old female, was driven down the highway by a therapist. The intensity of anxiety cues was raised throughout the sessions. The patient had to overcome events such as traffic intensity variation, tunnels and crossings. From HADS questionnaire, very high anxiety and depression scores were reported. IES results also indicated a reduction in intrusion and avoidance scores, even though the subject remains within the severe PTSD cohort. Physiological measures such as ECG and GSR pointed out a reduction in psychophysiological activity.*

Keywords: *PTSD, VR, exposure, motor vehicle accident*

INTRODUCTION

In Portugal, Motor Vehicle Accidents (MVA) are a serious public health problem. On average, for a driving qualified population of more than 5 million people, 40,000 MVAs are registered per year in Portugal (DGV, 2005). Though decreasing in death toll, 1,094 deaths from MVA were registered in 2005. This fact propels this country to the leading position as far as MVA is concerned in the European context, having the first highest death per capita rating in the western European Union. Regrettably, this is not the only concern with MVA consequences. The numbers related to small and severe physical injuries are also alarming. 50,000 Portuguese, around 0.5% of the Portuguese population, are victims of MVA. It is estimated that MVAs cost between 2 and 3% of Portuguese GDP.

The consequences of MVA, are not circumscribed to physical injuries. Phobia, Acute Stress Disorder (ASD) and Post-traumatic Stress Disorder (PTSD) are some of the possible consequences from a traumatic MVA experience. The consequences of a MVA can also include depression and panic attack (Blanchard et al, 1995; Mayou, Bryant & Ehlers, 2001).

Albuquerque, et al. (2003), developed a community study in which 5.6% of the individuals exposed to serious MVA present PTSD symptoms. Blanchard & Hickling (1997) estimate that 8 to 40% of MVA victims present PTSD. Pires & Maia (2006) presented results in which they suggest that on the first post accident evaluation (3/4 days), 55% of the 42 subjects presented PTSD symptoms. Four months past the accident, the percentage was reduced to 31%, even though 7.1% of the subjects presented more symptoms than in the first evaluation. Furthermore, they found a significant correlation between the perception of fear at the moment of the accident and PTSD symptoms.

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 the chosen technique used by psychotherapists. 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. By itself, the avoidance of recalling the traumatic experience

is a PTSD symptom. 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 reside in Virtual Reality Exposure (VRE). The use of VRE, despite being in its infancy, is not a novel technique within the anxiety disorder therapies milieu. In fact, for more than a decade, VR is being used to treat patients with acrophobia (Emmelkamp et al, 2001), arachnophobia (Garcia-Palacios et al, 2002; Carlin, Hoffman & Weghorst, 1997), claustrophobia (Botella, 2000) and fear of flying (Rothbaum et al, 2000), among other pathologies. Even where PTSD is concerned, there are several studies published. Difede et al (2002) studied patients with PTSD from World Trade Center attacks, Josman (2005) patients with PTSD from suicide bomb attacks in Israel, Rizzo et al. (2006), soldiers that had returned from Iraq with PTSD and Gamito et al. (2005) reported a case study with an Angola Veteran. However, studies are missing when it comes to the use of VRE on MVA patients. In this way, this paper reports an ongoing study about a patient that developed PTSD after a traumatic MVA.

METHODOLOGY

The participant was a 42-year-old Portuguese woman. The patient met DSM-IV (APA, 1994) criteria for PTSD with depressive symptoms. Prior to trial, the participant was in psychotherapy and was medicated with Fluoxetina, Clobozam and Lorazepam, with stable medication 3 months before VR exposure.

Participant was exposed through a 295 X 225 cm Translucid Screen installed in the Neurophysiology Service of the Hospital of Júlio de Matos. A wide lens XGA VPLPX 41 Sony projector and a Creative 5.1 surround sound system plugged to a P4 3.4 GHz with a 7800 GT graphic board were in use. The patient was seated on a chair positioned over a platform coupled with a set of 2 Aura bass shakers. The projected VR world was developed using Valve graphic editor Hammer and consisted of a driving environment where the subject was driven through a highway scenario. Throughout 4 sessions, the participant was exposed to increasingly anxiety triggering events such as horns, an increasing proximity to the surrounding buildings, increasing traffic and highway obstacles (i.e. driving trough tunnel) (Figure 1).

While electrodes for EEG (Electroencephalography), GSR (Galvanic Skin Response) and ECG (Electrocardiography) where put in place, the patient engaged in dialogue counseling with her therapist assistant. This dialogue was maintained during exposure and at the end of sessions. On these two situations, the therapist also asked the patient to control her anxiety levels using anxiety management techniques learned in psychotherapy. Besides EEG, GSR and ECG recordings, video imagery was also registered.

Besides psychophysiological records, data was collected through clinical and self report measures, namely, the Clinician-administered Impact of Events Scale (IES; Horowitz, Wilner & Alvarez, 1979); and ITC Sense of Presence Inventory (ITC-SOPI; Lessiter et al. 2001). PTSD was diagnosed through a structured clinical interview for DSM-IV. Self-report measures were applied before first session and after final session (4th session)

Figure 1: VR world highway

Virtual Reality Exposure sessions

	Sessions			
	I	II	III	IV
Description	Driving in a low intensity traffic highway	Driving in a medium intensity traffic highway	Driving in a high intensity traffic highway	Driving in a high intensity traffic highway with reduction of field of view
Duration (min.)	20	22	21	22
Trigger	No trigger	Horns	Horns + cross-over	Horns + cross-over + narrowing field of view

Note: Low intensity traffic: approximately 10 vehicles; Medium intensity traffic: approximately 50 vehicles; High intensity traffic: approximately 150 vehicles; High intensity traffic with reduction of field of view: approximately 150 vehicles with addition of buildings close to the highway.

This protocol used the same graded exposure approach as in other PTSD studies in which VRE was applied (Rothbaum et al, 2001; Gamito et al., 2005). Nevertheless, as literature is absent on the existence of VR worlds developed to treat MVA PTSD patients, a new setup and new cues were needed. This VR world is available on request from the Laboratory of Computing Psychology, at Universidade Lusófona de Humanidades e Tecnologias (Lisbon). However, in order to unleash its full potential and customizable capabilities, the requesters must have Half-life2 software (in order to present the scenario) and Hammer World Editor (in order to edit it).

RESULTS and DISCUSSION

Results, for psychometric measures, were divided into different moments, pre treatment and post treatment assessments. Since this study was a single subject trial, no statistical inferential analyses were performed. As can be seen in the tables below, scores on self-report measures decreased from pre treatment to the post treatment assessment (4 sessions). Accordingly, reported anxiety and depression scores (HADS), evidenced a decrease in these dimensions between pre and post treatment assessments (Table 1).

The same pattern was observed for symptoms related to PTSD; in a pre treatment stage the patient related 31 for Intrusion and 31 for Avoidance behaviours with a total score of 62 corresponding to a severe condition. In the post treatment stage, scores showed a decrease in these symptoms with 27 for Intrusion, 21 for Avoidance and a total score of 48, however, still corresponding to a severe PTSD condition (Table 2).

Table 3 presents the reduction on the scores for HADS and IES.

Psychophysiological records, namely ECG (Electrocardiogram) and GSR (Galvanic Skin Response), showed a decreased global pattern of physiological activity. Within each session, psychophysiological measures were evaluated in four different moments, in a stage before virtual exposure (baseline), in the initial stage of the virtual exposure, 10 minutes after the begin-

Table 1. Total scores for Anxiety and Depression in the initial and final assessment.

HADS	Initial assessment	Final assessment
Anxiety	13	11
Depression	17	16

Table 2. Total scores for Anxiety and Depression in the initial and final assessment.

IES	Initial assessment	Final assessment
Intrusion	31	27
Avoidance	31	21
Total score	62	48

Table 3. Scores reduction proportion.

Measures	%
Anxiety (HADS)	-16
Depression (HADS)	-6
IES Total Score	-22
Intrusion	-13
Avoidance	-32

ning and at the end of the session (around 20 minutes after beginning). These results are presented in Chart 1 for ECG and in Chart 2 for GSR.

From charts analysis, a reduction on every measured dimension was observed. However, in session 2 the subject presented a larger increase on the autonomic reactivity than previous and later sessions. However, no significant differences were found between sessions, for ECG and GSR values. In fact, through ANOVA of Repeated Measures, the test values for ECG and GSR were, respectively, $F(3) = 3.222$; $p = .075$ and $F(3) = 1.363$; $p = .315$.

Nonetheless, a within sessions analysis showed significant differences ($F(3) = 9.217$; $p = .012$) between moments of exposure for ECG. In this way, patient heart rate was significantly higher ten minutes after beginning the VRE, following which a significant decrease was reported (see Chart 3). No significant differences were found for GSR.

Through observational methods, a decrease in observable emotional reactions (e.g. crying) between sessions was also reported. On first two initial sessions, patient revealed extreme anticipatory anxiety reactions, which were decreasing in intensity during treatment.

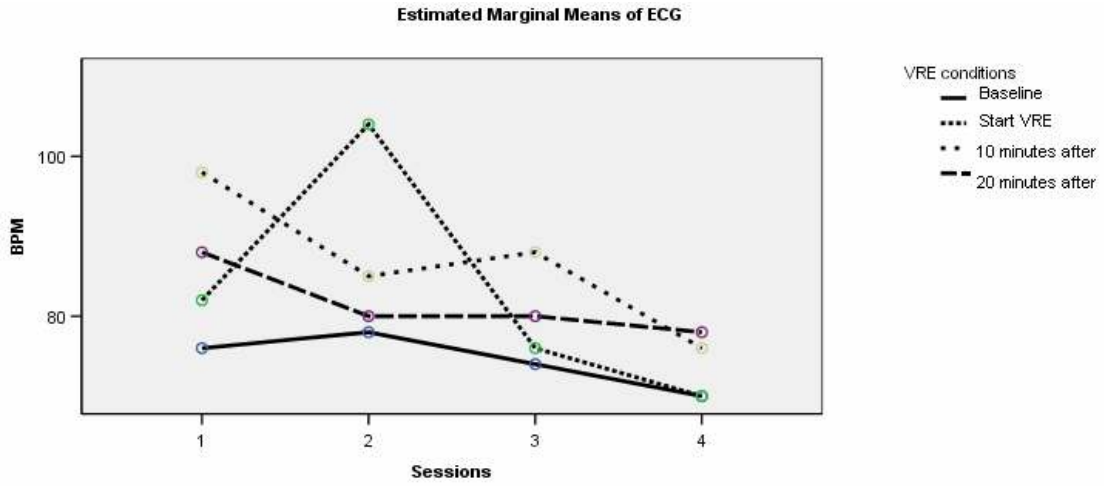

Chart 1: ECG data

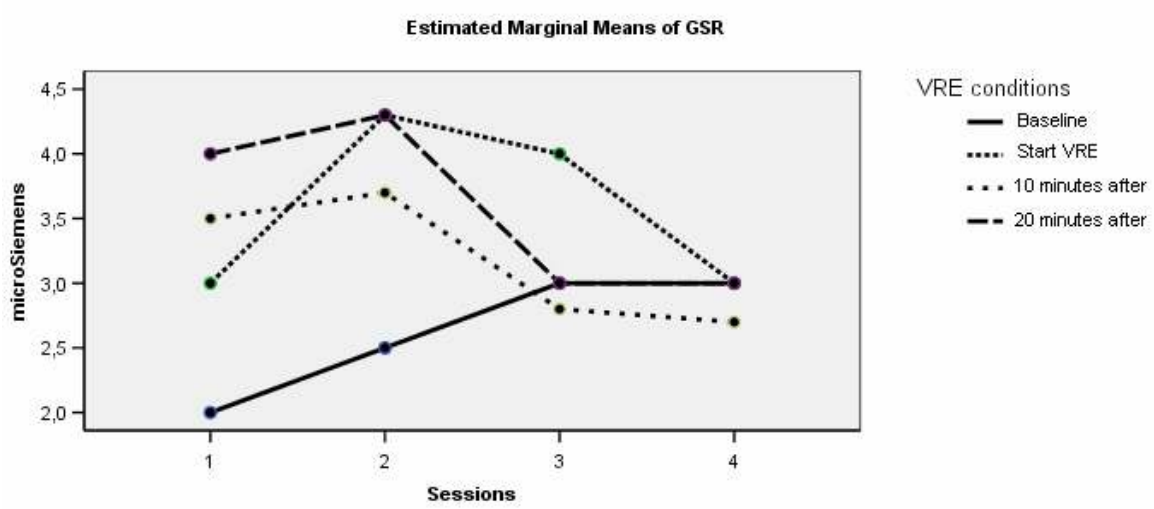

Chart 2: GSR data

The results of this case study indicate a slight decrease of the anxiety and depression symptoms after a 4-session treatment. Furthermore, the observational results derived from the video recording analysis strengthen the indications given by HADS questionnaire. Patient non-verbal behaviour showed clear reduction in agitation and rejection behaviour as the sessions progressed. In the 4th 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 related Avoidance and Intrusion symptoms, since the subject is still in the severe PTSD cohort.

Also, psychophysiological measures pointed towards these results. Heart rate reduction (considered to be an important marker) from session 1 to session 4 may indicate a reduction in the anxiety and PTSD symptoms. This evidence was also referred to by other authors (Foa & Kozac,1986;Wilhelm et al, 2005). Moreover, the fact that the psychophysiological activation has increased from the first to the second session, and progressed downwards afterward, is congruent with the results of the therapeutic process.

These results are in consonance 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, respectively, found in two studies with American Vietnam combatants that were exposed to VR worlds (Rothbaum et al., 1999; Rothbaum et al., 2001). In one case report from one Portuguese veteran, a decrease of 14% on Avoidance and Intrusion criteria was observed (Gamito, et al., 2007). However, further studies are needed in order to fully assess VRE within

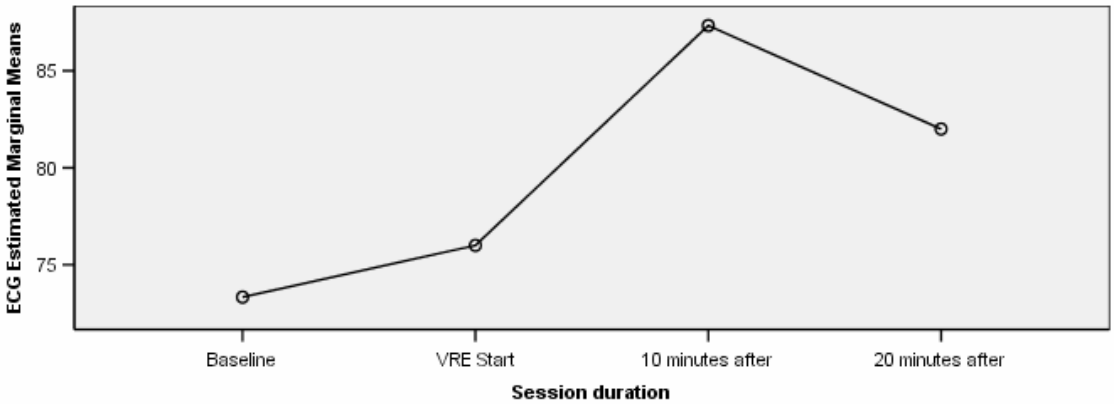

Chart 3. Estimated marginal means for ECG.

MVA PTSD patients. With the knowledge learned it is now possible to open this protocol to other patients with this pathology.

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Virtual reality induced side effects: exploration of participants' characteristics in severe cases of cybersickness

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Since 2001, the UQO Cyberpsychology Lab has conducted many studies on the effectiveness of virtual reality (VR) exposure therapy and factors contributing to the level of presence. More recently, the team has grown a particular interest for the impact of cybersickness on VR applications. The aims of this study are: (a) to report on the incidence of cybersickness following immersions in VR and (b) to describe some characteristics of the few participants who suffered from severe symptoms.

Of a group of 371 adult participants who completed the Simulator Sickness Questionnaire (SSQ; Kennedy et al., 1993) after an immersion in VR, 18 of the most severe cases were included in the present study. Participants were divided into two groups: (1) the three most extreme cases of cybersickness (e.g. those who reported significant adverse events such as vomiting or having 48 hours of cybersickness); (2) participants who scored above two standard deviations of the mean score on the SSQ (n=15). Note that participants in group 1 are not included in group 2 and all analyses were conducted separately. Group 2 was compared to 15 participants who scored zero on the SSQ following a virtual immersion. General results from the entire sample will first be presented, followed by a description of our findings for each Group.

For Group 1, results show that all participants are phobics and scored more severe symptoms on the nausea subscale than the oculomotor and disorientation subscales. At the follow-up 24 hours after the immersion, two of the three participants still had severe symptoms of cybersickness. Symptoms disappeared after 48 hours.

Results for Group 2 show again that all participants were phobics and 86.7% are female. Mean score on the SSQ-total is 101.01 (s.d. 19.61) and severe symptoms vary between participants and SSQ subscale. Oneway ANOVAS showed a significant difference on the Beck Depression Inventory ($p<.05$) but no difference on age, gender, the State-Trait Anxiety Inventory, the Presence Questionnaire or the Immersion Tendencies Questionnaire.

These results suggest that phobics and women seemed to be more susceptible to cybersickness. Also, the SSQ seems to be a good instrument to assess some cybersickness symptoms but does not differentiate symptoms which clearly interfere with people functioning (e.g. vomiting, vertigo, dizziness, nausea, etc.) from those who do not interfere as much (e.g. fatigue, difficulty focusing, sweating, etc.). General clinical implications are also discussed.

Revising the factor structure of the Simulator Sickness Questionnaire

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The Simulator Sickness Questionnaire (SSQ) from Kennedy et al. (1993) is the most commonly used instrument to measure virtual reality induced side effects. The symptoms of the SSQ are supposed to form three factors: nausea, oculomotor and disorientation. However, many items of the SSQ load significantly on more than one factor (e.g., nausea is scored in the Nausea factor and in the Disorientation factor). The validation of the instrument was also performed with military participants, a population that may differ from the general public.

The factor structure of the SSQ was therefore tested in a sample of 371 adults immersed in a variety of VR environments and using different technologies (from inexpensive HMD to CAVE-like systems). Participants were recruited in the general population either for research on anxiety disorders (n = 164 received an official diagnosis of specific phobia or social anxiety) or experiments with "normal controls" (n = 207 screened for the absence of anxiety disorders). The immersions in virtual reality lasted between 5 to 60 minutes. A principal component analysis was performed, followed by a varimax rotation. The number of factor was assessed based on three criteria: eigenvalue higher than one, the scree-plot test and the interpretability of the factor solution (including reducing cross-ladings to the minimum). A probable three factor solution was found, but the number of cross leadings was high (5 items loaded higher than .40 on two factors). The two-factor solution was clear and interpretable. All loadings were larger than .40, with no cross-leadings, and with nine items on Factor 1 and seven on Factor 2. Before any attempt to interpret the factor solutions, both the two-factor and three-factor models were put to the test with structural equation modeling using the AMOS software. The two-factor model fit the data very well, as shown by the following fit indices: GFI = .92, CFI = .91, PCFI = .75, RMSEA = .07 (± .009). The AIC (354 vs 369), BIC (498 vs 536) and CAIC (535 vs 580) indices showed that the two-factor model provided a better fit of the data than the three-factor model.

Our results suggest that, in our sample, the SSQ items belong to two distinct but correlated (.73) factors. The first factor consisted of items 1, 6, 7, 8, 12, 13, 14, 15 and 16 and express nausea, while the second factor was oculomotor and was made of items 2, 3, 4, 5, 9, 10 and 11 from the original SSQ. Participants suffering from an anxiety disorder scored higher on both subscales than those who do not suffer from an anxiety disorder [$F(1, 369) = 30.99$, $p < .001$]. Results of the factor analyses remained similar when the analyses were performed separately for the anxious and non-anxious participants. SEM analyses were not conducted on the two samples because of sample size.

Our results suggest that there may be a simpler factor structure for the SSQ. The oculomotor items may be more relevant to the apparatus used to display the images in VR (resolution and weight of the HMD, image clarity, etc.) while the nausea factor may be more relevant to postural imbalance and tasks performed during the immersion. These results deserve to be replicated in a independent sample and with different populations.

Motion Sickness, Console Video Games, and Head Mounted Displays

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The effectiveness of simulation and virtual environment systems, and their acceptance by users, can be limited if they produce motion sickness [MS]. While theories of MS etiology have typically been based on the concept of sensory conflict, the present study utilized the postural instability theory of MS. This theory claims that postural instability is both necessary and sufficient for the occurrence of MS. In the present study, we sought to test the hypothesis that postural instability will precede MS within the context of commercial console video games. We collected data on body movement prior to the onset of MS, and evaluated nauseogenic properties of commercial console video games when presented through a head-mounted display [HMD] to test the hypothesis that, prior to the onset of subjective symptoms of MS, movement would differ between participants who did and did not eventually became motion sick.

Participants played standard console video games, using an Xbox system (Microsoft Corp.). We varied the participants' posture (Standing vs. Sitting) and the video game (*Whacked* and *Halo*, two popular action/first person shooter games). Participants played for up to 50 minutes, and were asked to discontinue if they experienced any symptoms of MS. Our dependant variables included MS

and movement data. We assessed the incidence of MS, and divided participants into Sick and Well groups based on their explicit verbal statements to a yes/no question about whether they were motion sick. We assessed the severity of MS using the Simulator Sickness Questionnaire, or SSQ (Kennedy, Lane, Berbaum, & Lilienthal, 1993), which were administered both Pre- and Post- experiment. 6-DOF position data were collected from the head and torso with a magnetic tracking system (Fastrak, Polhemus, Inc.) at 40 Hz.

Sickness occurred in all conditions, but was more common during stance. The difference in MS incidence between Standing and Sitting participants reflects the significant effect of posture on susceptibility to MS among users of console video games. While Sitting down brought a reduction in the incidence of sickness, it did not significantly reduce the severity of symptoms. MS measures of seated participants playing *Halo* did not differ from seated participants playing *Whacked*.

As expected there were significant differences in movement data between the Sitting and Standing participants; movement greater in the Standing condition than in the Sitting condition. In addition, during seated play there were significant differences in head movement between Sick and Well participants before the onset of MS. Sick participants moved more in the vertical axis than Well participants. When playing *Halo*, participants who later became motion sick exhibited greater medio-lateral head movement than Sick participants playing *Whacked.*

The results indicate that console video game can induce MS when presented via an HMD, and support the hypothesis that MS is preceded by instability in the control of seated posture. The difference in the variability of vertical head movements between Sick and Well participants in the seated condition is consistent with a central hypothesis of the postural instability theory of MS. These results confirm that postural instability precedes MS, and extends this finding to the seated use of an HMD.

Is there more to cybersickness than simply conflicting information between senses?

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In the context of another study on the impact of distraction on presence in virtual reality, we recruited a sample of 27 participants aged between 18 and 30 years old and randomly assigned them a sequence of three repeated VR immersions using: (a) a low-quality head-mounted display (HMD); (b) a high quality HMD; or (c) an immersive room (CAVE-like system). The low quality HMD was an I-Glass SVGA (resolution of 800 X 600, FoV: 26 degrees) and the high quality HMD was a nVisor SX (resolution of 1280 X 1024; FoV: 60 degrees). The CAVE-like system was a three-wall rear projection system (10 X 10 foot walls). Head tracking for both HMDs was provided by an I-Cube from Intersense. Motion tracking in the immersive room was provided by an IS-900 from Intersense. During each of the three consecutive immersions, participants had to visit a virtual apartment for three minutes, answer few questions and physically change rooms for the following immersion. The Simulator Sickness Questionnaire was completed before and after the experimentation and brief ratings using a 100% Subjective Units of Discomfort Scale were conducted immediately after each immersion.

Based on the sensory conflict theory, we could formulate three hypotheses: (a) cybersickness would be greater in the HMD with the widest field of view; (b) the CAVE-like system would induce more cybersickness than the HMDs, and (c) there should be a progressive increase of cybersickness over the three immersions. Our results did not confirm the third hypothesis. The general 3 times X 3 conditions repeated measures ANOVA revealed a significant time effect [$F(2,48) = 4.89$, $p < .05$], no significant group

effect [F(2,24) = 1.12, *ns*] and a significant interaction effect [F(4,48) = 11.64, $p < .001$]. Interaction contrasts revealed that in both occasions where the low and high quality HMD were used, the symptoms were higher, but not statistically, with the HMD with the largest field of view. The second hypothesis was confirmed, with the CAVE-like system inducing more symptoms if the preceding immersion ($p < .001$) or if the following immersion were conducted using an HMD ($p < .05$). However, changing from a wide field of view HMD to a CAVE-like system induced more symptoms ($p < .01$), as expected, but a statistically significant decrease in symptoms ($p < .05$) is unexpected when further changing to a small field of view HMD. Based on the sensory conflict theory, the frequent changes from one system to another, without time to readapt, should lead to a progressive increase in cybersickness symptoms, even after the immersion in the CAVE-like system.

In conclusion, even if this study was designed with another purpose in mind, it questions the simple relationship between the intensity of virtual reality induced side effects and having to adapt to conflicts among sensory systems. Results are more consistent with factors specific to each VR system. Given the methodological limitations, alternative explanations cannot be ruled out, such as the lack of a completely random assignment or differences in the equipment used.

Perceived Anxiety in a Virtual Grocery Store in Persons with and without Vestibular Dysfunction

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Introduction

People with vestibular disease often experience increased symptoms of dizziness and anxiety in visual environments that have complex textures and motion. The grocery store is one such environment that commonly elicits symptoms in patients. The purpose of this study was to investigate perceived anxiety and simulator sickness in persons with and without vestibular dysfunction as they searched for products in a virtual grocery store.

Methods

Twenty healthy subjects with no evidence of neurological disease (10 female, mean age 59 y, range 37 to 69 y) and 9 patients with unilateral vestibular hypofunction (3 female, mean age 45 y, range 21 to 79 y) participated. A single-aisle virtual grocery store was displayed in a full field-of-view virtual environment (2.4 m high, 2.4 m wide, 1.5 m deep). Subjects were asked to find 2 common cereal boxes placed along the length of a 120 m aisle that also included 30 other types of products. On each of 2 separate visits, subjects navigated down the aisle by: a) standing and pushing forward on a joystick, or b) walking on a custom-made treadmill placed within the environment. On each visit, subjects performed 3 consecutive trials while standing and 3 while walking; the order was counterbalanced across visits. The speed of the treadmill and thus the speed of moving through the store were controlled by the amount of force subjects exerted on an instrumented shopping cart. Perceived anxiety was measured after each trial using the Subjective Units of Discomfort (SUD) scale, in which 0 corresponded to no anxiety and 100 to their worst anxiety. In addition, after each trial, subjects completed the Kennedy Simulator Sickness Questionnaire, in which subjects rated the intensity of 16 symptoms from 0 (none) to 3 (severe). Group differences were examined using the non-parametric Mann-Whitney U test and between-visit or between-trial differences were tested using the non-parametric Friedman test.

Results

Patients had greater SUD scores (range 0-59, mean 21) compared with controls (range 0-23, mean 4) ($p = 0.004$). There were no differences in SUD scores between standing and walking. In addition, there were no differences in SUD scores between visits or between trials. Patients also had a greater number of symptoms reported on the SSQ than controls ($p=0.003$). On average, patients reported having 3 to 4 symptoms (out of 16) on the SSQ that were rated at 1 or above (range

0 to 12 symptoms). Control subjects reported between 0 and 1 symptom on average (range 0 to 3 symptoms). There was no systematic increase or decrease in SSQ symptoms from Trial 1 to 6 in patients or controls.

Discussion/Conclusion
Subjects with and without vestibular abnormalities were able to complete all trials when navigating through a virtual grocery store. Patients began with higher SUD and SSQ scores, which remained relatively stable over the 6 trials, suggesting that subjects in both groups tolerated exposure to the virtual grocery store. This finding suggests that studies of the use of a virtual grocery store for rehabilitation of persons with vestibular disorders are warranted.

Description of a multicomponent program including Virtual reality for the treatment of fibromyalgia

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Fibromyalgia syndrome (FMS) is a chronic condition characterized by widespread musculoskeletal pain that affects 2% of the population, mostly women. Patients suffering FMS complaint about generalized and disturbing pain in several parts of the body. Other symptoms include sleep problems, depression, and anxiety. The features of this disorder provoke an important degree of impairment and distress. Although several interventions are being used in the management of FMS, the response to treatment is still far from satisfactory. However, psychological aspects play an important role in the understanding of acute and chronic pain. Melzack's theory (Melzack & Wall, 1965) inaugurated a multidimensional conceptualization of pain including biological, psychological and social aspects. In the last years, psychological techniques have been incorporated for the treatment of chronic pain. Multicomponent and multidisciplinary treatment is showing promising efficacy data in the treatment of chronic pain syndromes like fibromyalgia (i.e. Nelson & Jensen, 2004; Turk, Okifuji, Sinclair & Starz, 1998). These programs include several intervention components such as medication, exercise, relaxation, psychoeducation, cognitive therapy, problem solving and coping skills.

Virtual reality (VR) is demonstrating to be effective in the treatment of acute pain associated with medical procedures like wound care and physical therapy in burn patients, or port access in cancer patients (see Wismeijer & Vingerhoets, 2005 for a review). VR is a powerful distractor because it involves multiple sensory modalities, active emotional involvement and active participation of the user. These could be the features that explain the efficacy of VR for pain control. Up to now there are no VR applications for the treatment of chronic pain. We present the first treatment program that includes VR for the treatment of FMS. Our aim is to improve the treatment of chronic pain by including VR as a tool in a multicomponent program for the treatment of FMS. VR can help to enhance the involvement of the patient in some techniques like relaxation or cognitive therapy. In this work we describe our assessment and treatment protocol and present preliminary efficacy data of a pilot study we are currently carrying out.

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Analgesic effects of opioids and immersive virtual reality distraction: Evidence from subjective and functional brain imaging assessments

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Background: Immersive virtual reality (VR) is a novel form of distraction analgesia, yet its effects on pain-related brain activity when used adjunctively with opioid analgesics are unknown. We used subjective pain ratings and functional magnetic resonance imaging (fMRI) to measure pain and pain-related brain activity in subjects receiving opioid and/or VR distraction.

Methods: Healthy subjects (n = 9) received thermal pain stimulation and were exposed to four intervention conditions in a within-subjects design: (a) control (no analgesia), (b) opioid administration (hydromorphone [4 ng/ml plasma level]), (c) immersive VR distraction, and (d) combined opioid + VR. Outcomes included subjective pain reports (0-10 labeled graphic rating scales) and blood oxygen level dependent (BOLD) assessments of brain activity in five specific, pain-related regions of interest (ROIs).

Results: Opioid or VR alone each reduced subjective pain ratings and pain-related brain activity in some, but not all ROIs. Combined opioid + VR reduced pain reports more effectively than did opioid alone. Patterns of pain-related BOLD activity were consistent with subjective analgesic reports.

Conclusions: These subjective pain report and objective fMRI results demonstrate converging evidence for the analgesic efficacy of opioid administration alone and VR distraction alone. Furthermore, patterns of pain-related brain activity support the significant subjective analgesic effects of VR distraction when used as an adjunct to opioid analgesia. These results provide preliminary data to support the clinical use of multimodal (e.g., combined pharmacologic and non-pharmacologic) analgesics.

CyberTherapy: Developments in Mexico

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Objective: Virtual reality (VR) based therapies have been focused on treating behavioral, anxiety and stress related symptoms. Recently, VR has also been used to reduce pain or discomfort during simple medical procedures such as: intravenous cannulation in pediatric patients, wound dressing, and teeth extractions in dentistry, but use of VR in invasive procedures for pain distraction has not been documented. We present preliminary clinical results in 11 medical procedures with the purpose of reducing distress and pain.

Methodology: Between October 2004 and February 2007, 5 Public Health Hospitals in Mexico City participated with VR scenarios displayed on a Head Mounted Display HMD

on their patients with various invasive procedures. The 5 virtual reality scenarios displayed on the Head Mounted Display included, Cliff-FINAL, Dream Castle, EM-Runtime, Enchanted Forest and South Pole Fantasy. Overall 302 participants ranging from 2 days of life to 70 years of age, male and female, divided into 11 groups, participated in the study. General patient inclusion criteria was conscious, normal vision, free airway, no intravenous or depressive medication, full-integrity arms and hands, and absence of cardiovascular or homodynamic disorders.

Results and Conclusions: A total of 302 patients participated in the following procedural areas: upper gastrointestinal endoscope, infectious surgery, Colonoscopy, labor and delivery, cesarean surgery, neonatology critical care unit (CUC), post surgical care, CUC of heart, kidney transplant CUC, epidural block and ambulatory surgery. The decrease in the distress levels was evaluated. The distress was found to be different in each group, the three best groups were with lowest distress were: Post surgical critical care unit of heart, colonoscopy, and ambulatory surgery. The success depends on disease, sex, age and anatomical region manipulated during the procedure. CyberTherapy is for patients who accept and can concentrate during hospitalization or manipulation in medical or surgical procedures. We demonstrate the usefulness of CyberTherapy in the majority of applications to reduce distress; also we can estimate the absolute and relative indications to suggest VR scenarios.

Virtual Reality for Acute and Chronic Pain Management

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Due to the significant role of attention in pain sensation, distraction is often an effective pain management technique. Studies have found that the more immersive and interactive the distraction, the more relief the patient experiences. In virtual reality environments, the distracting image is provided for the patient in a realistic, immersive manner. This advanced technology allows users to interact with the virtual environment at many levels, using multiple senses, and encourages them to become immersed in the virtual world they are experiencing. When immersion is high, much of the user's attention is focused on the virtual environment, leaving little attention left to focus on other things such as pain.

Recent studies have shown the effectiveness of VR for the management of both chronic and acute pain. Utilizing software developed with funding from the National Institute on Drug Abuse, the Virtual Reality Medical Center, Virtual Reality Medical Institute, Interactive Media Institute, Interactive Media Institute-Europe and colleagues around the world have examined the viability of using VR for: reducing pain during dental procedures, managing surgical pain (both during surgery and in recovery), alleviating labor pain, decreasing pain in those with fibromyalgia and migraine, managing pain after injury, and reducing ischemic pain. An overview of study results will be presented.

Physiology During Anxiety-Provoking VR Simulations

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Anxiety is often accompanied by changes in breathing, heart rate, and skin conductance. Virtual reality (VR) simulations designed to provoke anxiety typically find changes in skin conductance, but have not consistently found changes in heart rate. Some researchers have speculated that this may be because most VR simulations do not allow the subject to make large motor movements as in a fight or flight response. If this is true, it calls into question the assumption that virtual reality simulations for anxiety research are effectively mimicking real life at a physiological level.

In an attempt to investigate this discrepancy further, data was analyzed from four anxiety-provoking simulations that allowed the sub-

ject to navigate freely for all but a brief period of time when they were forced to view the simulation at its most dramatic point for about 10 seconds before escaping. One simulation involved a Rottweiler dog inside an abandoned house; the dog could be triggered to break down a fence and threaten or attack the subject. A second simulation involved a panhandler/mugger in a subway station without other people; the mugger could be triggered to follow, verbally threaten and then pull a gun on the subject while demanding money. A third simulation involved a rattlesnake in the garage of a house; the snake could be triggered to rattle its tail loudly and then strike at the face of the subject. A fourth simulation involved a hit and run of a pedestrian attempting to cross an urban street in plain view of other people; the pedestrian ended up laying in a pool of blood on the street as the car sped away. For each simulation the subject was allowed to navigate freely throughout the virtual world for several minutes until they were locked in place for a brief period of about 10 seconds and forced to view the most anxiety-provoking part of the simulation.

Twenty-four subjects were tested, and data on 17 has been analyzed so far. Subjective ratings of anxiety on a 0-100 scale were obtained before, during and after each simulation. Physiological data for heart beat, respiration, skin conductance and skin temperature was recorded continuously by a Biopac MP100 system with AcqKnowledge analysis software. Mean subjective ratings of anxiety level before the simulations were 15 and increased to 41 within 30 seconds after the simulations, so subjects reported experiencing anxiety. However, there was no consistent trend for heart rate, respiration or skin temperature across the data set, with some subjects showing increases, others decreases, and still others little change at all. Only skin conductance showed a clear and consistent change across nearly all subjects with an average maximal increase of 14.4% in the 30 seconds post-stimulus compared to a 30 second pre-stimulus period. Therefore, the preliminary data from this study agrees with the hypothesis that VR simulations which do not allow significant motor movements involving a fight or flight response may not accurately mimic the physiology of real-life anxiety responses.

Visual attention during virtual social situations depends on social anxiety

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Theories of anxiety propose that phobics involuntarily allocate their attention towards and thereupon draw their attention away from threatening stimuli. Therefore, in the current research attention on and avoidance of social cues in virtual fear-relevant situations were investigated. More specifically, open visual attention was assessed by means of EOG-based eye-tracking combined with head tracking while participants viewed virtual persons with different facial expressions (happy or angry) in a free viewing virtual elevator condition. Overall, 26 female students participated in the study. Actual anxiety was induced in half of the participants by the announcement that after leaving the virtual elevator they have to give a talk. Habitual social anxiety was assessed by questionnaires. Participants initially attended more to happy than angry virtual persons, and especially participants that had to give a talk afterwards sustained to attend to the happy virtual persons but to avoid angry ones for several seconds. Correlational analyses revealed that higher social anxiety is related to initial avoidance of happy and even stronger of angry virtual persons. Thus, higher socially anxious participants seem to initially avoid (angry) facial expressions. These results are in line with the assumption that faces are especially meaningful for socially anxious people, but contradict findings of initial hypervigilance toward threatening stimuli. This might rely on methodical differences between studies. Additionally, virtual social situations seem especially suitable to measure overt attention in an ecologically valid environment.

Virtual Reality for the application of psychological treatments in children: darkness phobia

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One of the most frequent phobias in children is darkness phobia. The prevalence of this disorder in children is around 2.3%. This problem may cause an important impairment in the child's life, affecting academic, family and social functioning. With regard to treatment, CBT (combining exposure and coping skills designed for the child to cope with the fear) offers positive efficacy results (i.e. Kanfer et al., 1975; Graciano & Money, 1980; Silverman et al., 1999). Several studies have tested the efficacy of these techniques (Orgiles, et al., 2002). These programs use stories and games (i.e. Mikulas & Coffman, 1989), or adaptations of systematic desensitization, like emotive imagery (Lazarus & Abramovitz, 1979). In the emotive imagery procedure the relaxation as inhibitory response to anxiety is substituted by a story that evokes positive emotions (happiness, feeling proud, etc.). Following Lazarus & Abramovitz (1979), Mendez (1986) developed the program "emotive dramatization" that includes several components: gradual in vivo exposure to the phobic stimuli, modelling of brave behaviors, and reinforcement. This program has demonstrated to be effective, showing better results than the Mikulas & Coffman program (Mendez, 2004).

On the other hand, in the last years new therapeutic procedures using Virtual Reality (VR) have been developed and tested. There are already an important number of studies supporting the efficacy of VR for the treatment of psychological problems (Botella et al., 2007). However, there are very few studies testing the efficacy of VR in children. Some studies have used VR for pain control in samples that included children (Das, et al., 2005; Hoffman et al., 2000), and some studies have used VR in paediatric oncology patients (Gershon et al., 2004; Wolitzky et al., 2005). We think that VR can be a useful tool for the treatment of phobias in children. VR offers a protected environment where the child can be exposed to the phobic stimuli gradually. Besides, VR is an attractive tool that can help to reduce the aversiveness that exposure entails. VR is also a versatile technology that can be incorporated in the already existing treatment programs to enhance their effectiveness and the child's motivation to be involved in therapy.

The purpose of this work fits the aim of Cybertherapy 2007: t*ransforming healthcare through technology*. We present the first case study using VR to enhance emotive dramatization for the treatment of darkness phobia in children. We used an adaptive display: EMMA's World, software developed in the EU Project: "Engaging media for mental health applications" (IST-2001-39192-EMMA). Finally, we discuss the utility of new technologies for improving the treatment of psychological treatments in children.

Development and pilot study of a VR system to assess criteria of patients with checking symptom of obsessive compulsive disorder

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Background/Problem

Obsessive-compulsive disorder (OCD) is a common psychiatric disorder, and chronic

disability from it incurs high costs for patients, their families, and communities. Virtual reality (VR) is a useful tool for psychiatric disorders, for example phobias, schizophrenia, and autism. There are some reasons why we apply VR to patients with OCD. First, OCD involves primarily high-level brain functions, and therefore some of its symptoms may be manifested only in an ecologically valid environment with a strong sense of presence. Second, by replacing the traditional "boring" test procedure with a "fun" game in a virtual environment, we may be able to overcome the low motivation and lack of concentration exhibited by patients with OCD. The authors' goal was to test the possibility of research of OCD by using virtual reality technology to build complex, multimodal environments. We would like to focus on parameters related to the checking symptom within the various OCD symptoms.

Method/Tools

Performance on a novel, virtual reality (VR) assessment of characteristics was investigated in 32 patients with obsessive compulsive disorder and 20 matched healthy controls. The virtual environment was designed to induce checking impulse, and subjects were measured for response time, behavioral response (object operation, gazing, and trajectory) and checking urge. The virtual environment consisted of 2 spaces: a house (with a gas burner, a gas valve, a water tap, a window, a light switch, a door, and a lock to a gate) and an office (with a heater, a computer, a cabinet, a light switch, a door, and a lock to a gate). After a learning phase and distracting phase, participants were given a mission to check whole things in the environment. The virtual reality assessment was administrated with validated measurement tools of the OCD patient (Y-BUCS: Yale-Brown Obsessive-Compulsive Scale; GAF: the Grobal Assessment of Functioning, MOCL: Maudsley Obsessive-Compulsive Inventory; and WHO-QOL: The World Health Organization Quality of Life-Brief).

Results/Conclusion

The VR parameter can measure the quantitative aspects of behavior of OCD patients. According to the analyzed results, there was no significant difference in basic mission success percentage between OCD patients and matched healthy controls (age, gender, education, VR experience and intelligence matched controls). But there was significant difference in checking time, number of over-operation, gazing time during checking phase and pre-post anxiety difference between OCD patients and matched healthy controls.

The relationship between VR parameters and established OCD measurement tools were assessed using Pearson's correlation. Gazing time during checking phase was correlated with Y-BUCS score (0.425, correlation is significant at the .05 level) and GAF score (-0.434, correlation is significant at the .05 level). Number of over-operation was correlated with GAF score (-.389, correlation is significant at the .05 level). Checking time was correlated with Y-BUCS score (.395, correlation is significant at the .05 level). And there was no significant correlation between VR scores and another measurement tools (MOCL, QOL).

Novelty/Discussion

To our knowledge, this is first study to utilize the technology afforded by VR to provide a more objective assessment of characteristics in patients with OCD. The measured VR parameters were correlated with established OCD measurement tools. Based on these results, we could attempt the new assessment system of OCD using virtual reality technology.

Using Video, Vikings and Teddy-bears to Reduce Anxiety

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This study was initially motivated by the perceived need to provide effective anxiety-reducing activities to long-term patients at the Brisbane Royal Children's Hospital. The ComeRideWithMe project (Newman, 2005) conducted in 2002 used text-based online communication environments to present narratives while also allowing an effective feedback loop for the patients to engage with the fictitious characters. This earlier study gave rise to the question of whether it was possible to sustain similar levels of engagement with video-based communication environments. In the transition to a video-based en-

vironment, however, problems occur with the immediacy of story generation, the intervals between episodes, and the question of whether video can impede narrative engagement by being *too literal* for imaginative play. This paper describes the experimental project *Albert in the Land of the Vikings* in which questions of engagement, in a video-based communication environment were investigated. In this project a test group of subjects were invited to follow the adventures of Albert the motorbike-riding, film-making teddy-bear as he travelled around the UK and Scandanavia making stories about Vikings. Measurement of engagement was done by analysis of server statistics and qualitative evaluation of subjects' interactions with Albert. Video production techniques were developed to support the low-budget, rapid-development model required for this project. The findings led the researchers to conclude that video-based communication environments can be used to provide suitable and effective anxiety-reducing activities.

Using Virtual Reality to Test Educational Strategies for Genomic Concepts

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In order for the advances of the Human Genome Project to be translated into tangible improvements in health outcomes, research is needed to determine how best to communicate abstract scientific concepts to lay individuals. Medical and public health professionals need to communicate genetic susceptibility information in an understandable and usable way so that individuals can benefit from the information. However, existing research provides little guidance for the development of effective educational strategies for genomic concepts, and research comparing different educational strategies can be challenging in community or clinic-based settings due to uncontrolled variation in factors within those settings. Virtual reality provides an ideal laboratory setting in which to test different ways of educating lay individuals about concepts related to genetics and genomics in an innovative approach to health communication research. Investigating these issues in a virtual environment affords the combination of experimental control and mundane realism that allows for meaningful comparison of different educational strategies and holds presentation medium constant across educational strategies. The focus of this study is education about one particular genomic concept, the idea that genetic and environmental factors interact to affect risk of common disease.

The primary objective of this study is to examine the effects of pedagogical modality (i.e., learning mode) on conceptual understanding using immersive virtual environments (IVEs). The experimental comparison is between an *active learning* (i.e., self-driven, interactive activities) condition and a *passive learning* (i.e., didactic lecture) condition to assess the effects of learning mode on comprehension. We have hypothesized that the active learning condition will be more effective in increasing comprehension. The study will also examine possible moderators and mediators of the hypothesized relationship between learning mode and comprehension.

We have developed two active learning IVEs and two passive learning IVEs. The IVEs use one of two metaphors to convey the concept of how gene-environment interactions affect risk of common disease: a "risk elevator," in which movement in a virtual elevator represents changes in levels of disease risk, or a "bridge," in which likelihood of crossing a virtual bridge without falling represents different disease risk levels. The active learning IVEs involve game-like tasks, while the passive learning IVEs present the information in virtual lectures. We are pilot testing the IVEs with 40 participants who are healthy, English-speaking, adult volunteers with no specialized genetics knowledge. Primary dependent variables include measures of recall and transfer (i.e., applying content to new situations). We will present pilot data on which learning mode is most effective in increasing recall and transfer, and will also discuss the effectiveness of the two metaphors in conveying the genomic concept of interest.

This study illustrates an innovative use of virtual reality technology in health communication research to test ways to educate the lay public about genomic concepts. The implications of the results for patient education about abstract scientific concepts in other areas of health will also be discussed.

Science Learning by Blind Children through Audio-Based Interactive Software

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Most children have difficulties learning science, no matter their origin. The situation of children with special needs is poorer, since they have many difficulties accessing information and also because science learning methods are designed to be achieved using mainly visual channels. A growing line of research on designing educational software for children with visual disabilities is using audio as the chief sensory channel to assist the construction of knowledge and meaning making. Although there are some software titles to support the development of mathematics learning and problem-solving skills with significant gain for blind children, no relevant work using audio-based science software to enhance science learning in blind children has been described in the literature.

In this research we evaluated the impact of *AudioLink*, interactive audio-based multimedia software for children with visual disabilities, on science learning. The main purpose of the full-field study was to answer questions such as: Can we develop scientific method thinking in blind children through audio-based multimedia software? Does this type of software assist in the learning of scientific content? We also expected this software to enhance cognitive skills both analytical (classify, relate, analyze and compare) and critical (evaluate, discern). We present the main results obtained when using this software in a field study during a six-month period, combined with the utilization of concrete materials and cognitive tasks. The research was experimental and exploratory, using a pretest-posttest design and the *Wechsler Intelligence Scale for Children-Revised* (WISC-R), to determine the impact of using the software.

As a result of this study, children were able to learn and practice scientific method processes, and had fun when learning new topics (or reviewing already learned ones). They were able to widen their theoretical conceptualizations and enhance their acoustic perception. There were manifest physics learning gains, even though the sample was comprised of very young students. Analytical cognitive skills were enhanced over 15% (and more) between pre and post-test measures in some of the children. There were some cases were the posttest measures doubled or tripled the achievement level in the posttest. Children were also able to map, use and understand a game with a complex dynamic and interaction, and solved complicated science problems.

Considering the results of this study we can confidently establish that the use of *AudioLink* promotes scientific content learning (particularly Physics), and also enhances problem-solving skills through experimentation conveyed through the application of the scientific method. These results validate this software as an attractive, challenging and effective way to learn science content and to develop science related skills. This provides enough information to use *AudioLink* to close the gap in science learning opportunities between sighted and blind children.

Technology-enabled Conflict Negotiation

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Despite sporadic attempts to revitalize the peace process, the attitudes of both sides in the Middle East conflict do not seem to have changed in any dramatic way. Feelings of mistrust, hate and radicalization are common within both populations. The present social action research is directed towards the development of an intervention paradigm for supporting shifts in attitudes among Jewish and Arab youth. Specifically, this study aims to shift attitudes of Jewish and Arab youth towards more positive views of each other via interactions that take place during a collaborative narration task. The study is based on conflict resolution theory which hypothesizes that youth, who are perceived as enemies in a stereotypical manner, may achieve a greater understanding of and appreciation for the other's viewpoint under conditions that support a joint task, shared narration and role changing.

We have programmed MERL's DiamondTouch (DT) together with customized software to "enforce" collaboration during a narrative task. The DT is a multi-user touchable interface that detects multiple simultaneous touches by two to four users. Each user sits or stands on a receiver (a thin pad) such that touching the table surface activates an array of antennas embedded in its surface (capacitive touch detection). The Narrative Negotiation Table (NRT) is based on the StoryTable (ST) (developed previously by the Italian members of our team) an interface based on the DT technology which enforces collaboration between children while telling a story. The device is multimodal in character, providing visual stimuli, responding to touch commands, and enabling the recording of narratives. NRT supports single or multiple users, including successive or in-tandem actions such as simultaneous touch commands and multi-user drag-and-drop acts.

Story-telling partners (Jewish-Arab pairs of youth aged 15-16 years) work in tandem to create and record a shared story for three hypothetical audiences -- Jewish, Arab, and a third party who is not involved in the conflict. The pairs jointly prepare and tell a story, each in their own language (supported by simultaneous translation to English to ensure that both partners fully understand the story). Collaboration is enforced by means of programmed functions which require both partners to jointly activate the DT. Intervention by a moderator during the story-telling sessions is provided in accordance with the different phases of conflict escalation and conflict resolution theory. The entire session is videotaped and participant behaviors are coded such that all verbal interactions (negotiations and the stories themselves) are transcribed for subsequent analysis.

To date we have completed several pilot studies using a low-technology version of the paradigm. We anticipate that the use of the enforced collaboration together with conflict resolution-based intervention during the shared narrative task will positively affect the attitudes of the Jewish and Arab youth towards each other. (Work in progress.)

The Change of Implicit Attitude after Exposure to a Sexual Violence Computer Game

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Self-reported attitudes toward socially controversial objects could be deceiving. Attitudes supporting sexual violence that predict sexual offenses or coercive acts could also be concealed by the tendency to be socially desirable. In this respect, to predict recidivism exactly in correctional institutes, an indirect measure, which cannot be manipulated, of attitudes on sexual violence (ASV) would be needed. Thus, this study created Sexual Violence Implicit Association Test (SV-IAT), modified from the original IAT (Greenwald et al., 1998), to measure ASV indirectly, and then examined a relation between implicit and explicit ASV (measured on Rape Myth Scale: RMS) in order to find a feasibility of the use of indirect measure of ASV in correctional settings. In addition, considering the changeability of implicit attitude depending on a context (Foroni & Mayr, 2005), we tested the changeability of implicit ASV after an exposure to the video clip extracted from a commercial sexual violence 3D game.

In experiment 1, among 80 male college student respondents on RMS, those above 25th and below 75th percentile on RMS score were selected, then 30 participants (15 higher and 15 lower) were recruited. And then, they engaged SV-IAT individually.

In experiment 2, 30 new voluntary male participants, in the same university, engaged in the same SV-IAT task twice, one week before and immediately after the exposure to one of the two video clips (fifteen people viewed a control video clip and the others viewed a 3D computer game clip, shown a rape scene but not genitals, and both clips were shown via HMD for 9 minutes), and to reduce difference of familiarity with IAT between the two tasks, initially did another IAT task, irrelevant to this study. After engaging in the second SV-IAT, participants were asked to respond to RMS again. SV-IAT consisted of a total of 24 sexual behaviors, sexual crime, 'unilateral', and 'bilateral'-related words. The magnitude of implicit attitude supporting sexual violence was measured by subtracting the latency to respond association between sexual violence and bi-directional words from the latency to respond association between sexual violence and one-directional words.

From the t-test of between-group difference on IAT scores in experiment 1, the higher RMS group showed less negative implicit ASV than the lower group. In experiment2, a repeated measures ANOVA revealed reduced negative implicit ASV after viewing the rape video clip; however, there was no effect from control video clip. In addition, both video clips did not affect explicit ASV.

These results suggest that implicit ASV correlates to explicit ASV, and, in contrast to explicit ASV, implicit ASV can be modified by a specific condition. To generalize the correlation, this comparison between implicit and explicit attitude should be applied to sexual offenders who were eager to show good impression, and it would be helpful to compare the magnitude of implicit ASV change with other recidivism risk assessments in correctional settings. It's the first study to measure attitude on sexual violence indirectly using IAT paradigm; furthermore, this study suggests a sexually violent computer game also affects processing of sexually violent information.

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The Efficacy of Virtual Immersive Scenarios in Cardio Pulmonary Resuscitation Training. Measuring Reality – Is Seeing Believing?

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3D Virtual Immersive Scenarios (VIS) are being widely employed across task based training as a technology to improve task investment by emulating greater reality than traditional text based or 2D screen based platforms. Whilst previous studies have not indicated any significant improvement in overall performance, there are indications that the efficacy of 3D Virtual Immersive Scenarios lies in the participant interaction with the environment.

There are indications that participants are desensitized, in varying degrees, to the multiple stressors or a real life situation replicated in the Virtual Immersive Scenario. Wiederhold 2006 describes this phenomenon as "Stress Inoculation"

This paper discusses the use of more ecological 3D Virtual Immersive Scenarios in layperson Cardio Pulmonary Resuscitation at basic life support level under ILCOR 2001 guidelines and the "best approach" to measuring efficacy. The validity of measuring the efficacy of any virtual environment can only be as good as the subjective experience of the participants. Results show a dichotomy in relating an objective measurement to a subjective experience. This is highlighted

when video footage of participant interaction with the Virtual Immersive Scenario is compared to paper based questionnaires of the experience.

A feasibility study for the use of a multiplayer virtual reality game to enhance "talented" individuals' organizational cohesion

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In this paper, we present some first results from an ongoing project for the investigation of the usage of commercial or custom multiplayer virtual reality scenarios that could enhance and empower the "talented" individuals' organizational cohesion. The target organization for this project is the private health organization in the city of Kozani, Greece, which has more than 29, previously assessed, "charismatic" or "talented" workers at high-ranked positions in 8 different departments like the IT department, the Emergency Medicine department, and the Surgery and the Chronic care department. Increasingly, talented and highly qualified individuals in this organization do select roles based on how much 'flow' they can achieve at work. Flow is achieved by designing jobs around signature strengths or choosing employees whose strengths present a good fit for the role. First the researchers collected data using the Sense of Coherence (SOC) concept by Antonesky (1987) for handling the demands of life and their performance in a standard "emergency incident drill" that involved all the talented individuals' roles from all departments. We then introduced to the workers a very recent multiplayer game called, Battlestations: Midleway multiplayer by Eidos, which puts the player in many different perspectives, playing as a pilot, a gunner, a submarine captain or even a carrier fleet commander. The rational for this study was that the introduction of the "virtual reality game", would act as a mediator between the Sense of Coherence of the talented individuals and their generalized resistance resources (GRR's), which are the resources they have at their disposal for handling the demands of some emergencies and stressful events. The pilot experimental design included a session in the game for all the individual workers in all of the games perspectives for a maximum of 8 simultaneous players per game. At the end of all the game interactions the researchers assessed the SOC again. In addition we collected another performance measure using a different "emergency incident drill" which involved again all of the talented workers in this health organization. As a result, conclusions were drawn regarding the possible integration of this game in the organization cohesion research portfolio and also some interesting remarks were made regarding the implications that such an approach might have on a more positive realization of the ongoing "war for talents".

Stress Inoculation Training's Effectiveness on Combat First Responder Students

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"Stress Inoculation [or "exposure," "hardening," "habituation"] Training (SIT)" is designed to mitigate the potential negative effects of stressors in healthy individuals. As a cognitive-behavioral therapy technique, SIT is applied in a gradual, controlled, monitored, and repeated manner with the goal of desensitizing individuals to stimuli. A priori simulated exposure can help prevent a fight/flight/freeze stress-response, allowing individuals to accomplish tasks at hand. In our study, Soldiers (e.g., Flight Medics, Rangers) navi-

gate through virtual reality (VR) applied to SIT ("VR-SIT") while performing tasks (e.g., putting a tourniquet on a casualty) in a stressful, but controlled, simulated combat casualty environment. Participants receive feedback on their psychological, physiological, and biochemical stress levels and practice coping strategies (i.e., combat breathing). We predict that this approach will not only improve Soldiers' performance on real tasks, but also increase their stress resilience and hopefully prevent chronic psychological decompensation (e.g., post-traumatic stress disorder). Study results will be discussed during the presentation.

A Virtual Human Agent for Training Clinical Interviewing Skills to Novice Therapists

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Virtual Reality is rapidly evolving into a pragmatically usable technology for mental health (MH) applications. As the underlying enabling technologies continue to evolve and allow us to design useful and usable "structural" clinical virtual environments, the next important challenge will involve "populating" these environments with virtual representations of humans. Over the last five years, the technology for creating virtual humans (VHs) has evolved to the point where they are no longer regarded as simple props to be strategically "peppered" in VEs, but rather can serve a functional interactional role. This will be vital to create MH training tools that leverage the use of VHs for applications that require human-to-human interaction and communication. This would open up possibilities for clinical applications that address interviewing skills, diagnostic assessment and therapy training. Early efforts in this area have produced virtual patients for medical examination training (Lok et al., 2005). In this application, instead of using the costly and labor intensive approach of hiring professional patients for novice medical students to practice on, they constructed a VE to represent an examination room where a virtual patient could be interviewed verbally using *Dragon Naturally Speaking*. The goal in this application was to determine, via clinical interview, whether the virtual patient's ailment was due to appendicitis.

The USC Institute for Creative Technologies has been conducting similar virtual human research as part of its primary mission over the last seven years to create artificially intelligent VHs or "agents" to be used for VR military leadership and negotiation training. This VH effort built on prior work in the areas of embodied conversational agents and animated pedagogical agents, but integrates a broader set of capabilities than any prior work. For the types of training scenarios we are targeting, the VHs must integrate three broad influences on their behavior: they must perceive and act in a 3D virtual world, they must engage in face-to-face spoken dialogues with people and other virtual humans in such worlds, and they must exhibit human-like emotions. Classic work on virtual humans in the computer graphics community focused on perception and action in 3D worlds, but largely ignored dialogue and emotions.

Our current project involves the construction of a natural language-capable virtual human agent, named "Justin" who was morphed from a military negotiation training tool into a virtual therapy patient for training novice clinicians the art of clinical interviewing with a resistant client. Justin portrays a 16-year old male with a conduct disorder who is being forced to participate in therapy by his family. The system uses a sophisticated natural language interface that allows novice clinicians to practice asking interview questions in an effort to create a positive therapeutic alliance with this very challenging virtual client. We will present initial user data from a sample of psychiatric residents and psychology graduate students that is ongoing as part of our iterative design process and outline our long term vision—that of creating a comprehensive DSM diagnostic trainer having virtual humans that are modeled after each diagnostic category.

Game and Gamer Characteristics: Implications for Training

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Recent technological advances in the videogaming world have been leveraged for training purposes. There are a variety of arguments for the adoption of videogame-based training tools. Among these is the potential to capitalize on the motivational draw of game play. With training games, the learner may be engaged, but is the learner actually learning or just playing? Some research has demonstrated knowledge acquisition and transfer of the skills learned in the game to real-world tasks. However, the research on videogame-based training is not all positive, with a fair share of research showing that instructional games do not always lead to the desired instructional gains. Given the increasing popularity of using videogames for instructional purposes, we and others have sought to identify factors that maximize the effectiveness of this instructional medium. In short, how can a training game be created that is both engaging and an effective instructional tool for learners?

As with any training system, two critical factors that impact the training effectiveness of PC-based training games are: a) the training program and its design characteristics and b) the learner (in terms of personal characteristics and attitudes). Accordingly, the purpose of this presentation is to review theoretical and empirical research concerning these two factors and to offer suggestions of how game-based training systems can be better implemented and utilized to enhance learning outcomes. Specifically, we will discuss key pedagogical or instructional design decisions made by game designers and organizational trainers during training design/delivery, as well as trainee personal characteristics, that contribute to the effectiveness of game-based training environments.

Game Characteristics
As technology advances, the number and types of platforms training designers have to select from is growing rapidly, and some may be overly concerned with making a game visually appealing and engaging to learners, without placing equal emphasis on determining how to ensure that the game is effectively teaching the intended training objectives. Some researchers hypothesize that games are instructive because they engage the learner, leading to skill acquisition and retention. We suggest that trainers and game developers need to better understand how to incorporate gaming into training to provide engaging training games which are also pedagogically sound.

Learner Characteristics
Little prior research has examined individual characteristics of the learner that may facilitate or impede training motivation and learning in game-based training environments. We argue that it's important to factor in certain characteristics of the intended group of learners. For instance, in a series of research studies, we found that many Soldiers have limited or no videogame experience. Additionally, our research demonstrated that amount and type of prior gaming experience was predictive of several learning outcomes, including performance, time on task, motivation, and training satisfaction. We also have found support for the impact of learners' self-efficacy and goal orientation on various learning outcomes.

In this talk, we will present a set of game characteristics and learner characteristics, which based on empirical research appear to influence the effectiveness of instructional videogames within the context of specific learning objectives.

The Practice of Medical Simulation: Education, Research, and Technology

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Simulation for medical training shares many of the same goals and requirements as cybertherapy. Virtual reality is used to create synthetic reproductions of actual situations. The intensity of the experience can be controlled. Both applications aim to change individual behavior through repeated exposure. Opportunities exist for cross-fertilization. In this talk, the current state-of-the-art in medical simulation is presented. Developments in technology and in their application to medical education are highlighted. Recent trends toward training in teams will be discussed. Recent work at the National Capital Area Medical Simulation Center in constructing a 1,000 sq. ft. immersive virtual environment also will be presented.

Pulse!!: Researching high-level medical learning in virtual space

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Entertainment has been the main use of virtual reality, but virtual training in various formats also has been explored. In the academy, there has been incidental development of human-simulation trainers anchored to computer-assisted case presentations for surgeons, U.S. Army combat medics. The military originally developed the state-of-the-art *America's Army* online war game for recruitment, using the "first-person shooter" game genre, but the game also has become a training platform. A U.S. Military Academy study (Farrell et al, 2003) showed that cadets trained in map reading and land navigation using a modified version of "America's Army" performed significantly better than cadets who were not.

Issenberg et al (2005) conclude "that high-fidelity medical simulations facilitate medical learning under the right conditions." This first comprehensive review of 34 years of research on the efficacy of simulation in medical training found that "high-fidelity medical simulations are educationally effective and simulation-based education complements education in patient care settings." The "right conditions" noted by Issenberg ratify the underlying principles of Pulse!! The Virtual Clinical Learning Lab, including immediate feedback, repetitive practice, controlled environment, individualized learning, defined outcomes and educational validity.

Watters et al. (2006) propose that substantial learning occurs through what has become standard entertainment-game architecture, including instantaneous feedback, a rising scaffold of challenges, visible goal indicators, personalization and customization, fluidity and contextual grounding. Watters and Duffy (2004) proposed "a framework of motivational constructs" found in games that are applicable in developing interactive health-related software: self-regulation, or autonomy; relatedness, which includes role-playing, narrative and personalization; and competency, or self-efficacy built upon completion of meaningful tasks.

Reznick and MacRae (2006) observe that well-established learning theory (Fitts & Posner, 1967), as it applies to surgical training, ratifies the use of simulators in the acquisition of motor skills through three stages – cognitive, integrative and autonomous. Ericsson (1997) applies a thicker description directly to surgical training with the concept of "deliberate practice," defined as "repeated practice along with coaching and immediate feedback on performance." Simulation and virtual reality appear to be options for medical learning as rare opportunities for deliberate practice become more so. Reznick and MacRae note: "A Food and Drug Administration panel recently recommended the use of virtual reality simulation as an integral component of a training package for carotid artery stenting."

The Pulse!! research project is designed to transfer and further develop state-of-the-art game design and technology to create subject matter for clinical medical learning in virtual reality. The project will develop case-editing tools associated with environment-

generating capabilities for problem-based medical cases created from a patient-attribute catalogue that replicates the real world by offering the same fluid learning experiences in asynchronous virtual space. The cases will be evaluated to ascertain which ones facilitate just-in-time learning, as well as enfold pervasive and progressive curriculum threads. The Pulse!! problem-based case scenarios will be designed for degree-based education and post-degree certification, as well as continuing education and training for health-care professionals that is pedagogically structured for deep and rapid experience-based learning.

A Virtual Arm to Stop Smoking, A Perceptual Learning Experiment

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Cigarette smoking is a complex process of conditioning with generalized stimuli and a sustained reinforcement of a psychoactive substance (nicotine). A one pack a day smoker puts his hand to his mouth an average of 90,000 times/year. Our study focuses on this automatic movement and we hypothesize that it is possible to modify this conditioned reflex with a type of operant conditioning strategy. We designed a virtual arm that is able to move and crush cigarettes in an environment called UT2004. The hardware consists of a PentiumIV PC and eMagin Z800 head mounted display was used. The participants were volunteer smokers who had to complete four sessions of 30 minutes each twice a week. The main goal was to crush 25 cigarettes a session with no time limit, no competition and no obligation to stop smoking.

Results: Sixteen heavy smokers participated in the experiment, 8 men and 8 women with an average age of 48.6 years. They smoked one pack a day and after stopping, all sixteen relapsed on an average of 5 times in our NICOT* program based on the guidelines of AHCPR 1996 and WHO 2002. The subjects reported that the sessions were like a fun user-friendly video game and the virtual arm became a part of their body. The subject's profiles were approximately the same as the control group for the Immersion Property Questionnaire and the Presence Status Questionnaire. However, cybersickness symptoms reported were more intense and frequent than normal, especially disorientation where nicotine was considered as a cause. After each session, most reported some flashbacks (virtual arm, sounds, images), return to walking into the virtual environment, the need to crush cigarettes and reviving sessions in their sleep. So, the new mental images may be spontaneous or may be activated by any original smoking stimulus. These may block the urge to smoke or create a state of confusion. Some subjects reported that they crushed their cigarettes in the ashtray instead of tapping them while smoking. Two smokers systematically denied that they crushed their cigarette and said instead that they stored them in their pocket. Six participants gave up before the end of experiment and continued to smoke. Ten completed the experiment and eight quit smoking. A month later, only one subject had failed. The smokers reported that it was easier to quit with this method and the urge to smoke was less.

Conclusion: The VR environment seems to ease the imprinting of a new cognitive map of actions in the brain, which acts not only on the arm's specific movement but also on all conditioning process. The original conditioned response CR_1 (smoking) can be blocked in some subjects who learn a new virtual conditioned response CR_2 (crushing) and help them quit smoking. Regarding the subjects who did not complete the experiment, disruption may have been the cause. Two subjects crated a new virtual conditioned response CR_3 (storing) which allowed them to keep on smoking. This experiment may be a way for an action-exposure therapy (AET).

Reference:
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Establishing Preferences to Virtual Environments using Cocaine

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Traditionally, studies of drug abuse in humans provide little insight into the underlying factors of environmental or contextual cues that provoke drug cravings. For example, it is well known amongst clinicians that a patient can undergo detoxification and therapy, but once immersed back into their previous drug-using environment, the patient relapses back into drug use. This phenomenon is commonly explained by considering the cues in the patients' environment as conditioned cues that result in cravings for the drug. In effect, the environmental context serves as a conditioned stimulus to predict drug just as a bell would predict food for a dog in Pavlov's classic experiments. Whereas it is well accepted that context and environment have a critical role in drug abuse (Siegel & Ramos, 2002), there currently are no methods available to study these factors in humans within the laboratory.

The purpose of this experiment is to examine how human preferences change after administering cocaine in one of two distinct virtual reality environments. Once this groundwork is established for studying contextual effects on drug use, we can propose larger studies that examine how various medications block the acquisition and/or retrieval of preferences for places where drugs were obtained. In addition, we would use the results of the current experiment to design larger studies that use brain imaging to determine the brain circuits involved in various types of drug use and abuse.

To examine contextual influences of drug abuse, we created a VR analogue of a conditioned place preference task which is commonly used with rodents. In this paradigm, a rodent is given repeated pairings of cocaine in environment X, and repeated pairings of placebo in environment Z. On a later date, the animal is allowed free access to both environments. It has been repeatedly shown that the animals choose to spend more of their time in the drug paired room (X) than the placebo paired room (Z).

In this study, eight non-treatment seeking cocaine abusers were given two sessions in which cocaine is paired with one specific virtual environment, and two sessions in which placebo is paired with a different virtual environment. After these pairings, there was a test session in which participants were allowed unrestricted access to both environments without the influence of cocaine. Throughout all phases of the experiment, cardiac and galvanic skin response measures were obtained. The results indicate that the "conditioned place preferences" seems to be greatly influenced by each participant's feelings of guilt about their cocaine use. Participants with a hedonistic, guilt-free attitude about their cocaine use displayed a preference for the cocaine-paired room, while those who felt guilty and depressed about their cocaine use actually displayed a strong aversion to the cocaine-paired room. These results indicate that personality measures will add important information in interpreting how a drug-paired environment will be later perceived. Additionally, we will discuss how the physiological measures and attitude rating scales lend insight into conditioning to VR environments using cocaine as a primary reinforcer.

Avoidance Coping Strategy User's Attentional Bias and Emotional Change to Appearance-related Stimuli

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Those who are not satisfied with their bodies and use body image avoidance coping strategies tend to have abnormal eating attitudes (Cash et al., 2005). Also, when exposed to appearance-related stimuli, they indicate attentional bias and emotional change. In preceding studies, attentional bias and emotional changes were measured by stroop task and self-reported method, but in

present studies, we use an eye-tracking device. Eye movements are normally automatic, and are guided by changes in covert selective attention (Kowler, 1995). Especially, the initial fixation and gaze duration are a suitable index for indicating the attentional bias, and pupil dilation is sensitive to emotional state. Therefore, eye movements and pupil size are suitable methods for identifying attentional bias and emotional change.

All participants were female college women. In study 1, we divided participants into groups using their avoidance coping strategy (high avoidance group; N=12, low avoidance group; N=12). Their eye movements were recorded when looking at attractive and non-attractive female body stimuli. Their emotional change was measured by VAS scale.

In study 2, we separated groups by avoidance coping strategy and body satisfaction state. Their initial fixation direction, gaze duration time, and the pupil size were measured when three types (attractive, neutral, and non-attractive) of female body stimuli were presented. Also their body dissatisfaction was ascertained by Body Image Assessment Software (BIAS) program.

In study 1, a 2X2 repeated measures ANOVA (group and picture type) showed a significant interaction in gaze duration, but not in initial fixation. That is, the high-avoidance group gazed longer at attractive stimuli than non-attractive stimuli, in comparison with low-avoidance group. A 2X2 repeated measures ANOVA (group and mood measuring time point) showed a significant interaction in emotional change. Namely, high-avoidance group emotionally changed negative after they were exposed to appearance-related stimuli, compared with low-avoidance group.

In study 2, the high-avoidance and body dissatisfaction group would indicate attentional bias to non-attractive stimuli and high degree of body dissatisfaction, in comparison with low-avoidance and body satisfaction group. Also their pupils would dilate after they were exposed to female body pictures.

The results of study 1 suggest that high-avoidance group had a tendency to initially fixate on non-attractive stimuli, but significantly gazed longer at attractive stimuli. Also their mood was sensitive to exposing of appearance pictures. But this study has few limitations that stimuli presentation frequency was so low that analyzing the initial fixation, emotional change was assessed by self-report scale, and body dissatisfaction was not rated. To make up for the weak points of the study 1, stimulus organization and calibration method are changed and added in study 2.

From these studies, we can identify the attentional bias, body dissatisfaction, and emotional change according to types and exposure of appearance-related stimuli in high-avoidance body image coping strategy user's group. When applying virtual reality for prevention and treatment of eating disorders, adjusting the avatar's body according to individual characteristics would enhance the effect.

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Using Virtual Reality to Investigate Cross-Cue Reactivity and Environmental Cues in Nicotine Dependent Problem Drinkers

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Virtual reality (VR) has been successfully employed in the treatment of anxiety disorders such as fear of heights and fear of flying, and has been repeatedly demonstrated to elicit craving in drug- or alcohol-dependent participants in previous studies conducted both in our lab and elsewhere. Traditional cue exposure has been limited by the inability to replicate realistic, complex, contextually based cues in a laboratory or clinic setting, and as a result any reactivity observed in these settings has typically failed to general-

ize to the real world. VR cue exposure represents an opportunity to expose participants to environmentally situated, complex, standardized cues without the expense or risks associated with a real-world drug or alcohol use situation. This study will examine the effects of VR nicotine cues on craving for nicotine and alcohol in non-treatment-seeking nicotine dependent drinkers who meet diagnostic criteria for alcohol abuse or dependence. This study will have two overarching goals: 1) to determine whether and to what degree nicotine cues stimulate craving for both nicotine and alcohol (cross-cue reactivity), and 2) to determine whether and to what degree the environmental context of these cues affects levels of subjective craving for both nicotine and alcohol. The VR environments to be utilized in this study contain visual, auditory, and olfactory nicotine cues such as cigarettes, lighters, other people smoking, coffee, soft drinks, and food, situated within a virtual courtyard setting (simulating the outside of an office building) and a virtual party setting. Twenty (20) nicotine dependent participants with problematic drinking patterns (meeting diagnostic criteria for alcohol abuse or dependence) will provide subjective ratings of craving and attention paid to cues. While alcohol- and nicotine-focused VR cue exposure has been investigated several times in the past, this study is the first to utilize VR cue environments in an investigation of cross-cue reactivity. In addition, this study will contribute to the growing body of literature concerning the potential effects of continuing to smoke after achieving alcohol sobriety, particularly on the probability of relapse.

Virtual Reality for Cue Exposure and Cell Phones as Cue Extinction Reminders in Treatment for Crack Cocaine Dependence

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Despite experimental findings supporting the use of cues to induce and extinguish cocaine cravings, treatments using cue exposure for cocaine addiction have not demonstrated efficacy. Two problems related to cue exposure treatment are (1) reliably re-creating conditioned responding and extinguishing cravings to a variety of conditioned stimuli, and (2) generalization of extinguished responses to cocaine-related stimuli in the patient's natural environment. To date, these problems have not been adequately addressed by cue exposure-based treatments for cocaine addiction, and therefore may be responsible for a lack of treatment efficacy. The purpose of this study is to develop and begin pilot testing an intervention for cocaine dependence using virtual reality (VR) based cue exposure/extinction software and cellular phone-based cue extinction reminders (CER) for use in high-risk situations outside treatment sessions. This study is ongoing. To date, 8 participants completed 12 weeks of the VR and CER interventions, as an augmentation to 6 months of standard individual and group substance abuse counseling. In the treatment protocol, cravings to use cocaine are elicited using VR (e.g., seeing crack paraphernalia, drug dealers, crack being smoked, etc.), and after repeated exposure to VR cues, cravings are extinguished. Self-report and psychophysiological data suggest that the VR platform is capable of eliciting cravings. Once extinction occurs, a series of novel audible tones are played as CERs in the presence of VR stimuli which previously had elicited cravings. Using cell phones, participants then call the lab to listen to the audible tones (i.e., the CER) when in high-risk contexts for drug use or when cravings are present. On average, participants reported on the cell phones that cravings were reduced after hearing the CER, both when they called to hear the CER and when receiving automated calls. Lastly, qualitative data were collected regarding the acceptability and feasibility of using VR and cell phones as part of treatment. These data will be presented and discussed from the perspective of treatment development, with a special emphasis on issues surrounding the use of virtual reality-based cue exposure as an augmentation to treatment for crack cocaine addiction. Results of this study should be considered preliminary, given the small sample size and uncontrolled nature of an open trial. A randomized controlled trial is ongoing.

VR-based assessment and therapy system for spatial orienting and spatial memory disorders

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Introduction: Virtual reality (VR) provides a natural, intuitive human-computer interface, which allows real-time interaction with a three-dimensional, computer-generated environment. This interface is being used for the assessment and therapy of patients suffering from spatial orienting disorders, spatial memory disorders or visuo-spatial neglect. Therefore a virtual city named Eurade was created in cooperation with the Centre for Computing and Communication at the RWTH Aachen (Germany). Eurade comprises different pathways to learn as well as to retrieve a given route in certain conditions e.g. by means of a displayed city map showing the subjects current position.

Objectives: The main aim of the studies is a VR-based assessment and therapy system for patients suffering from topographical memory disorders. Therefore it is necessary to standardize the existing pathways in Eurade and to create four equivalent parallel forms (each with and without local landmarks) in order to assess topographical memory and to examine spatial topographical performance. Further more, Eurade has to be evaluated as a therapy approach.

Treatment of spatial orientation disorders:
Use of local and global landmarks that help the patient to orient and to find topographical sites in the virtual environment corresponding to those displayed on the map.

Treatment of spatial-topographical memory disorders:
Use of semantic and emotional-motivational cues to help the patient link topographical information with semantic or emotional information to facilitate the encoding of the pathway.

Methods: 80 male or female healthy volunteers aged 18 – 45 (mean = 26, SD = 4.92) performed a memory task in Eurade and several Paper Pencil Tests in order to validate this instrument. The VR task was presented either via a Head Mounted Display (HMD) or in a CAVE-like display. Subjects were guided once through the path and asked to learn it. Then they had to retrieve the path from memory. At certain junctions, they had to make a decision were to go next, according to the path previously presented. The correct route had to be learned within five trials at most. The task was presented in two conditions: with and without global and local landmarks.

Results: We found a highly significant main effect for the Field of View (FoV) ($p > .001$). Further on, we found a highly significant covariate in the subtest “path memorizing” of the VVM (verbal and visual Memory Test) with $p = .017$.

Conclusions: Although the analysis has to be continued we can show a distinct advantage of the larger FoV. All subjects were significantly faster and made significantly fewer mistakes when they learned the path in the CAVE-like display. But even for the smaller FoV we found learning effects. Our approach to develop a VR-based assessment and therapy system for patients suffering from topographical memory disorders seems to be an appropriate substitute for conventional neuropsychological testing, that has to be standardized and evaluated in the next steps.

Towards realistic emotional characters for training health professionals

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A framework to represent realistic emotional behaviours in animated characters is needed, as most animated human characters today still seem unnatural (Kunkler 2007).

This could affect the virtual character's capacity to elicit an emotional response. "To be socially engaging, animated characters must be able to express many different kinds of emotion" (Lester et al. 2001), without which they cannot generate empathy in the user. This would be a key element for training some health professionals.

To create a truly realistic virtual environment a human character is required to display realistic behaviours as well as realistic features. This will bridge the uncanny valley, which is a drop in believability as characters acquire greater similarity with humans (Brenton et al 2005) but do not form a perfect representation.

This would be vital, for example, in order to train counsellors. Such an environment would need an emotionally expressive character, in order to communicate its internal state to the user, as well as an accurate model of the mechanisms underlying any distortions (Gratch and Marsella 2005). The character would need the capacity to display non-verbal cues, body language, from which trainees could assess the inner emotional state of the agent. In this scenario, the character could communicate both verbally and through body language, although the message may be contradictory. This multi-modal communication would be engaging and thus should facilitate a strong sense of social presence (Heere 1992), which is beneficial as it provides a concrete experience for effective learning; the first stage of Kolb's learning cycle (Kolb 1984).

Work has been conducted to determine which emotions have to be displayed at a specific moment for an agent. Researchers in AI have produced computing models based on conventional psychological theories (Adam and Evrard 2005). For example, the OCC model (Ortony, Clore & Collins, 1988) defines 22 different emotions as valence reactions to events that are assessed by a character regarding its goals, standards and attitudes (appraisal). However, because human beings are 'intuitive psychologists' when it comes to observing and interpreting nonverbal behaviour (Duncan 2006) it is necessary to determine which nonverbal cues and movements viewers usually focus on and hence could be adopted for an accurate body-language model for an animated character.

Moreover, it has been suggested that to be believable each agent must have a specific personality (Thomas and Johnston 1995) as "the final intensity of emotions is biased by personality, supporting a greater differentiation of behaviour between characters" (Aylett et al 2005). Personality models like the Myers Briggs Type indicator (MBTI), which defines key traits, could provide a starting point to enhance the believability of emotions for a computer generated character. The chosen personality type could then provide each animated character with a set of likely behaviours, which would mitigate the final emotional response, and hence dictate the range of body cues to be displayed. This diversity could help viewers to suspend disbelief and engage emotionally in a virtual experience.

Tinnitus variability in middle-aged women

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The goal is to examine the comparability of tinnitus complaints based on two methods of data collection: standard collection advertised via regular health bulletins versus internet volunteered information. Tinnitus involves the internal perception of noises and sounds that are not generated by the auditory sensory system. Baribeau (2006, 2005) showed that out of 500 individuals affected by tinnitus, approximately 350 expressed significant distress and impact on daily activities and quality of life. About half this sample involved women.

Methodology. Selection criteria: 45 to 55 years of age. Women who had attained menopause were excluded. In the first procedure, tinnitus variance was reported on a grid covering each day for a 2 month period, and a few questions targeting the degree of related discomfort. In the 2nd procedure, similar questions were asked on an open-ended questionnaire covering the same period, complemented by a list of objective questions

on the ways tinnitus affected daily activities (Baribeau et al, 2005). In the first group, hundreds of individuals in the target age range received the invitation to participate in a mail distribution of a bulletin. Ninety women responded. In the second group, out of approximately 350 individuals expressing a need for support groups, 98 provided contact by email/ internet, composed by women for half the sample. Forty women met the age criteria between 45 and 55. Using qualitative item analysis these cases were examined with reference to 4 rating scales derived by the examiner, varying from 1 to 10, going from light to severe: A) Monthly variability. B) Intensity of tinnitus C) Impact on daily living D) Distressing quality of tinnitus. The first group was assessed using a calendar type grid. The latter group responded without a grid and was followed-up by phone in order to obtain evidence of variability over the same time period.

Results. The temporal aspect of variance will be analyzed quantitavely in a future report. The analysis suggests similar contents in the two groups. Primary contents were concerned with the communication of factual information, particularly with questions about symptom quality, intensity, duration, prognostic factors, and medical causative variables. Secondary contents invoked a theme related to the interpretation of evolution of symptoms. The 3rd category related to requests for references to medical and para-medical practitioners; The 4th theme referred to issue of care, to ways of handling symptoms and related impact on stress tolerance, depression, anxiety, fear of aggravations. These results provide the basis for the offering of an internet-based continuous service for women suffering from tinnitus. As expected, the main factor discriminating participants involved by internet and those involved by mail was age, followed by education level. The internet group was 5 years younger with 2 years higher level of education. This study indicates that middle-aged women indeed present monthly variability in their report of tinnitus. The results suggest that women responding via the internet are representative of the larger sample accessible via standard traditional recruiting approaches.

A Tool for Alcohol Craving Induction System using Virtual Reality: Craving characteristics to social situation

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Alcohol addiction is a chronic disease with genetic, psychosocial, and environmental factors. Drug treatment and mental therapy are used for alcohol addiction treatment. One kind of mental treatment is cognitive behavioral therapy, which contains alcohol craving regulation and coping. In this therapy, it is very important to evoke one's craving by exposing them to alcohol related stimulus, then let patients recognize and cope with the state of one' craving. In previous studies, pictures with alcohol were used to induce alcohol craving. In the previous study, it was discovered that alcohol craving can be triggered when people are exposed to alcohol related objects or environments. Therefore, conventional cognitive behavioral therapy in hospital treatment has used those stimuli to treat alcoholism. However, patients with alcoholism easily relapse in cases of exposure to alcohol situations, particularly a situation of social drinking. Therefore, experiencing and learning to cope with social pressure situations is very important in cognitive behavioral therapy. However, conventional methods using two-dimensional stimuli are not enough to evoke craving and train for coping skills in a social situation. Virtual reality (VR) techniques can provide a realistic object, immersive environment, and interactive social pressure situation using avatars. These are important advantages that VR techniques can satisfy all conditions of alcohol craving. In this study, we developed an alcohol craving induction VR system to provide social situations in which an avatar asks the user to

drink together. For investigating craving from social pressure, 2 X 2 (alcohol related place X social pressure) experimental paradigm was used. Thus, social pressure situation was designed in two virtual places, which are alcohol related places (bar) and unrelated places (office). In each place, the avatar asked to drink together several times. Nine males and one female (age from 21 to 27 years) who do not have any history of alcohol related disease were recruited for this experiment. All participants experienced eight situations, in four situations they were just placed in virtual situations without an avatar. And in the other four situations they experienced the avatar's asking. Alcohol craving was measured using VAS before and after performing each task. In the results, alcohol craving in situations with an avatar who presented social pressure is significantly higher than situations without the avatar (30.23% increases in situation with avatar, 4.29% increases in situation without avatar). And alcohol craving showed a tendency of higher craving in alcohol-related places than that in alcohol unrelated places, even though it is not significant (19.96% increase in alcohol related place, 14.57% increase in alcohol unrelated place). It is regarded that the social pressure situation is more influential to alcohol craving than alcohol related place. The developed VR system could measure change in alcohol craving of people when they experience VR with a social pressure situation. Also the system can overcome a limit of previous studies by suggesting social pressure situations. Therefore, the developed alcohol craving measure system using virtual reality, particularly VR is able to apply to cognitive behavioral therapy for alcoholism.

Sweden's Polar Rose as a Potential Tool for Law Enforcement and Health Care

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Many tools that are emerging on the Internet appear for one purpose, but have many useful designs for diverse communities. The digital picture frames with sound can be useful to persons with Alzheimer's disease, providing comfort with pictures of family. Pleasant memories may be easily cycled through to lessen some of the cognitive impairments of the disease. Pictures may also be edited to provide labels with names and places to help sufferers remember their life: a sort of "memory wallet." The same digital picture frame may be used by an investigator to hold various important digital images and audio that can be easily cycled through and played to discuss aspects of an investigation with a client, insurance agent, or emergency management personnel. Other tools such as Sweden's Polar Rose are useful visual search engines to provide people with cognitive impairments an ability to identify people encountered in their daily lives. Through the use of a browser plug in, the software gives people the ability to upload pictures that they take of people in their daily lives and identify family members, as well as friends from registered web albums that care givers may provide. The same tool which uses face biometrics gathered from a two dimensional picture, also has a potential to help investigators expose fugitives who may have adopted a new identity in a new place but have posted pictures online in album sites licensed for Polar Rose's application for face detection and perhaps other public online places. This paper and poster suggests how many tools can be useful to both Cyber investigation and health care.

The Sims in Therapy: An Examination of Feasibility and Potential of the Use of Game-Based Learning in Clinical Practice

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Easily adaptable commercial computer game simulations may be of use to art and play therapists, providing a customizable venue

for creating meaning and facilitating communication, and at the same time offering many of the established strengths of game-based learning (empowerment, motivation, insight, and engagement (Prensky, 2001) to achieve healing and resolution. More specifically, Electronic Arts' game ***The Sims2,*** with its tools that allow users to create a character's appearance and personality attributes, and a game engine that runs character interactions based on these user-directed qualities, may be ideally suited for use in art and play therapy.

This pilot study examines the possibility of using ***The Sims 2*** and computer-based simulation games with similar tools in a therapeutic setting. While use of ***The Sims 2*** at this point is for the most part casual and often user-directed for addressing and possibly mediating emotional issues, its more formalized use and adaptation by professionals is most likely imminent. However, before ***The Sims2*** can be used by clinicians, it is necessary to assess some of the technological and conceptual issues that may impact its use as a treatment modality. This manuscript documents a pilot study involving interviews with and observation of art, play, and occupational therapists learning about and exploring ***The Sims2*** for possible clinical use in the treatment of certain psychological disorders.

While all of those who participated in the study were interested in the possible use of digital simulation games like ***The Sims2*** in their professional practice and recognized its probable implementation in the near future, many identified factors that would be necessary for its successful use. In particular, transference was the paramount concern of all of the therapists interviewed, maintaining that while a computer-based game may have tools and functionalities that would support and facilitate a client in connecting with deeper issues, perceptions, and concerns, this new realization would still require the careful mediation with a professional.

Painful Conversations, a Game-based Simulation: How to Learn to Say What No One Wants to Hear

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It is one thing to teach medical students the concrete skills and knowledge they need to recognize and treat common diseases. It is another thing altogether to teach students to manage the unpredictable and emotionally charged discussions that take place when biotechnology has failed and cure is not an option. This aspect of medical education, which addresses psychosocial as well as biological issues in patient care, encompasses the art of medicine and calls on empathy, moral imagination, courage, and reflective practice. When it comes to delivering bad news, or soliciting advance directions, or asking patients and their families to consider hospice, medical students receive little formal teaching, nor do they have many opportunities to watch what happens when housestaff and attendings approach complex decisions during family meetings.

Painful Conversations is a computer simulation game that attempts to mediate this learning deficit by providing a venue in which health care providers can develop the affective skills necessary for difficult discussions. The game is designed to allow users to practice saying the right things at the right time to patients near the end of life. Currently in the prototype phase, ***Painful Conversations*** features a complicated patient scenario involving a case of incurable breast cancer.

After the prototype is developed it will be refined based on feedback from palliative care specialists, medical residents, and 2nd year medical students. The educational utility of the final product will be tested in a randomized study that uses a standardized patient encounter to compare game-prepared students to game-naïve students. Bad news is all too common in medical practice, and other simulations are planned.

Why do you Drink? Virtual Reality as an Experiential Medium for Assessment of Alcohol-Dependent Individuals

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The use of virtual reality in the form of simulated context can provide a realistic environment in which to study complex naturalistic behaviours (Calhoun, Carvalho, Astur, Pearlson, 2005). Virtual Reality has been used to assess cue reactivity in controlled simulated tasks with nicotine-dependent patients, or in drug-dependent patients or in drunk drivers (Bordnik, Graap, Copp, Brooks, Ferrer, Logue, 2005; Freeman, Liossis, Schonfeld, Sheelhan, Siskind, Watson, 2005), but it is less explored in alcohol-dependent subjects. Many of the behavioural effects of alcohol intoxication are well known, but there is relatively little exploration about alcohol behaviour in simulated natural situations.

The aim of this study is to assess social, personality and behaviours of alcoholics using virtual reality. Specifically, we defined a virtual reality protocol to investigate the following factors: Intrapersonal factor (Emotional Management and Self Esteem) and Environmental factor (Relational Competences and Social Pressure). During the protocol, the therapist analyzes both verbal and non-verbal behaviours focusing on emotional responses, interactions with the virtual environment and the content of the individual answers.

In this preliminary study we are checking the difference between assessment methods by comparing VR assessment with traditional self-report questionnaires in a sample of 10 alcohol-dependent individuals entering a non-pharmacological outpatient treatment.

The protocol is based on three different virtual environments: the park; the apartment and the restaurant; developed within the NeuroVR Project. NeuroVR is a cost-free virtual reality platform based on open-source software. It offers to the clinical professional a cost-free VR editor, which allows non-expert users to easily modify a virtual world, to best suit the needs of the clinical setting.

The NeuroVR platform includes two main components, the Editor and the Player; they are implemented using open-source components that provide advanced features; these include an interactive rendering system based on OpenGL which allowing for high quality images.

In the park the interaction has three main goals: teaching the user how to move in the virtual environments; relaxing him/her; a preliminary evaluation of both emotional and relational dimensions without a direct link with the alcohol use.

After the park session, the therapist may customize the two following environments according to the needs of the alcohol-dependent individual. There are two choices: the apartment and the restaurant. In both of environments it's possible to add drinks, bottles of wine, food, features and individuals (family, friends, boss etc…).

In the apartment the assessment has three main goals: investigate the nature and strength of the family and social links; evaluate the emotional arousal when the subject interacts with significant others, such as the partner or the sons, or significant objects such as bottles of wine and drinks; and verify the typical in-home alcohol consumption patterns.

The last environment is the restaurant, in which the therapist observes the behaviours of participants in a social context. Here, too, the assessment has three main goals: explore the behaviour of the subject when somebody invites him/her to drink; explore the influence of social pressure on drinking behaviour; evaluate the emotional arousal

when the subject interacts with significant others not related to the family, such as his/her own boss.

At the moment the study is in progress. Final results will be presented preview at the 2007 Cybertherapy Conference.

A Relaxing Journey: The Use of Mobile Phones for Well-Being Improvement

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The new generation of mobile phones has many additional features -as PDA (Personal Digital Assistant), camera and media player- that make it a potentially powerful tool for cyber-psychology. The aim of this project is to test this potential by analysing the effectiveness of mobile narratives to improve relaxation and reduce anxiety in a commuters' sample.

Mobile narratives, narrated video experienced on mobile phones, are used in this study to perform relaxation exercises aiming at introducing emotional changes in participants, to improve their well-being in everyday life stress situation (Green M. C., Brock T.C., Kaufman G., 2004). The narratives guide the subjects during the exploration of four different areas of a tropical island proposing different relaxation techniques based both on the "Progressive Muscular Relaxation" protocol (Jacobson, 1938) and the "Authogenic Training" protocol (Schultz, 1977).

The project sample is composed of 120 commuters, college students aged between 20-25 years old (60 female and 60 male), recruited on the Varese-Milano local train (70 minutes trip).

The project is divided into two parts: in the first part participants experience either audio-video contents or only audio contents during their train trip, for two consecutive days using different devices (mobile phone, mp3 player). In the second part, follow-up, participants listen to the audio contents through a cd audio for three weeks from the end of the first part.

Specifically the sample has been randomly assigned into four different conditions:

- VRnar group: who experienced the mobile narrative on a mobile phone during their daily train trip;
- Nnar group: who experienced video contents only (the beach of a virtual tropical island) proposed on a mobile phone during their daily train trip;
- Mp3 group: who experienced only the audio contents (the relaxation exercises only) proposed on mp3 player during their daily train trip;
- Ctrl group: a no treatment condition.

Each participant was administered the following questionnaires before and after the experience:

- State questionnaires:
  - the STAI (*State Trait Anxiety Inventory,* state version, Spielberger, Gorush, Lushene, 1970);
  - the PANAS (*Positive and Negative Affects Schedule,* Watson, Clark, Tellegen, 1988);
  - the Vas (*Visual Analogue Scale,* Gross e Levenson, 1995).
- Trait questionnaires:
  - the COPE (*Coping Orientation to Problems Experience,* Sica, Novara, Dorz, Sanavio 1997);
  - the Generalized SELF-EFFICACY scale (Jerusalem, Schwarzer, 1995);
  - the STAI (*State Trait Anxiety Inventory,* Spielberger e coll., trait version, 1970).
- Presence questionnaires:
  - Ucl-Sus (Slater, Usoh, Steed, 1994);
  - Itc-Sopi (Lessiter, Freeman, Keogh, Davidoff, 2001).

In the follow-up phase, participants have only to listen to the relaxation exercises and to do visualisation exercises based upon the contents of the first phase for three weeks through an audio cd. During this practice they complete a "diary of experience." At the end of the follow up condition each subject is administered the Trait questionnaires.

At the moment the study is in progress. Final results will be presented at the 2007 Cybertherapy Conference.

Implicit Affective Association to Lie and Deceptive Behavior in a Virtual Environment

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Although lying is 'publicly condemned', at the same time it is 'practiced by almost everyone'. Lying and deceit occur for a variety of reasons and during everyday life are seen as the goal of some social interaction. We assume that lying is included as a socially stigmatic issue like racial or gender prejudice. To assess concealed prejudices to show that people who lie more have positive affect associations regarding lie we adapted a test known as the Implicit Association Test (IAT). We hypothesized that lying would be associated with negative emotions in explicit and implicit measures and on IAT, participants who choose to lie would show a reduced negative association to lying compared to participants choosed not to lie. This positive affect that liars show might only manifest itself in an implicit measure.

Thirty-four undergraduate students were participated. Two explicit attitude measures ; the feeling thermometer and semantic differentials and *Manipulativeness scale*, a self-reported personality scale assessing lying ability, were administered. Implicit attitudes were assessed with the Implicit Association Test (IAT), a computer program that recorded reaction times as participants categorized target (of LIE and HONESTY) and attribute (pleasant or unpleasant). To observe lie-related decision-making behavior, we used VR city wayfinding software as a racing game in this in which participants had chance to deceive experimenter in order to get an extra monetary compensation.

As expected, the IAT differed significantly between participants who did deceptive behavior (deceptive group) and participants who didn't (honest group). Deceptive group showed much weaker association between lie and unpleasant and between honest and pleasure in the IAT than honest group whereas the Manipulativeness score and explicit attitude did not differ significantly between groups.

Our results indicate that people who choose to lie might have had more good feelings associated with lying which may lead participants to continue to engage in deceptive behavior and also it was found that the Lie IAT was a better predictor of real deceptive behavior than explicit measures. Present results could help understanding the complex underlying structure of human deceptive behavior.

Investigation of head gazing response and virtual movement trajectory in obsessive compulsive disorder using virtual reality

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Background/Problem

OCD (Obsessive compulsive disorder) is a debilitating disease involving multiple and diverse symptoms. There is no biological marker to diagnose OCD, and today diagnosis is achieved primarily by psychiatric evaluation, which relies on symptoms, medical history, interview, and observation. These procedures are difficult and somewhat unreliable, since each patient manifests a different subset of symptoms.

The goal of the current study is to provide new methods as tools for measuring symptoms in OCD patients. In this study, we induced symptoms through head gazing and movement trajectory in the virtual world. Our specific hypotheses were as follows: (1) patients with OCD would be more impaired in head gazing and movement trajectory than matched healthy controls; (2) performance on the head gazing analysis and movement trajectory would be related to a standardized, validated paper-and-pencil measure.

Method/Tools

According to established knowledge, head gazing reflects eye gazing and it is an easy method for measuring gazing. To calculate head gazing times for objects in the virtual world, we make an invisible virtual con to cover the periphery of the subject's eye position. If a subject gazes at any object in the visual scope, we can calculate their gazing time per object (pocket book, cellular phone, wrist watch, bag, umbrella, water valve, gas burner, gas valve, light switch, window, door, door lock, computer, cabinet, and heater). To record a patient's movement trajectory, we saved patient's position at each rendering time. And it was resampled in the same time period. Patient's position which have same time period, was drawn by MATLAB 7.1 according to their rendering time.

To compare head gazing and movement trajectory, we made two phases: distracting phase and checking phase. In the distracting phase, subjects must perform a distracting task. During in the checking phase, subjects can freely check virtual objects in the virtual world.

Results/Conclusion

According to analyzed results, the difference of gazing times between OCD patients and matched healthy controls during the checking phase is longer than those of the distracting phase (distracting phase: 2.43s, checking phase: 16.98s). And the number of intersection points of OCD patients is bigger than matched healthy controls (OCD patients: 38.75, matched healthy controls: 27.38). A correlation exists between our head gazing parameters and classical paper-and-pencil test (Y-BOCS, GAF). But we can't confirm any relationship between movement trajectories and classical paper-and-pencil tests.

Novelty/Discussion

The advantages of a using VR instrument analysis over interview based and paper-and-pencil assessment of OCD patients is that (1) it dynamically engages a broad range of neurocognitive functions through the use of complex multimodal environments that more closely approximates how neurocognitive skills are utilized in a patient's natural environment and that includes common environmental distractions, (2) it may provide a closer estimate of the actual community performance, (3) it allows for careful measurement of how performance on this VR task may break down by quantifying patterns of behavior within the virtual world.

The Efficacy of Cue Exposure Treatment for Nicotine Craving in a Virtual Environment

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Smokers show an increase in cue reactivity and cardiovascular reactivity when they are exposed to smoking-related cues compared with neutral cues. Also, brain activation using post emission tomography (PET) and func-

tional magnetic resonance imaging (fMRI) studies have shown the correlation between specific brain regions and craving during exposure to substance-related cues. Cue exposure treatment (CET), which aims at extinguishing the drug seeking and consumption behavior by repeated presentation of substance-related cues alone, has been claimed a potentially effective method of treating addictive behaviors, including cigarette smoking. The participants were eight late-adolescent males who smoke at least 10 cigarettes a day. The cue reactivity scenario in virtual environments (VEs) was based in part on our preliminary task (Lee et al., 2003, 2004). Each session was administered for 20 minutes and included introduction, VR navigation, interviews about feelings, and self-report questionnaires about cravings. The six sessions consisted of initial and closing sessions, person-, object-, and situation-focused sessions, and a comprehensive review session. Before performing the first session and the last session, brain activation of the participants was scanned by fMRI while photographic smoking-related and neutral cues were presented. The MRI scan was conducted on a 1.5T GE Signa CV/i scanner (General Electric Medical Systems). The neutral cues were shown for 30 seconds after 12 seconds of dummy, and smoking-related cues were shown for 30 seconds after neutral cues. Between the intervals of presenting each cue, there were 30 seconds of fixation time. This whole process was cycled three times. Prior to VR-CET, the group mean of participants had increased activity in the prefrontal cortex (PFC), left anterior cingulate gyrus (ACC), right superior temporal gyrus, left uncus, right fusiform gyrus, right lingual gyrus, and right precuneus. Detected areas of activation after VR-CET were as follows: the PFC, right uncus, and right fusiform gyrus. We compared pre-CET regions to those of post-CET (pre-CET minus post-CET) to confirm the efficacy of VR-CET. Activated brain region was that the PFC, including the inferior frontal gyrus and the superior frontal gyrus. This finding is consistent with previous studies of activated brain regions related to nicotine craving (Domino et al., 2002; Due et al., 2002; Brody et al., 2004) as well as this study suggests that brain region and gray matter volumes to craving induce stimulus change as craving decreases. Therefore, CET conducted in VE seems to be an effective method to treat nicotine craving. In this study, we utilized a new technique, VR-CET, and its high immersion and great realism led to decreases in craving in nicotine-dependent individuals. We confirmed the effectiveness of this method by scanning brain activation with fMRI. It is expected that it would be a useful method to treat substance-dependent individuals and to confirm the efficacy of the treatment in clinical field.

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CyberTherapy and Open surgery: Preliminary results in ambulatory surgery

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Purpose: There are reports using virtual reality (VR) scenarios to reduce pain or discomfort during simple medical procedures

such as: intravenous cannulation, wound dressing and teeth extractions, but use of VR in invasive procedures has not been documented. Using VR in open surgery could have an important impact to support surgeons but can specifically support patients to aid surgeons indirectly. This area of research using VR in invasive procedures has not been explored. In this article we demonstrate the usefulness, advantages and disadvantages of virtual reality scenarios to reduce discomfort in patients during ambulatory surgeries. A group of patients underwent ambulatory surgery participated in this VR based novel technique to alleviate discomfort.

Methodology: Virtual reality scenarios were displayed to 20 patients during inguinal hernia surgeries and lipomas at the Hospital General regional 25 of the IMSS in Mexico City. 8 Females and 12 males over 20 years of age were included. Inclusion criteria were complicated hernias (Constriction of the hernia contents, such as, an intestinal loop and of its mesentery in the sac) and non complicated hernias (Nyhus classification), umbilical hernias and lipomas with size over 5 cms. A diagnosis was essentially done by palpation in physical exam, both standing and lying down, and the patient was asked to cough in order to increase intra-abdominal pressure and favor protrusion of the hernias. The virtual reality scenarios were displayed on the Head Mounted Display and on the wall with a projector. Included virtual reality scenarios were Cliff-FINAL, Dream Castle, EM-Runtime, Enchanted Forest and South Pole Fantasy. We performed 17 surgeries under local anesthesia, 2 with epidural and 1 with intravenous anesthesia.

Results and Conclusions: We did not use intravenous medication in 19 patients. With this result we reduced the price of a normal surgery by 20% because we did not use epidural block in 17 patients. Virtual reality applications in surgery are possible only when the patient is conscious and surgical procedure permits arm mobilization. The success of virtual reality to reduce pain during ambulatory surgeries depends on: (1) individual response to pain and adequate infiltration of medication on patient tissues. (2) Age of patients to choose virtual scenarios. Ambulatory surgery with VR reduced the medication cost and reduced cost of hospital stay.

Visuospatial Ability and Navigation Learning with Mild Cognitive Impairment Patients in a Virtual City

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Patients with Mild Cognitive Impairment (MCI) have deteriorations in memory, executive, and visuospatial functioning. These three types of complex cognitive functioning, especially visual memory, influence wayfinding behaviour which has the impact on daily living. This study hypothesized that elderly patients with MCI have more difficulties in navigation than normal elderly adults. To assess navigation ability, Virtual Environment (VE) tasks were utilized offering a 3D real-time-based realistic world and supplementing the disadvantages of existing 2D tests. In addition, this study investigated the relationship between visual functioning and VE tasks. The participants consisted of 22 MCI patients (CDR=0.5; mean age 72.1, SD=7.6) and 27 normal (CDR=0; mean age= 69.46, SD=7.4). At first, traditional neuropsychological tests including copy, immediate- and delayed-recall as per the Rey Complex Figure Test (RCFT), the Benton Visual Retention Test (BVRT), the Trail Making Test (A and B), Digit Span subtests (forwards and backwards), and the Groton Maze Learning Test (GMLT) were conducted to evaluate visual

and memory functioning of the participants. Secondly, VE navigation learning tasks were performed. The participants attended 6 trials (Path A: Trials 1–3; Path B; short-delayed trial; and long-delayed trial) in a virtual city. The time required, the distance traveled, and the number of navigation errors were calculated to access the 'VE Index' of each trial and two-way (2X6) repeated measures ANOVAs were conducted. Significant effects were found in the trials, within-subject factor ($p < 0.001$), and there was a significant interaction between trials and cognitive status (MCI or normal) in the VE task ($p < 0.05$). These results demonstrate that the ability of the MCI group to perform VE tasks was inferior to the ability of the normal group. For the GMLT, the MCI group tended to perform inferiorly compared to the normal group but it was not statistically proved. Furthermore, as the trials were repeated, the learning of the MCI group for the GMLT tended to increase slowly and decrease rapidly during the delayed and reversed trials compared to the learning of the normal group. Significant correlations between the GMLT and the VE task were found in most areas. The VE task significantly correlated with the immediate-recall RCFT, the delayed-recall RCFT, and the BVRT. These RCFT and BVRT accounted for 45% of the VE performance. In conclusion, our study suggests that patients with MCI are less capable of navigating in VEs than normal individuals. Visual retention and memory play a role in these navigation abilities. These also demonstrate that VE technology can be used to access spatial memory and navigation skills. Moreover, the VE task can contribute to the examination and training of individuals with cognitive deficits, including MCI, in future studies. In this study, the small sample size does not provide sufficient results to explain the deterioration in navigation abilities of individuals with MCI. This is an area which needs to be explored with empirical studies to clarify the diagnosis of MCI and prevent progression to severe cognitive disorder from MCI.

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Attention Performance in Children with Autism in a Virtual Reality Classroom

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The frontostriatal system (dorsolateral prefrontal cortex, lateral orbitofrontal cortex, anterior cingulate, supplementary motor area, and associated basal-ganglia structures) is impacted in both attention deficit hyperactivity disorder (ADHD) and autistic spectrum disorders (ASDs). The system is responsible for adaptive responses (initiation, execution, or withholding) to environmental situations. The effectively excessive release or withholding of various types of response, are both a consequence of changes in specific frontostriatal regions.

Literature on executive functions related to ASD and ADHD is inconsistent and warrants closer analysis. Children with ADHD display symptoms such as impulsivity, hyperactivity, inattention and motor restlessness (Daley, 2005). The executive functions in which the population with ASD frequently shows impairments are: planning and cognitive flexibility (Happe et al., 2006). A few studies show conflicting evidence for both impairments and normal functioning in spatial working memory (Bennetto et al., 1996; Ozonoff & Strayer, 2001). Inhibitory control, however, seems to be the one executive function that is relatively spared in children with autism (Geurts et al., 2004). There are a few reasons why such conflicting data has surfaced. One possibility is the problem of ecological validity in assessment of executive functioning in ASD and ADHD. Virtual reality (VR) can be viewed as an advanced form of human–computer interface that allows the user to "interact" with and become "immersed" in a computer-generated environment in a naturalistic fashion (Rizzo and Buckwalter, 1997). VR offers

the potential to deliver systematic human testing and training environments that allow for the precise control of complex dynamic three-dimensional (3D) stimulus presentations, where sophisticated behavioral recording is possible. When combining these assets within the context of functionally relevant, ecologically valid virtual environments, a fundamental advancement emerges in how human behavior can be addressed in many scientific disciplines.

We have developed a VR classroom that has demonstrated value as a cognitive assessment tool for measuring attention performance in normal children and children with disorders affecting the frontostriatal system. The virtual classroom consists of a classroom scenario that allows for comprehensive and integrated diagnostic assessment of attention (e.g., Stroop, Boston Naming Test) and motor reactivity while in the presence of systematically delivered distractions. Presently, an open clinical trial to evaluate our system's efficacy for attention assessment with children with autism is being conducted at the Children's Hospital Los Angeles. This presentation will summarize the results of our research as they stand at this time.

Addressing Challenges of Social and Behavioral Genomics Research using Virtual Environments

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Social and behavioral scientists are being presented with the unique challenge of determining how scientific discovery in genetics and genomics can lead to advances in chronic disease prevention and management and improvement in the public's health. This requires assessing public opinion, understanding, and affect with respect to the current realities and the potential future of genomics. In this arena of genomics and public health, our individual and collective outcomes are oftentimes difficult to clearly or accurately envision, and decisions will often be multifaceted and quite affect-laden. Concepts necessary to inform these decisions are largely complex, technical, and alien requiring individuals to understand their health and their bodies in entirely new ways. Many traditional methodologies and communication paradigms are ill-equipped to convey these complex themes with a weight that clearly conveys their importance (e.g. predicting desire to take a genetic test based on responses to a short written vignette). For this reason, there is a great deal of room for new research and communication technologies in this enterprise. Virtual environment technology is posed to make a great impact on research and practice relating to genomics and public health as it has the ability to fill the gaps and address the shortcomings left by traditional research methodologies.

There are a number of major areas in genomics and public health translation and practice that stand to benefit greatly from the strengths of virtual environment technology. These strengths include, but are certainly not limited to: elimination of the typical mundane realism/experimental control tradeoff, the ability to manipulate objects or characteristics typically immutable, invisible, or intangible, and the ability to measure behavior implicitly and covertly.

Members of our research group at the Social and Behavioral Research Branch, National Human Genome Research Institute, National Institutes of Health are designing several experimental virtual environments to address a number of issues that become increasingly pressing as we work to keep pace with the rapid advancement of scientific genomic discovery. Our inaugural areas of inquiry include:

1. Development and testing of experiential virtual learning environments that will engage individuals in the complex, abstract, and inherently probabilistic genomics concepts required to understand one's own disease risk
2. Basic and applied research to understand patient decision-making with respect to electing for or against genetic testing focusing on realistic, experiential contexts for decision simulation
3. Creation of virtual healthcare spaces to serve as subtle manipulations testing environmental and/or interpersonal influ-

ences on perceptions of genetic risk
4. Examination of genetic and disease stigma perceptions and responses using implicit temporal-spatial measurement to assess constructs high in social desirability concerns.

Several genomics and health research areas as well as development and design of virtual environments suited to address key questions within these areas will be discussed at more length. In each of these areas and in several other related ones where we plan future work, development of specialized virtual environments will allow us to address key health issues with all the benefits this flexible, immersive technology has to offer.

Instrumental Kinesiology Approach in Neurorehabilitation Follow-up

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According to the severity of functional stroke sequelae (emiplegia, aphasia, etc) and according to the presence of comorbidities (diabetes, hypertension, etc), post-stroke patients are admitted to an intensive or extensive rehabilitation treatment. Intensive rehabilitation means a treatment of about three hours a day, while extensive rehabilitation implies a longer (in time) but weaker treatment (about 90 min./day): it is suitable for subjects with a less severe damage. Patients stay in hospital about two months.

After the hospital stay(s), for the less severe cases needing a time-limited neuro-motor rehabilitation treatment, there is a periodical treatment under an out-patient ambulatory regimen; for more severe situations or for cases requiring a multi-disciplinary rehabilitation plan (e.g. cognitive, occupational, neuropsychological or ortesical approach), again there is either an intensive or extensive day-hospital regimen.

With the aim of fostering the home rehabilitation for these patients, we propose the use of a kinesthetic garment (with piezo-resistive sensors included) able to detect posture and movement of the upper limb. The garment, wireless connected with a Personal Computer, is the basis of a system that will detect correct and incorrect movements and will provide alerts or reminds to both patients and physicians.

The instrument could be used for the patient during the intermediate and final period of the hospital stay (in such a way the subject is trained on the exercise to be repeated for his rehabilitation and data acquisition, interpretation and transmission are assessed). After the hospital training period, the patient may continue at home, with his “remote controlled” exercises.

The advantage for the professional is that he can maintain a link with his patients also after discharge. Often the discharge time is imposed by institutional constraints, and physicians “loose” patients without the possibility of an efficient and effective follow-up. The system could improve the collection of follow-up data also for scientific purposes, since the rehabilitation effectiveness of some exercises has never been demonstrated.

The advantage for the healthcare establishment derives from earlier discharge (savings costs and increasing turnover while maintaining quality).

Virtual Reality for Shoulder Rehabilitation: A Quantitative 3-Dimensional Approach

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Restricted shoulder movement is a common impairment, from neuro-muscular deficit in stroke patients through to mechanical and pain restriction in traumatic and atraumatic conditions. Upper limb Virtual Rehabilitation

programs have demonstrated therapeutic potential, and recent studies have investigated hand motion, coordination and grasping. Shoulder motion has generally received less attention, with existing shoulder complex studies generally concentrating on motion in a single plane. However, restriction or loss of controlled motion at the shoulder can reduce the ability to effectively utilise improvements in a real world setting, where positioning of the arm is vital to align the hand appropriately for tasks demanding reaching and grasping.

Professional intervention can help to maintain shoulder joint mobility, but during active movement, antagonist muscles show heightened tone towards end range of motion (ROM), to discourage joint movements that might cause pain or further injury. This reluctance to allow free movement can lead to progressive restriction and physical impairment, and is an important consideration when attempting to engage patients' compliance with rehabilitation exercises. During passive ROM (movement is under the control of the practitioner), the musculature is in a state of decreased tone, therefore there is less resistance at end ROM.

Virtual Reality (VR) environments have demonstrated a potential to act as a therapeutic modality providing a distraction and suppression of pain, as well as a goal driven motivation to encourage rehabilitative exercises and patient compliance. Some studies suggest that this, coupled with altered perceptual distance cues, may facilitate an increased ROM in active movements.

The study currently in progress uses a '6 degrees of freedom' magnetic tracking system (Ascension Technology Flock of Birds) in order to avoid conflicts with 'line of sight' obstructions, monitoring motion in internal/ external rotation as well as flexion during reaching and positioning movements. Sensors are placed on key anatomical landmarks on the upper limb in order to track motion through a range of conventional therapeutic tests for ROM thereby establishing the extremes and limits of active and passive ROM in differing subject groups. The outcomes are also observed by a qualified therapist to provide conventional findings as a reference. Measuring the progress of rehabilitation is often a subjective process, and the ability to incorporate objective positional feedback into VR rehabilitation programs could convey real time benefits and also facilitate a consistent standard of measurement of the efficacy of such programs. Our initial proof of concept model provided preliminary data enabling shoulder motion to be precisely monitored with coordinates and orientation in 3 dimensions, allowing for development of a richer interaction with the VR environment and a more effective rehabilitation program with quantifiable outcomes. Further work is proposed to develop goal driven VR exercise regimes with real time objective feedback on actual motion and progress. The Virtual Environment is intended to convey an orchard with "apples" placed at predetermined positions to encourage the desired reaching actions, with internal/ external rotation promoted by a simulated objective of placing "good apples" in a "backpack" and discarding "bad apples" behind the subject.

Exploring Cue Reactivity in Nicotine Dependent Young Adult Smokers Using Virtual Reality with Expanded Olfactory Cues

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Nicotine use among young adults is a serious health concern that many researchers feel should be addressed through the use of technologically-driven interventions. While craving for cigarettes has been reported as an antecedent to smoking and relapse, many traditional laboratory methods of assessment and intervention for nicotine dependent young adults lack generalization to the real world as they do not sufficiently address the contextual environmental cues that often elicit craving within this population. Virtual reality (VR) cue exposure methods incorporate a standardized set of ecologically valid complex cues utilizing social, physical, and affective interactions provided in an immersive environment that provides visual, auditory, and olfactory stimuli. This study is designed to explore the effects of exposure to

VR nicotine cues in a sample of nicotine dependent, non-treatment-seeking young adults. In addition, the effects of exposure to VR olfactory cues will be examined. The goals of this study are twofold: 1) to determine to what extent exposure to VR smoking cues will increase subjective reactivity in nicotine dependent young adult smokers as opposed to exposure to VR neutral cues, and 2) to determine if and to what extent exposure to VR olfactory cues, along with VR auditory and visual cues, will increase subjective reactivity as opposed to exposure only to VR auditory and visual cues. VR environments utilized in this study include neutral and smoking cue rooms. Neutral cue rooms consist of narrated nature scenes with a floral scent. Smoking cue rooms consist of a paraphernalia room with visuals of cigarettes, lighters, coffee, and ashtrays; accompanying scents; and music and a party room with music playing and the sights and smells of people smoking, eating, drinking, and offering cigarettes. Twenty nicotine dependent young adults between the ages of 18 and 24 will experience VR environments that include visual, auditory, and olfactory cues or VR environments that provide only visual and auditory cues. Subjects will provide ratings related to subjective craving and attention to cues in each room. Given the relationship between olfaction, emotion, and memory, olfactory stimuli may contribute substantially to the smoker's environmental context, leading to greater subjective reactivity than elicited by only visual and auditory stimuli. Additionally, this study contributes to the increasing body of literature that demonstrates the potential use for VR systems that elicit craving responses by exposing participants to complex drug stimuli in the context of a real world smoking environment to allow arousal, assessment, skill development, scenario repetition, and skill generalization in an effort to assist individuals in prevention, assessment, and cessation efforts.

Immersive Virtual Reality Therapy for Communication Disorders

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It is estimated that communication disorders (including speech, language, and hearing disorders) affect one out of every 10 people in the United States. Given this prevalence, there is a need to continue to create and improve effective treatment programs in the field of communication disorders. Although previous research studies have demonstrated that a variety of therapy treatments are efficacious, many people are unable to maintain speech and language gains made in therapy once released from a clinical setting.

The transfer of speech gains made in treatment to real world settings is the essence of effective treatment for communication disorders. Thus, there is a need to develop a treatment paradigm that emphasizes the transfer process from the onset of treatment. Immersive virtual reality (IVR) technology has the power to create realistic virtual environments of every day settings tailored to meet the needs and experiences of children and adults with communication disorders.

The Department of Communication Sciences at Case Western Reserve University and Virtra Systems, Inc. has built a revolutionary, interactive 180 degree immersive virtual reality (IVR) cave simulator for communication disorders called the Virtual Immersion Center for Simulation Research (VICSR). This IVR-Cave research environment surrounds the user with three eight by ten foot screens and enables them to experience an interactive training simulation, which utilizes state-of-the-art rear projection-based technology.

Previous research has shown that immersive virtual reality learning environments demand a high level matrix of knowledge, skill and judgment; qualities that contribute to effective treatment. The purpose of this research is 1) to create an immersive virtual reality treatment paradigm for communication disorders 2) to determine its effectiveness compared to traditional therapy paradigms and 3) to explore the nature of cognitive and emotional factors related to attitudes and motivations based on the uses and gratifications theory. In this investigation, the uses and gratification perspectives will be used because individual predispositions and the functional use of IVR ther-

apy may impact treatment outcomes.

Research participants with a diagnosed communication disorder are currently being recruited from the Cleveland Hearing & Speech Center (CHSC). These research participants will randomly be assigned to one of two treatment conditions. Treatment group I will receive a traditional therapy program while treatment group 2 will receive an immersive virtual reality therapy program. Research data will include: levels of perceived presence in therapy settings, general attitudes about communication and communication disorder therapy, and motivations to receive treatment for communication disorders. Relationships between these differences and how they affect outcomes associated with traditional and IVR therapy treatment experiences will be explored.

The goal of the Virtual Immersion Center for Simulation Research is to provide a means to promote generalization of therapy skills into real life settings. IVR technology has the ability to offer an unlimited supply of lifelike settings for clients with speech and language disorders to practice their therapeutic skills in a safe and controlled environment. Initial pilot data for IVR therapy will be available in the Spring 2007.

Playing in a make-believe world: VR intervention for increasing playfulness of children with Cerebral Palsy

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Children with Cerebral Palsy (CP) are often restricted in their ability to play and their playfulness is also diminished. Their limitation of participation in play, which is supposed to be their main occupation at this period of their life, may impact their physical, cognitive, emotional and social development. The objectives of this study were to (1) investigate the feeling of enjoyment and success of young children with CP while playing in a low VR environment, and (2) examine whether an intervention using VR technology may improve the playfulness of the children in the physical world as well. This is an innovative study as it targets a very young population and explores the ability of VR technology not only for physical rehabilitation, but as a tool for facilitating social and emotional development.

Being a feasibility study, the research employed a single subject study design. The participants were a girl (6.0) and a boy (5.4) with CP, learning in a rehabilitation kindergarten. The children played 10 sessions with the Sony PS2 Eyetoy system in couples. Each child had 24 observations (pre-intervention, during intervention, and post-intervention), that were analyzed by the Test of Playfulness (ToP), which is a valid and reliable test, intended for children aged 6 months to 18 years. A significant improvement was found on the playfulness of one child. The other child showed some behavioral changes without a significant improvement of her playfulness. Both of the children managed to play with the Eyetoy easily, and experienced success and enjoyment. They preferred playing the games in which they could gain points. The initial results of this study suggest that playing in a VR environment has a promising potential of improving the playfulness of young children with CP. This low cost VR system presents a great opportunity for those children to experience feelings of fun, success and control in a normative, popular, age appropriate game. Furthermore it enables and motivates cooperative play with another child and may enhance the participation of the child with CP in play and leisure activities at school and at home.

Development and Feasibility Experiment of Virtual Reality Gait Training System for Knee Joint of Hemiplegic Patients

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Patients with stroke have difficulties with standing, walking, and frequently falling down because of gait disorder. Therefore rehabilitation training is required in order to improve gait disorder. For efficient rehabilitation training, suitable rehabilitation training is required appropriate to various symptoms of gait disorder. In the case of gait disorder of hemiplegic patients has an asymmetric gait symptom due to a hemiplegic paralysis. For suitable gait training for hemiplegic gait disorder, angles of hip, knee, and ankle joint are measured to grasp the condition of illness and difference between normal and abnormal sides. In particular, knee joint is more important than the others to patients with hemiplegia. At present two pieces of equipment are used to measure characteristics of walking and joint movement of hemiplegic patients in hospitals. Both measurement systems have the common advantage that the measuring result is comparatively exact. However these systems are used to evaluate only symptoms of hemiplegic patients. In other words these systems do not apply real-time feed-back such as joint angle in real-time during rehabilitation training process. For more efficient gait rehabilitation training, applying real-time feed-back is required. Therefore we developed marker based joint angle measurement system which is able to apply real-time feed-back using PC and PC camera. Also we developed Virtual Reality (VR) rehabilitation training system which is able to apply real-time feed-back using developed measurement system. VR tasks were constructed crossing stepping-stones to improve ability of knee control. In this paper, to validate accuracy of the developed system, we compared measured angle between the electrogoniometer and the developed system. Also, to validate feasibility of VR system, we performed experiment using a treadmill with same speed (2.0 km/h) and various target angles (40 degree, 50 degree, 70 degree). The purpose, we performed with various target angles, is that we ascertain that normal participants make a success of task with the abnormal target angle as well as the normal target angle. Four healthy male participants (age from 24 to 28 years) were recruited for this experiment. We measured average trial number to success each task had different target angle. In the result of accuracy test experiment, difference of measured knee angle range between electrogoniometer system and developed marker based system was from -2.92 to +2.93. Also, in the result of feasibility experiment, participants tried 3.29 times at 40 degree, 2.73 times at 50 degree, and 3.83 times at 70 degree. In conclusion we prove that the developed system is able to use in measurement of the knee angle because the results of developed system were similar to the electrogoniometer used in hospital. Also, we ascertain that VR system help with increasing control ability of knee joint of the participants. From now on we expected that developed VR gait training is possible to use in practical gait training with hemiplegic patients. Therefore we will need a clinical test to apply this system to patients with hemiplegia in hospital.

StarTour: A Low Cost Webcam Tracking System for Home-Based VR Motor Tele-Rehabilitation

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Stroke-related loss of upper extremity (UE) function can be recovered or improved via a repetitive task-oriented motor training regimen that practices activity targeting specific relevant movement, and is intensified in a hierarchical fashion based on patient progress. By designing VR environments that not only look

like the real world, but actually incorporate motor interaction challenges requiring real world functional behavior, the potential exists to create more effective rehabilitation methods. Thus far, early research suggests that VR technology has shown value in improving motor skills for post-stroke rehabilitation of functional deficits including reaching, hand function and walking. Further, tele-rehabilitation methods that patients can practice at home are proposed to increase treatment access, time spent doing rehabilitation exercises and when embedded in a game-based context, could enhance the engagement and motivation needed to drive neuroplastic changes that may underlie motor improvement. VR tele-rehabilitation tasks can also send performance information for storage and analysis to a remote central site that can be either observed and acted upon in real time or reviewed at a later point by the patients' therapist.

However, to create effective VR motor rehab systems, a 3D User Interface that supports natural interaction similar to what is typical in real world performance situations is required. Thus, advanced sensing systems with high sampling rates and six degrees of freedom, such as magnetic tracking systems, are often used to capture motion data accurately for the rehabilitation process. Such systems are typically employed to deliver motor rehabilitation in clinical settings that have good economic resources. However, home-based systems need to be affordable and easy to deploy and maintain, while still providing the interactional fidelity required to produce meaningful motor rehabilitation activity that can foster transfer of training to real world challenges.

Some researchers have tackled this problem by implementing off the shelf game console scenarios, such as with the Sony Eyetoy. However, these applications are limited in terms of giving clinicians the capacity to alter the stimulus parameters of the system as is needed to optimally rehabilitate precision UE motor skills beyond simple flailing! Also, such applications are restricted to the capture of unnatural single plane activity. We have addressed this challenge by creating a low cost optical motion capture system that employs off the shelf Logitech Webcams that track 6 DOF movement from low cost LED's attached to handheld adjustable "jogging" weights (or for that matter any relevant object). We have also constructed a wireless cell phone vibrating system that provides the patient with feedback to signal collisions with game stimuli or other interactional content. At the conference, we will present our StarTour stereoscopic game scenario and stimulus control interface for training relevant motor action involving supination/pronation, range of motion, general eye/hand coordination tracking and strength training. We are currently running motion capture fidelity trials with our system yoked to an Ascension magnetic tracker and will present this data, some user trial data, and will be giving out our software to interested collaborators for future testing and application design partnerships.

Gain-Matching and Perception of Self-Motion: The Relationship Between Optic Flow and Treadmill Walking

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Immersing patients in a Virtual Environment whilst walking on a treadmill may stimulate a greater level of effort by providing an engaging and motivating experience. Initial work has demonstrated that adjusting the rate of optic flow influences walking speed, and hence could enhance the recovery process for patients undergoing locomotor rehabilitation. However, some studies have also shown that there is a perceived mismatch between treadmill walking speed and correctly matched optic flow speed.

The consistency of this phenomenon within and between subjects is currently unclear; therefore this "gain mismatch" is being investigated in a treadmill-mediated Virtual Environment. A simple linear virtual walkway was presented to participants on a back-projected

screen, 5m wide and 2.5m high, using polarising projectors to create a stereoscopic view. A self-paced treadmill was interfaced to the environment, via an optical sensor, so that the walking of the participant produced virtual motion through the environment. The ratio of the actual movement to the displayed movement was mediated by software gearing, to enable investigation of gain mismatch.

Participants were presented with 40 gearing changes, ranging from 0.1 (10m in real world moves 1m in the virtual world) to 2.0 (10m in real world moves 20m in the virtual world) in increments of 0.1. Two conditions were presented to all participants in counterbalanced order. Condition one presented stepwise changes starting from 0.1 and increasing by 0.1 until a gearing of 2 was reached, descending in the same manner. The second condition also presented each of the gearings twice but in a randomised order.

Participants walked steadily on the treadmill, observing their movement along the virtual walkway. After each gearing change they gave a verbal judgement of the on-screen speed:

1. "Slow" (on-screen movement appears too slow)
2. "Normal" (on-screen movement appears to match walking speed)
3. "Fast" (on-screen movement appears too fast)
4. "Unsure" (after careful observation, the participant is still unable to decide)

After a short rest, the test was repeated, and then the same process was carried out for the second experimental condition (four tests in total for each participant). The actual distance walked and timestamp were recorded 5 times per second, and the current gearing was recorded with each participant response.

Although the study is still in progress, early indications, from only three participants, suggest that substantial changes in optic flow are required before they are perceived as unmatched. Moreover, the perceived mismatch is direction biased, with faster optic flow speeds more likely to be perceived as normal than slower optic flow speeds.

Unlike a traditional gearing system, which requires an increase in physical effort to drive the treadmill as the gearing increases, the use of software gearing allows the biomechanical effort to remain constant whilst altering the rate of progress through the virtual world. Incorporated into a rehabilitation program, increasing the perceived rate of progress could provide positive feedback and encouragement even at low walking speeds, whilst also providing the potential to decrease the rate of flow to promote faster walk speeds.

HandiSim: A VR-based Manual Wheelchair with Visual Feedback and Physical Simulation

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Piloting a manual wheelchair (MWC) is an imperious necessity for everyday activity and social life of a number of people with physical and/or cognitive disabilities. In the same time, such a control may become a tiring and stressful obstacle course during outside travels and social activities. These difficulties related to the use of the MWC come in addition to the motor and/or cognitive disabilities, and may reduce the autonomy of the person and lead to more isolation. Moreover possible negative sight of the others and lack of understanding may increase the feeling of handicap among people using wheelchair. In order to heighten public awareness to the difficulties encountered by people piloting a MWC, our purpose was to design a MWC simulator based on Virtual Reality technology.

The HandiSim project presented here may give a user access to a wide range of the sensorial and cognitive perceptions felt by a MWC user carrying out some everyday activities in a virtual urban area. Sensorial perceptions are provided in real time thanks to visual, audio and force feedback. The user wears a light stereoscopic head mounted display (HMD) and navigates in the virtual environment (VE) by manipulating the wheels

of the chair, just as in the real world, thanks to an adapted mechanism. The user may be involved in various action and communication tasks, such as withdrawal of money or talk with a teller. The HandiSim MWC takes advantage of the various well known potentials of VR technology: graduation of the difficulty/ realism of the situations, record of data, or review of the performance. Using our system, users such as estimators or urban developers can test the difficulty of the transportation or daily life activity with experiments and the record of data from motor output values as a resistance. The VE and dynamics of the MWC are developed using the VR platform Virtools, in collaboration with the Nautilus Society. A study of validation will be carried out in real and virtual conditions, with healthy subjects and age-matched users of manual wheelchair.

In a first step, this simulator is intended to heighten the awareness of the urban development actors and of the close relations of the MWC user. It also may be used as an educational tool to bring a change in the sight of the healthy people towards those who are suffering from disabilities. And finally the HandiSim MWC may also become a training tool to the secure practice of real MWC.

Several studies have been dedicated to the design of VR-based wheelchair simulators, mostly powered ones. Their purposes were related to training, decision-making aid or navigation aid. The novelty of our work is to address the physical perception of the manipulation of a MWC and the heightening of the awareness of healthy users with a general objective of handicap understanding increasing.

VR-enhanced treatment of emotional eating in obese subjects: a controlled randomized clinical trial

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Emotional eating is a dysfunctional eating behaviour that affects many obese subjects. It consists in eating food in response to negative as well as positive emotions. Clinical observations as well as laboratory studies have showed that:

- over-weight and obese subjects tend to eat more food in response to emotions than normal-weight subjects and
- tend to eat in response to emotions even when normal-weight subjects do not.

To help obese subjects to cope and manage the negative emotions related to emotional eating, we developed a new VR-enhanced therapeutic protocol including both pc-based and mobile sessions. The protocol lasts for two-weeks and it is administered in a in-patient setting.

It incorporates different clinical components, from progressive muscular relaxation and deep breathing exercises to cognitive-behavioural auto-monitoring techniques. Further, it includes some elements from emotion-focused therapy: emotion awareness and the induction of good feelings.

Specifically, it is composed by three VR therapist-based sessions, and three self-adminstered mobile sessions. During the VR sessions, subjects are immersed in a virtual environment in which they experience and learn relaxation by applying different relaxation techniques, listening to different therapeutic narratives. In the self-administered sessions, subjects continue relaxation exercises individually through the support of a mobile phone playing a relaxing video with a relaxing narrative.

The goal of this study was to evaluate the efficacy of this procedure in a sample of obese female patients. A total of 38 obese females (mean age 42; mean BMI 40) report-

ing events of emotional eating in the previous month were consecutively recruited and randomly assigned to three different groups: VR treatment; a similar relaxing protocol not supported by technology and a control condition. The questionnaires used were the State version of *State-Trait Anxiety Inventory (STAI-Y)*, the *Visual Analogue Scale (VAS)*, the *Positive and Negative Affect Scale (PANAS)*, the *ITCP-SOPI*, administered before and after each VR and therapist-based sessions, the *Weight Efficacy Life-Style Questionnaire (WELSQ)* and the *Beck Depression Inventory (BDI)*, administered only at the beginning and at the end of the whole treatment. Physiological assessments were also used.

Statistical analysis showed that VR group (n. 14) obtained higher and more significant improvements both in psychological (anxiety and sadness on one side, relax and good feelings on the other; weight-related self-efficacy) and physiological variables in comparison with the other treatment group (n. 10). Besides, VR group significantly improved the psycho-physiological state between the beginning and the end of the treatment. No similar result was found in the other groups.

In conclusion, this study suggests that the proposed treatment may be effective in reducing negative emotions, in improving positive ones and in improving the weight-related self-efficacy.

What factors come to play in our decision to use VR in therapy? Applying the Technology Acceptance Model with people who are already committed to VR

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Despite very positive results from outcome studies, the actual clinical use of virtual reality (VR) to treat mental disorders is still mostly limited to research settings. A variety of justifications may be evoked, from cost issues to general attitude towards VR or perceived ease of use. Instead of simply guessing on potential factors related to the intention to use VR in therapy, we decided to test how the Technology Acceptance Model (TAM; Davis, 1989, 1993; Venkatesh, 2000) applies to VR. The power of the TAM model to describe the variables involved in the intention of using a technology has been validated extensively. The TAM posits that *Intention of Use* of a particular technology is caused by two factors: *Perceived Ease of Use* (P-*Ease)* and *Perceived Usefulness (P-Usef)*. *P-Ease* is further explained by factors such as anxiety towards computers, self-efficacy, perception of external control, and enjoyment. The aim of the study is to empirically document factors that could have an impact on the intention of using VR in clinical practice. Because one has to know what VR is in order to be able to express an intention to use it, we targeted a population of people who were already interested in using VR. We adapted the classical items developed by Davis to test the TAM (1989, 1993) with a variety of technologies to the use of VR in clinical practice. A perceived cost (*COST*) factor was added to the proposed model as it was expected to play a role on *Intention of Use*. Since the TAM model is based on Ajzen and Fishbein (1977) theory of reasoned action, we also tested the potential role of *Attitudes towards VR (Attit)* as a mediator between ease of use and usefulness on intention of use. The current sample consists of 141 respondents (57% female), with an average age of 39,6-years old and an average of 11 years of clinical experience. Participants come from a variety of clinical settings: public setting (31%), private practice (22%), directors of a clinic or a research lab (21%), etc. They completed the questionnaire on-line (65%) or on paper.

The internal consistency of each scale is excellent (α >.80 to .90). The TAM model adapted to VR was first appraised with a series of multiple regression analyses. The general regression with *P-Ease*, *P-Usef* , *Att* and *Cost* is significant [R^2 = 69, Adjusted R^2 = .68, $F_{(4,119)}$ = 63.68, p <.001], with *P-Usef* being the only significant predictor (sr^2 = .48, p <.001). A regression where all four predictors of perceived ease of use are used instead of *P-Ease* is also significant (p < .001) but *P-Usef* remains the sole significant predictor. Factors that were not part of the original TAM model (*Cost* and *Att*) were therefore not tested with Structural Equation Modeling. Analyses were performed with the

EQS software. The final model provided an adequate fit to the data, as shown with a variety of fit indexes NFI = .90, CFI = .98, RMSEA = .045) and examination of the modification indexes. Examination of the statistical significance of each parameter of the TAM model revealed that intention to use VR in therapy is directly caused only by perceived usefulness of VR (*P-Usef,* .95, $p < .001$). Perceived ease of use (*P-Ease*) is significantly caused by a therapist's characteristics (perceived control, computer anxiety and perceived enjoyment) and, in return, significantly caused perceived usefulness (.78, $p < .001$). But the direct relationship between *P-Ease* and intention was not significant.

Our results show that *Intention to Use VR* is predicted only by *Perceived Usefulness.* Other factors such as cost, attitude toward VR or computer anxiety do not play a significant role in a clinician's decision to include VR in clinical practice. The results must orient dissemination efforts of VR toward documenting and highlighting the usefulness of this technology. Further study is also warranted with a population less familiar with VR.

Approaching Virtual Reality 2.0 – Creating and Sharing Open Source Virtual Environments for Healthcare and Research

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Web 2.0 refers to a second generation of services available on the World Wide Web (social networking tools, wikis, blogs, etc.) that emphasize online collaboration and sharing among users. Specifically, Web 2.0 empowers Internet users by allowing them to easily create and share their own contents. How will this trend affect Virtual Reality (VR)? VR technology is gradually reaching a level of maturity that brings this approach to the mainstream of healthcare, while it opens new opportunities and new challenges for research. In particular, VR has proven to be an effective means for improving clinical outcomes in mental health and rehabilitation applications. However, widespread dissemination of this technology is hindered by the high costs (up to $200,000 US) required for designing and testing a clinical VR application, usability problems, and the low availability of standardized protocols that can be shared by the community of researchers. A further deterrent to the adoption of VR in clinical practice is that most of the clinical professionals who are potentially interested in this approach have limited technological experience, and find it difficult to use VR systems. Finally, the majority of existing VEs for clinical psychology and rehabilitation are proprietary and closed source, meaning they cannot be customized to fit the specific needs of different clinical applications.

In the presentation, we will describe the technical and functional features of NeuroVR (www.neurovr.org), a free software platform that allows users to create, use and share VEs for clinical and research applications. The NeuroVR platform includes two main components, the Editor and the Player; they are implemented using open-source components that provide advanced features including an interactive rendering system based on OpenGL, which allows for high quality images. The NeuroVR Editor is developed by customizing the User Interface of Blender, an integrated suite of 3D creation tools available on all major operating systems, under the GNU General Public License; this implies that the program can be distributed even with the complete source code.

Using the NeuroVR Editor, the user can choose the appropriate psychological stimuli/ stressors from a database of objects (both 2D and 3D) and videos, and easily place them into the virtual environment. An interesting feature of the NeuroVR Editor is the possibility to add new objects to the database. The edited scene can then be visualized in the NeuroVR Player using either im-

mersive or non-immersive displays. The NeuroVR Player, leverages two major open-source projects in the VR field: Delta3D (http://www.delta3d.org) and OpenSceneGraph (http://www.openscenegraph.org). When running a simulation, the system offers a set of standard features that contribute to increase the realism of the simulated scene. The NeuroVR library includes different virtual scenes (apartment, office, square, supermarket, park, classroom, etc.), covering many of the most studied clinical applications of VR: phobias, obesity and eating disturbances.

Shared Virtual Environment (SVE): An environment for computer mediated communication

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Mediated communication is gaining ground on face to face communication. In mediated communication, a very important aspect is how a user perceives implicit and non verbal signals that are crucial in face to face communication. PASION (Psychologically Augmented Social Interaction Over Networks) is a European project that faces this mediated communication. PASION started the first of January of 2006 and it will end the 31st of December of 2009. PASION's working hypothesis is that in a mediated environment messages will take completely new forms and that these forms are due to group interactions in technology-mediated environments.

For contrasting this hypothesis, PASION will deliver an innovative Shared Virtual Environment (SVE) where a pioneering mediated social communication will take place. Using the SVE, two different types of applications will be developed: a collaborative work and a social gaming.

The SVE will be developed during the life of the project in an incremental way. At first, a set of libraries will be included for the development of different types of applications. Later, an authoring tool will be created; therefore the user will not have to have any programming language knowledge in order to develop the desired application.

During the first year of the project, a first version of SVE for the development of a specific social gaming application has been created. This first version is only for mobile devices and it has been developed in Java. For the storage of information, the native XML database, eXist, has been used. This first version of SVE uses XML schemes that have to be created as a first step. The first option is a simple graphical application that allows the introduction of the different nodes and subnodes that form the XML scheme as well as the type of information of these nodes (text, image, number or sounds, for the moment; it will be improved with as many different types of information as needed). Once the XML scheme has been defined, it is necessary to introduce the required information, that is, to fill in the nodes that we have defined in the scheme (XML file). Later, the XML schemes and files are used for the creation of the logic of the application. In this way a change in the image/clue/etc does not affect the logic of the application because it is stored in a XML scheme/file. That is where the application will access to show this information to the user. A change in the images, audio or language does not affect the logic of the application, the only change is that the file to be used is different.

With this first version of SVE, we have developed the first social gaming application, Bluenet (Bluetooth-Mediated Social Interaction in Outdoor Digital World). Bluenet is a Treasure Hunting game where participants have to visit a real city and have to find a final target. For arriving at the final target, participants have to find several sites. For helping this search, the system offers them a series of clues. With these clues, participants have to find sites until they have enough information to arrive at the final target. This is not the first treasure hunting game, but it is the first social game for treasure hunting that will be used for checking the importance of the augmentation of social clues. As an example of a treas-

ure hunting game, CatchBob (http://craftwww.epfl.ch/research/catchbob/) can be mentioned. CatchBob is a collaborative hunt in which groups of three people have to find and circle a virtual object on a campus. It runs on a mobile device (iPAQ, TabletPc).
For the next three years we will be working on the development of SVE and different types of applications, and in the near future we will be able to offer to the scientific community relevant results related to augmentation in social interaction over PDA networks.

Affective, behavioral and cognitive measures of stuttering during speeches to virtual and live audiences

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BACKGROUND
Stuttering is a speech fluency disorder with affective, behavioral, and cognitive components. The fear of public speaking (FOPS) is common in people who stutter (PWS) and those who do not (non-PWS). Virtual reality (VR), in particular virtual audiences, has been used successfully to augment treatment of FOPS in non-PWS. VR technology alleviates many challenges associated with exposure-based treatments, including: difficulty repeating realistic situations, decreased therapeutic control, and loss of confidentiality.
Stuttering has been measured in virtual worlds other than audiences and varies depending upon the interactions encountered in VR. VR has not been used to treat FOPS in PWS, perhaps because, until now, no direct comparison of stuttering behaviors across virtual and real environments existed.

Research questions included:
1. Are there differences in PWS' reactions when giving speeches to *live* and *virtual* audiences in terms of:
   Affective reactions (*self-reported communication, apprehension and confidence*)
   Behavioral reactions (*percentage of stuttered syllables spoken*)
   Cognitive reactions (*self-reported competence as a speaker*)
2. Do challenging and neutral VR audience behaviors lead to differences in the *percentage of stuttered syllables* in PWS?

METHOD
Twenty adults (10 PWS and 10 non-PWS) participated. Stuttering was measured using the standardized *Stuttering Severity Instrument-3*.

We audio-recorded participants as they gave three, impromptu, 5-minute speeches. Two speeches were given to virtual audiences (VAs) and one to a live audience. One speech was delivered to a *challenging* VA of approximately 20 listeners who were inattentive and made other non-verbal distracting behaviors (e.g., falling asleep). In the *Neutral* VA, audience members looked straight ahead and were neither distracting nor supportive. Participants viewed the virtual audiences via a HMD (VFX 3-d). *Live* audiences consisted of approximately 10 people who were attentive listeners. The order of speeches was counterbalanced.

Participants completed three standardized self-report questionnaires before and after each audience condition: *Personal Report of Confidence as a Speaker* (PRCS), *Personal Report of Communication Apprehension* (PRCA-24), and *Self-Perception of Communication Competence* (SPCC). We transcribed the speeches and coded the *percentage of stuttered syllables* (%SS) using standard procedures.

RESULTS
Repeated measures ANOVAs revealed no significant differences between VR and Live conditions for self-reported confidence, competence, or apprehension. Friedman's 2-way ANOVA by ranks revealed no significant differences in the %SS across audience conditions (power efficiency = .75). No significant differences were noted in stuttering behaviors between neutral and challenging VR audiences.

Repeated measures ANOVA revealed significant differences between groups for apprehension and competence, with PWS rating themselves as more apprehensive and less competent. There were no significant differ-

ences in confidence between groups.

DISCUSSION

This study presents the first direct comparison of stuttering in virtual vs. real world environments. No significant differences in stuttering behaviors in real and virtual audiences is a satisfying discovery for clinicians wishing to use VR to incorporate real-life situations into treatment.

Frequency of stuttering was similar in the challenging and neutral VR conditions. One explanation, supported by participant comments, is that the VR-Neutral audience was perceived as inattentive and uninterested, making them more similar to the VR-Challenging audience than originally intended.

Direct Biocontrol of Virtual Environments using Surface Electromyographic Signals

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Virtual reality (VR) is becoming increasingly important in numerous disciplines including aerospace, military, medicine, chemical and nuclear industry. Efficient control of VR environments, to a large extent, depends on the type of interfacing device used to measure the finger and hand movements. The current interfacing devices have to be externally worn and may be restrictive. Direct biocontrol of VR environments may be more natural, synergistic, light weight and nonrestrictive of free motion. We are developing techniques for direct biocontrol of VR environments using SEMG signals. There are two types of control possible for cyber-therapy: (1) control using finger/arm force, and (2) control using finger/arm motion. Force control can be used in VR environments for object squeezing and deformation, etc. Punching in VR games is an example of force control. We have developed techniques for object squeezing, and punching etc. using SEMG signals. We are developing techniques for tracking finger, wrist, and arm motion for use in the control of VR environments**.** The purpose of the present study is two fold: (1) to investigate if holding an object in the user's hand provides a better control of virtual object squeezing when compared to not holding any object, and (2) to investigate if extensor muscle provided a better tracking of the finger joint motion.

SEMG signals are dynamically acquired, filtered, and the RMS of a moving window is used for motion tracking and /or force tracking. In the first study, human subjects were asked to manipulate a virtual finger and squeeze a virtual object held by the virtual finger. SEMG from the subject's flexor muscle was used to move the virtual finger and squeeze a virtual object. The virtual finger movement was proportional to the SEMG until the finger touched the object. Once the virtual finger touched the virtual object, the force exerted on the virtual object was proportional to the SEMG. In the second study, SEMG signals from the flexor and extensor muscle obtained during semi-static and dynamic flexion-extension of the index finger, were fed, in realtime, to an intelligent system to obtain the joint angle for control of the virtual fingers.

The results showed that subjects were able to effectively squeeze (compress) virtual objects of various elastic stiffness, with or without holding any real object in the hand. However, the control was more accurate when the subject was holding an object in the hand ($p<0.005$). SEMG from extensor muscle provided a better accuracy when compared to the flexor muscle. In conclusion, SEMG signals can be used as interfacing devices for both motion tracking and force tracking VR applications.

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A Noninvasive Brain-Computer Interface Emulating Full Mouse Control

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Brain-computer interface (BCI) technology can provide nonmuscular communication and control to people who are severely paralyzed. BCIs can use noninvasive or invasive techniques for recording the brain signals that convey the user's commands. Although noninvasive BCIs are used for simple applications, it has been generally assumed that only invasive BCIs, which use electrodes implanted in the brain, will be able to provide multidimensional sequential control of a robotic arm or a neuroprosthesis. Our work shows that a noninvasive BCI using scalp-recorded EEG activity and an adaptive algorithm can provide people, including people with spinal cord injuries, with two-dimensional cursor movement and target selection. Users moved a cursor in two dimensions toward one of multiple targets simultaneously present on the screen. When the cursor reached a target, the user employed an additional EEG feature to select (or reject) the target. Thus, this task emulated the key features of mouse operation. The results indicate that people with severe motor disabilities could use brain signals for multidimensional sequential movement control without having electrodes implanted in their brains.

Targeted cortical reorganization via brain-computer interface (BCI) training in chronic stroke

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We have studied 8 patients with severe motor disability (MRC ≤ 1) resulting from a single, unilateral subcortical stroke (occurring at least 1 year prior), for whom there are virtually no therapeutic or rehabilitative treatments available. Although lesions in two patients extended into the insular region of the cortex, sensorimotor regions of ipsilesional cortex were not involved. A magnetoencephalography (MEG)-based brain-computer interface (BCI) system was utilized for this study. Patients participated in up to twenty training sessions with the aim of gaining volitional control of sensorimotor rhythms (SMR) recorded over ipsilesional hand sensorimotor areas. This was achieved via the BCI, which transformed the state of the SMR into a screen cursor display positioned in front of the subject. The subject attempted to direct the cursor towards one of two visual targets displayed on the screen. Performance feedback was provided visually in real-time. Successful trials (in which the cursor made contact with the target) resulted in opening/ closing of an orthosis attached to the paralyzed hand. This occurred simultaneously with a visual feedback reward display.

Training resulted in successful BCI control (defined as >75% success rate of desired orthosis action) in the majority of patients. This control was associated with increased modulation of SMR desynchronization as recorded from sensors overlying frontocentral and central regions of ipsilesional cortex. The location of neural sources underlying these changes in SMR has been more recently clarified with the integration of synthetic aperture magnetometry (SAM) source regression architecture. In comparison, sensor-based approaches revealed more diffuse desynchony foci over frontocentral and central regions of ipsilesional the hemisphere, likely due to large amounts of unaccounted MEG signal propagation. Thus, the integration of SAM with the existing BCI architecture, provides the potential to allow for BCI training that targets cortical regions with greater specificity. In turn, this training should drive more focal cortical reorganization within these areas. It is also predicted that this approach may also play an important role in increasing the performance of this BCI.

The Force Within the Game. NASA's

off-the-shelf Engagement Training

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President CyberLearning Technology

Researchers at NASA LaRC developed technologies using physiological measures for assessing pilot stress, sustained attention, engagement and awareness in a laboratory flight simulation environment. Biomedical spin-offs have emerged from this work through collaboration with medical centers and private industry.

NASA's technology goes beyond prior video game art in that it takes the form of a video game or training simulation that responds to physiologic activity in addition to joystick or game controller input. The technology is used with off-the-shelf video games and the ability of enabling a video game to respond simultaneously to physiological activity and joystick or game pad input provides a novel interactive mind-machine interface.

Sensors actively measure brain activity, anxiety and stress levels modulating the ability to play the games. Gaming now can have a purpose beyond the simple act of play. Playing "brain modulated" games increases attention span, memory and brain processing speed, decreasing anxiety and symptoms of stress while facilitating peak mental, physical and emotional well-being.

CyberLearning technology, LLC (CLT), under exclusive license from NASA, has commercialized this truly innovative immersive gaming technology in the areas of health, education and entertainment. CLT's technology has been used in medical and psychology offices throughout the US for the past three years, assisting thousands of individuals diagnosed with attentional disorders and learning disabilities. A consumer version of the technology was released June, 2005 with thousands now experiencing 'gaming that is good for you!'

Research will be presented demonstrating the benefits of using off-the-shelf commercial video games in attention and cognitive disorders.

CLT's NASA-developed technology includes a method of transforming physiological information obtained from biomedical instruments in order to use that information to modify the functioning of computer simulation or game controllers or joysticks. The technology involves modulation that transforms the controller signals received at the computer's game port prior to their being used by the computer simulation or game software. The result can be that the magnitude of the effect of the game or simulation's input device (e.g., joystick, game pad, steering wheel) is modulated by the strength of the physiological signal(s). By making the joystick's "control authority" proportional to the physiological signal(s), the player is encouraged to change the physiological signal(s) according to a programmed criterion (e.g., increase, decrease, or maintain) in order to perform better at the game task. When the physiological signal(s) are the target of physiological self-regulation or biofeedback training, the game play reinforces therapeutic changes in related physiological processes. However, the reinforcing feedback is preferably implicit in the task, and not explicit in the form of direct feedback (bar graphs, tracings), as in conventional biofeedback training. In this way, contingencies for subtle conditioning of the desirable physiological response(s) are rewarded.

The following topics will be presented:

NASA involvement in video game technology.

Research supporting improvements in attention and learning through playing EEG modulated video games.

How CLT has implemented NASA's technology in the areas of health, learning and entertainment.

Future directions including immersive games designed for physiologic improvement - "A Jedi Training Academy".

Enhancing Brain-Computer Interface Algorithms and Feedback: Implications for Use in Post-stroke Rehabilitation

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An electroencephalograph (EEG) based brain-computer interface (BCI) involves feature extraction from electrophysiological brain signals recorded non-invasively from the scalp of the subject while she/he is performing predefined mental tasks (e.g. motor imagery). A classifier then assigns the relevant EEG features to the corresponding mental tasks and the resultant classification is normally provided as visual feedback to the subject. It thus offers a non-muscular communication medium, critically needed by people with severe neuro-muscular disability, such as MND sufferers. It has been established that the systematic mental practice (MP) of therapeutic exercises is nearly as effective as actually performing those exercises for post-stroke rehabilitation [1]. However, it is difficult to motivate stroke survivors to undertake focused MP on a regular basis, particularly for arm rehabilitation. An MP of therapeutic exercises can play a role of a mental task in a BCI. Thus, this may render BCI suitable to provide on-line neurofeedback to help patients undertake more effective MP for the purposes of post-stroke rehabilitation. However, despite tremendous progress made in devising improved BCI technology over the last decade, it is still difficult to effectively account for non-stationary variability in stochastic EEG data due to varying brain dynamics and measurement noise. As a result, BCI systems lack sufficient robustness for constant practical use.

In order to examine the effects of non-stationarity in EEG, we have undertaken an extensive comparative evaluation of various spectral approaches to feature extraction to find a method that provides the best and most consistent feature separability. It resulted in the selection of power spectral density (PSD) approach for feature extraction. Additionally, a novel type-2 fuzzy logic (T2FL) based classifier design approach has been investigated to account for non-stationary variation at the feature classification stage. The T2FL classifier provides significantly better classification accuracy compared to state-of-the-art classifiers such as support vector machines (SVMs) and linear discriminant analysis (LDA). This is because the T2FL can learn the range of variability in the feature distribution from the training session and effectively handle changes in this distribution observed in the subsequent recording sessions within the so-called foot of uncertainty.

In order to assess the effect of feedback on the subject's performance, tests were conducted on six healthy subjects over nine sessions involving ball clenching by left or right hand as mental tasks, using two types of feedback: a simple cue-based paradigm and a game-like basket paradigm. In the cue-based paradigm arrows were displayed to indicate left or right actions, and the basket paradigm involved playing a game of horizontally manoeuvring a ball to a basket placed randomly in the bottom left or bottom right side of the screen. The majority of subjects showed significant improvement in performance with basket paradigm, which demonstrates that an appropriately designed feedback may provide enhanced motivation for undertaking motor imagery (or MP) exercises. This has obvious positive implications for using BCI to provide neurofeedback and thus facilitate more effective post-stroke arm rehabilitation through MP of therapeutic exercises.

Reference

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The role of stereoscopy in the sense of presence and the induction of emotions

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One of the main characteristics of Virtual Reality is that the users "have the feeling" of being in a different place from where they physically are, and this feeling has been named as "sense of presence". Currently, most authors agree to consider presence as a multi-component construct determined by two general categories of variables: user's characteristics and media characteristics. User's characteristics refer to the range of individual differences (for example, age, gender, user's perceptual, cognitive or motor abilities, and so on). The characteristics of the medium have been divided into media form and media content variables. Media form variables include the properties of a display medium (such as the extent of information presented, user's ability to modify the aspects of the environment, etc.); and media content variables include the objects, actors, and events represented by the medium. Regarding media form variables, one relevant highlighted in the literature is stereoscopy, the illusion of depth and 3-D imaging. This study investigates how stereoscopy affects the sense of presence and the intensity of the positive mood induction. A between group design was used and 40 volunteers were randomly assigned to one of the two experimental conditions (stereoscopy versus no stereoscopy). Participants were immersed in a virtual application designed to induce positive mood (relaxation and joy) which has been validated in previous studies conducted by our team. The mood state was assessed before and after the mood induction procedure. At the end of this procedure participants fulfilled two questionnaires that assess the sense of presence: the ITC-Sense of Presence Inventory (ITC-SOPI; Lessiter, Freeman, Keogh, & Davidoff, 2001) and the UCL Presence Questionnaire (Slater, Usoh & Steed, 1994). Differences in the change of the mood state achieved and in the sense of presence experienced by the users are analysed. The implication of the results for the concept of presence is discussed (work in progress).

The transformation of therapy through introduction of VR: a psychosocial integrated approach to investigate the VR based therapy design process

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In this study we offer the work done by Licent (Laboratory of Communicative Interaction and New Technologies) at the MIUR-FIRB-NeuroTIV project. The main objective is to prove the technical and clinical viability of using Virtual Reality Therapy in clinical psychology by means of portable and shared VR Systems, applied to anxiety disorders.

Method

The activity carried out by Licent research unit aims to verify the efficacy of the VR environments in anxiety disorder cognitive-behavioral treatment (CBT). The considered virtual environments were the Panic Disorders and Agoraphobia VR modules developed in the framework of the project. The study is based on:

- ergonomic analysis by means of *Guidelines on heuristic basis* (Galimberti et al., 2004)
- analysis of the therapist/patient interactions (51 sessions on the whole by 9 subjects and 1 who dropped out after 3 sessions) and on user-based tests (N°8), carried on at the end of the therapeutic cycle/protocol with the support of the Atlas.Ti 4.2 software for quali-quantitative analysis. 14 categories for the data analysis (56 codes on the whole) were defined on the basis of the elaboration of recorded material made by 6 independent researchers.
- Focus groups including therapists and stakeolders involved in the research were also carried out.

The observation of therapist/patient interaction allows us to study how VR is used and integrated in the framework of the therapeutic

protocol. Special focus is on VR scenarios and their ergonomic aspects, by the study of conversation between subjects and the interaction with the artifact; the observation of user-based tests allows the investigation of the patient's representation of the artifact and of possible/ wished interaction: outpatients are considered as expert users in order to evaluate and improve the structure and the navigability of VR scenarios. The perspective adopted is intended to improve the whole interactive process, abandoning both artifact and user-artifact centered interaction in favor of a situated and context sensitive ergonomic analysis. This approach gives evidence of how people, in specific social situations, are able to solve complex tasks producing shared meanings and achieving their goals during interaction.

Main results:
Data collected were analysed with reference to two different dimensions: ergonomic and clinical point of view. More specifically, 4 areas were delved into:

- Usability of the environments: to verify the correct technical operation of functions already or about to be implemented. The main applied methods were the functional analysis aided by expert heuristic evaluation and user-based tests.
- Interaction within the VR environment: to understand what level of environment interactions may be judged necessary and satisfactory for therapeutic purposes and for what reasons.
- Narration: to investigate the usefulness of including introductory pre-sequences or narrative sequences inside the environments, in order to complement the conventional therapist-guided exploration method with the aim of supporting the patient during the imagination/recollection process.
- Information on VR-based therapy: to comprehend the impact of information provided by the subject relating to experiences, representations and expectations regarding VR therapy.

The "emerging other": an essay about the study of social ecology of VR-therapy

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VR-based psychological therapy is largely used in different clinical approaches and a variety of studies can be found in literature about the experience of VR-therapy sessions. Usually, such studies are focused on a user's private experience.

With this contribution, we present a perspective to improve VR-sessions definition towards a "co-defined reality", abandoning both artifact and user–artifact centered interaction in favor of a "situated and context sensible" interaction analysis. Theoretical background is based on a ethnomethodological approach: this perspective gives evidence of how people, in specific social situations, produce shared meanings. From an *ecology of state*-oriented perspective we expanded the focus to the concept of *ecology of process*. *Ecology of state* includes both an *ecology of context*, which has been exhaustively defined and conceptualized by different research streams, and an *ecology of situation*. The wider *ecology of process* concept introduces the value of dialogical perspective, extending the social dimension of the studied context.

Within a dialogical approach, VR-based therapy sessions could be studied as a social co-construction of meanings, where therapist and patient negotiate what is going on, how it's going and who is present. From this point of view, both patient and therapist are interacting within a medium, with a medium and with the other in the medium. The last is an emergent actor that the therapist and patient co-define within their interaction and conversation; its emergence allows us to study VR-sessions as a social context where a new, more flexible way of producing and interpreting data is needed, since it is originating separately from therapist, patient and their interaction within the virtual environments.

Regarding produced data, the reference to

the ecology of process may be broken down into Interactional non-mediated data and Reported mediated data. Interactional data refers to observation of therapist's use of virtual environments (VEs), therapist-patient interactions during VE experience, situated interaction between users (therapist-patient) and co-definition of places and others emerging from virtual environment. Reported data are personal experience of VE use and observations reported by therapists.

Data (transcripts of 54 sessions by 9 subjects) has been collected during the MIUR-FIRB NeuroTIV project. In order to define a codebook, we analyzed, within a Grounded Theory approach, 54 sessions, and defined some characteristics of conversational actions performed. Patients and therapists can speak about elements inside the VE, or outside it; they can describe a social environment, or a physical place; they can speak about and to a virtual other: by doing each action (or a sequence of them) they co-define and negotiate a shared world. This shared world is not a social vacuum, but it's inhabited by a plurality of actors: the patient and therapist themselves, the other they are speaking about and the other they are speaking to.

Key elements of social presence for a psychosocial approach to VR based CBT: an interaction analysis

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An effective VR based CBT (Cognitive Behavioral Therapy) requires an explicit knowledge of presence and social presence dynamics fired by the virtual reality immersion. Presence research is often based on questionnaires or psychophysiological measures: they are useful to investigate the level of presence and social presence perceived but not enough to understand what it is happening and how interactive context can help the therapist to control the patient's "sense of being there" and "sense of being there with someone." The genealogy of social presence construct can be traced back to Mehrabian's (1969) concept of *immediacy.* Short et al. introduced and defined the term *social presence* as "the salience of the other in a mediated communication and the consequent salience of their interpersonal interactions." When messages are very simple or unequivocal, a lean medium such as CMC is sufficient for effective communication. Most of the literature suggests that CMC does not have the capacity to support social and affective interaction. However, recent reviews of the social presence literature question the extent to which this literature can be generalised to every communication medium and to every application of these media.

Method

We analyzed transcriptions of VR-based sessions with the interaction analysis method to point out social elements of the co-defined shared space that patient and therapist can experience within the virtual environment (VE). Data corpus is derived from transcription of 54 sessions (3 patients for each of the 3 therapists involved) within the VR based Experiential-Cognitive Therapy (ECT) treatment protocol for Panic Disorder and Agoraphobia. Subjects are consecutive patients, aged 18-55. They met DSM IV criteria for panic disorders and agoraphobia for a minimum of 6 months as determined by an independent clinician in a clinical interview, according to the SCID model. Interaction analysis qualitative method which has its focus on the 'action', at the same time observable as an object, and produced in a local and specific context. Within dialogical approach, VR-based therapy sessions could be studied as a social co-construction of meanings, where the therapist and patient negotiate what is going on, how it's going and who is present.

Discussion

Analyses point out how conversational dynamics between therapist and patient could bring a shared perception of a virtual other, expanding the social context of the VR-session. Virtual environment and the therapeutic place are populated by meanings and avatars that the therapist can use as narrative tips. Within a more traditional ergonomic framework, a psychosocial approach to VR-

therapy helps define social affordance that a designer could implement and therapist could exploit to enrich the immersion experience. We also investigated how specific elements emerging from the interaction process, in particular elements connected to the concept of social presence, influence the quality of the 'therapeutic immersive experience.' Such findings could be useful for an enhancement of the VE, to transform it into a more powerful tool, a shared place where therapist and patient can co-create social experiences.

The Sense of Agency and The Sense of Presence: The Example of Schizophrenia

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The sense of presence refers to a specific psychological state of "being there" intervened by an environment that engages our senses, implies our attention and encourages our active involvement. The environment can be real, virtual, or symbolic. The degree of presence felt in that environment depends on several factors such as the task or the type of interactions. According to the constructionist cognitive model, the interaction existing between the internal and external factors is a determinant of presence. However, recent empirical evidence in developmental research as well as studies on autism in virtual environments, suggest that presence may be more related to the experience of agency rather than to the state of "being there" or to a (re) construction of mental models. Following this idea, Brewer used the term "experiencing self" to characterize the awareness of oneself in the process of perception of the world.

In this work we explore the concept of presence under this aspect. We consider that agency is a variable or a component which participates in the type and degree of presence.

Schizophrenic dissociation comprises many symptoms which have in common disintegration, psychic disorganization and depersonalization. For instance, in the delusion of influence the individual does not feel in control of her/his movements and thinks that she/he is a passive instrument in the hands of an external will. According to several authors schizophrenia might be a "pathology of consciousness" and a deficit of agency. Thus, we can wonder what the level of presence is in schizophrenia patients even though they may not feel fully in control of their movements. We believe that exercising agency increases the sense of presence in schizophrenia in virtual reality tests, since agency and presence are intrinsically related.

We use virtual reality tests in which the subject's image and his surroundings are projected by a web cam in a virtual world. The user interacts with this virtual world by means of his movements. Those tests require a first person experience and an important sense of agency, as the user is not only an agent, but also sees herself/himself being the actor. We present preliminary results of a sample of ten schizophrenic patients and ten healthy subjects who were tested and who filled out a presence questionnaire. The results show that the schizophrenia subjects scored high in the presence questionnaire. We therefore suggest that virtual reality tests could be a good tool to rehabilitate agency, since the user is an active participant and fully engaged, even more so than in a real environment.

According to our findings, we support that within both controls and schizophrenia patients the levels of presence is correlated to agency. More specifically we argue that there is a radiant that starts with very low level of agency and physical passivity to a sense of being completely engaged in an environment.

A Second Life for Telehealth?

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Massively-multiplayer online role-playing games (MMORPGs) are persistent 3D digital environments in which a large number of players interact with one another through avatars on a daily basis. In recent years, MMORPGs have been expanding rapidly, with global memberships exceeding 15 million as of 2006. For example, Second Life, one of the most popular MMORPGs, has reached a milestone of 2,000,000 registered users and is still growing. Furthermore, revenues for MMORPGs exceeded half a billion dollars in 2005 and are expected to reach over a billion dollars by 2009.

The increasing popularity of this new paradigm in computer gaming stresses the need for investigating the opportunities they open for virtual reality-based telehealth services. Previous studies have suggested that virtual reality (VR) can be effectively used in telemedicine as an advanced communication interface, which enables a more intuitive mode of interacting with information, and as a flexible environment that enhances the feeling of physical and social presence during the interaction. However, this approach is still limited by several economic, technical and ergonomic issues, such as the cost of developing virtual environments (VEs), bandwidth restrictions, the difficulty of implementing multi-users virtual systems, and the lack of technological expertise of patients and clinicians. This paper analyzes how the emergence of MMORPGs can help to address these issues and contribute to improve the delivery of state-of-the-art health services. In particular, it examines the potential and challenges of using this combined approach in mental telehealth - the use of telecommunications to provide mental health information and care at distance.

National Internet-Systems of Medical and Pharmaceutical Information in Post-USSR countries

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Today the rash development of medicine and pharmacy can be noticed. Nowadays it appears that there is a necessity for modernizations in systems of medical and pharmaceutical information in the post-USSR countries because of the wide range of diseases, methodic nature of treatment and quantity of available drugs on the markets. Existing systems in modern circumstances, in conditions of limited labor and financial resources, and large implantation of evidence-based medicine, often can't effectively satisfy the requirements of the population and health professionals in medical and pharmaceutical information. The objective of this work was to determine the efficiency, performance requirements and financial practicability of using new (for post-USSR countries) systems of medical and pharmaceutical information, which are based on data communications via Internet. The work was based on the study of Ukrainian project Doctor.UA (non-commercial project which provides health professionals and citizens with quality medical and pharmaceutical information through the Internet, project is launching by JSC "Apteka Doctor").

The introduction of Doctor.UA is scheduled in several stages. First of all in January, 2003 a four-year test project opened, which was the part of corporate site of the company (http://apteka-doctor.com). It was named Pre-Doctor.UA and it modeled Doctor.UA in simplified form.

Pre-Doctor.UA has realized the following functional units (some units – partially):

- reference information for visitors in different directions of medicine;
- information about drugs which are available on the market (incl. instructions for using);
- teleconsultations;
- information about healthy lifestyle and role of preventive maintenance;
- news of medicine and pharmacy;

During January, 2007 the results of the activity of Pre-Doctor.UA were drawn up. The following information was analyzed for deciding given tasks: statistics systems, usability-testing, interviewing the visitors. Statistical data of attendances of the whole project and

separate it services was explored. The results from three different statistics servers were studied and the index of average attendance of the project was determined: it forms 406 persons daily; the growth was rather essential from at average 27 visitors daily in 2003, then 244 in 2004 and 650 in 2005, to 704 visitors daily in 2006. During that time the system has processed 33584 inquiries for granting the instructions for using a determined drug. Qualified specialists provided more than 1000 teleconsultations in 12 directions of medicine and pharmacy. In 2006, 97% of interviewed visitors (n=300) positively appreciate the idea of launching Doctor.UA.

As a result of conducted analysis of activity of Pre-Doctor.UA the necessity of large-scale implantation of Doctor.UA is planned for 2007-2009 (in 3 stages). Internet-systems of medical and pharmaceutical information proved their practicability of use in post-USSR countries. In this region such systems effectively solve the main tasks, satisfy requirements of visitors and have a significant popularity. Today the realization of such projects demands investment, however, they have good independent financial perspectives in the near future.

Cyber-Coaching in Quebec: Some Theoretical & Practical Dimensions

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It is increasingly understood by a growing number of Quebec-based industrial and clinical psychologists that Cyber-Coaching has come of age. According to extensive market surveys, professionals, the public and organizations alike are ready to take the next logical step of the Internet era. Yet doing so raises a host of ethical, theoretical and practical questions. These questions must be resolved satisfactorily prior to the wholesale adoption of cyber-coaching as a mode of interaction.

The ethical questions are clear and hinge on whether it is morally acceptable and equally effective to engage in cyber-counseling, as opposed to traditional methods of treatment or coaching. In principle, there is no substitute for the type of interaction that has characterized coaching from time immemorial, a point made clear by the governing body in the province of Quebec, the Quebec Order of Psychologists. Yet, the body has acknowledged in a recent position paper, itself in turn fortified by the latest research in the field, that cyber-interaction appears to be an inevitable trend and should be allowed to develop with the proper limitations protecting all parties involved, particularly the public at large. Its central considerations are effectiveness, privacy and security.

In theoretical terms, the advent of cyber-coaching presents professionals with both opportunities and dilemmas. The opportunities include the elimination of wait times, commuting, time barriers delimited by the business day and as well facilitates the incorporation of people from diverse or rural areas into mainstream or urban coaching. A crucial element of the cyber-practice enthusiast's approach is to allow clients to choose their own coach, as opposed to having one assigned or appointed to them. The web portal through which cyber-coaching is conducted is designed to ensure maximum user-friendliness and maximum user comfort, to the extent that individual coaches can be chosen on the basis of their approach, availability and personal substance as manifest in their own video presentation. It is the group's hypothesis that, if spontaneous affinity has been definitively isolated as a key success factor in coaching and counseling, then the success of cyber-coaching will be positively affected by enabling clients to choose their own coach.

A word about practical considerations will round out our position paper. There are serious issues in the design and implementation of a cyber-coaching regime, chiefly from a technical standpoint. The public network is an excellent example, as it does not always appear to be able to support the perfect synchronicity of voice and image that this medium demands, particularly during peak Internet usage hours. Similarly, designing a web portal which facilitates secured and privileged coaching sessions without technical flaws

has proven to be a challenge. Further, minimum PC requirements and tech support for video-camera installation and operation have also been factors in launching our portal. A final practical matter has been the issue of provincial and state positions on cyber-practice, as the latter each regulate their own jurisdictions. Having thus far addressed only Quebec, practitioners must anticipate tailoring their cyber-practice to meet the standards laid out by Canadian provinces and American states.

The Butler Project: First results of usability validation of a cognitive and emotional tele-assistance system for the elderly

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The Butler Project offers a cognitive and emotional tele-assistance system for the elderly. Specifically, with this system it is possible to carry out early diagnosis, intervention, and follow-up of the physical, cognitive, and emotional state of elderly people, and in this way to improve their quality of life and to prevent their social isolation.

From the technological point of view, the Butler system offers the elderly several tools based in telecommunication and Virtual Reality techniques. From e-mail, chat and video-conference applications designed to help the elderly to keep, improve and increase social relationships, to virtual environments designed to induce positive emotional states (joy and relaxation) and to learn techniques in order to reduce negative emotional states (relaxation, mindfulness, etc.) or the *Book of Life*, a specific tool used in order to create an individual memory space composed by several audiovisual stimuli related to their own life and shared it with other users in order to create a collective memory space.

Moreover, the Butler system offers several professional advantages. For the psychologist, this system offers an early detection of emotional state, diagnosis, easy assessment and therapy tool. For the geriatric hospitals, this system can be used like an occupational therapy tool. In this way, the professional (psychologist and geriatric hospital) can be warned by the Butler when it detects a severe emotional state.

The aim of this presentation is to describe in detail the first results of the validation of the Butler system. Specifically, in this presentation we will show the first phase of this validation: usability. In order to carry out this validation a representative sample of final users has been selected, from users without previous experience in the use of computers, to users with some experience. But, in all cases, any user has a high knowledge of computer use.

The Change of Brain Potentials to Offense Behavior Experience in Virtual Environment

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The present study aimed to find the P300 event-related potential (ERP) using a virtual environment in guilty knowledge tests. The guilty knowledge tests utilize P300 amplitude as an index of recognition of critical details of a crime or other concealed information. Participants were randomly assigned to one of three groups: an offense group, a witness group, or a control group. There were a total of 45 male participants (15 per group). EEG was recorded with silver electrodes attached to sites Cz, Pz, P3, and P4. Three group participants were trained and then performed each behavior scenario. The offense scenario involved crashing a car in the road, and fixing it at an auto repair shop. Probe items involved the make of the crashed car, fixing the car, and the location of repair. The witness scenario involved observing all of of-

fense group's behavior: car crashing and fixing a car at an auto repair shop. The control scenario involved driving a car to the destination safely. When participants arrived at

the laboratory, an assistant explained the experiment to them. Each participant was randomly given the scenario with offense, witness, or control. Offense participants were instructed to commit a car crash in a virtual environment. The offense VR consisted of getting in a limousine and crashing the car against a street light, and after the accident, the car was fixed at an auto repair shop. The witness participants observed all the offense group's behaviour through VR by using a head-mounted device (HMD). The control group drove the same route where the offense group drove in VR, but they had no accident. This study is ongoing, and it is expected that a larger P300 response is seen to the probe stimuli than the irrelevant at Pz in the offense group. The target would be larger than the probe, the morphologies of probe and target would be similar in offense and witness group. There would be little difference between the probe and irrelevant P300s in the control group. The responses to the probes which were similar to those of the irrelevants indicated that the control group was not knowledgeable for offense behavior. Probe responses similar to Target responses in offense and witness group would indicate that the subjects recognized the Probes and, therefore, the determination was offense information present. There would be some different probe P300s between the offense and witness group, because the Offense group with a guilty conscience were in a deceptive role. The predictable results will show that the response difference depends on the group conditions. This would provide the predictor of a malingering, lying or crime. We would suggest that the use of concealed information testing with experience in a virtual environment is more likely to promote general acceptance in the field. The truthful and deceptive responses in the three groups would provide more specific differences because the participants determined, according to their own group, whether to respond truthfully or deceptively on the guilty knowledge test.

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Detection of Concealed Information: P300 Response to a Visual Guilty Knowledge Test in a Virtual Mock Crime

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Deception (or lie) detection based on physiological methods including respiration and electrodermal activity have been used to identify the guilty. More recently, event related potentials (ERPs) which can be considered to be affected by the recognition of important events are commonly used. The P300-based guilty knowledge test (GKT) uses the P300 amplitude as an index of actual recognition of concealed information relevant to the crime that the perpetrators remember. Few field studies have assessed the GKT in real-life criminal investigations. Using the benefit of virtual environments, the validity of the GKT should be higher in mock-crime studies that are more akin to real crime. The purposes of this study were to examine the P300 signature of concealed information using GKT in a virtual mock crime and to investigate whether virtual mock crime and P300-based GKT are useful in the detection of deception. 38 male undergraduates were randomly assigned to one of the two possible roles (Guilty / Innocent) and then performed a mock crime scenario in a virtual library using the HMD and keyboard. The virtual library of normal appearance had 15 typical objects. The guilty participants were instructed to conceal a lost roll of bills in three objects with the liberty of choice and then to lie about their concealing behavior. The innocent participants who had never concealed a roll of bills explored the library

freely. The visual GKT comprised six stimuli and was performed on a monitor. The first stimuli was always a question ("Is this the place where the roll of bills was concealed?") and the following five alternatives comprised Probes(concealed information which was known only to the guilty), Irrelevants (unrelated to the criminal acts and thus unrecognized by all participants), and Targets (usually irrelevant items, but all participants were asked to do a task). The GKT stimuli protocol was similar to that used by previous studies. For data acquisition, P300 was recorded with silver electrodes attached to site Pz using QEEG-4 (LXE3204, LAXTHA Inc) and the response time to pressing the button from the stimulus onset was measured. Both conditions showed the strongest P300 peak amplitude for the targets. Remarkably, guilty participants reacted with stronger P300 peak amplitudes to probes than irrelevants, whereas no differences in innocents occurred (i.e., probes was more like irrelevant). In behavioral measurements, both conditions elicited longer response time for targets than for probes or irrelevants. Although not significant, the data showed a trend toward a slower response to probes than to irrelevants in guilty but not in innocent participants. This study concludes with discussion of future research and the potential for an index of recognition of critical details of a crime or other concealed information as a detective method in a wide area including criminal and clinical cases. This is the first study to use a mock crime in a virtual environment to detect concealed information. This study provides the basis for developing the successful representation of crime situations by incorporating a 3D-based environment and applies theses in forensic investigations.

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Brain Activities reflects feeling of Ownership of a Virtual Body: An fMRI Study

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Virtual reality technology advances make the user able to "have" their own body in virtual environments. The feeling of ownership of virtual limbs is an important factor for understanding and constructing interactive virtual environments. Previous studies reported that the user who has a virtual body and interacts with virtual environments could affect the user's feeling of presence about the virtual environment. Therefore, observing the brain activity is necessary in order to assess that the user's perception and cognition for the virtual body as well as stimuli occurring on the virtual body. For this, virtual reality contents were composed of an avatar lying on the MR bed so that subjects could see the avatar's body in a virtual MR room similar to a scene in real MR scanning. A virtual fire is rendered on the virtual avatar's thumb to investigate ownership of the virtual body and cognition to the stimuli occurring on virtual limbs. Eight right-handed healthy subjects were recruited (age: from 20 to 23, mean=20.9, SD=1.1). The fMRI was conducted with a 1.5T machine (GE Medical System). After the fMRI experiment, subjects answered to two questions: 'Q1- How much did you see the fire on the avatar's hand as a fire on your own hand in the virtual reality?' and, 'Q2- How strong did you feel the stimulus?'. We conducted a correlation analysis with the brain activities when the fire occurred on the avatar's finger and the subjective scores of each question. The correlation analysis revealed that several brain areas were positively correlated with each question. The results showed that the right precentral gyrus, right middle frontal gyrus, right inferior frontal gyrus, left SMA, right SMA, right middle temporal gyrus, right angular gyrus and right lingual gyrus are correlated with Q1. Furthermore, the left temporal pole, right me-

dial temporal pole, left putamen, left SMA, left cerebelum, left inferior frontal gyrus, right inferior frontal gyrus and right amygdala are correlated with Q2. Brain areas correlated with Q1 question might be interpreted as a subject seeing the virtual body as their own. This is supported by the data showing that the precentral gyrus and SMA is involved in the processing of proprioception. In addition, brain areas correlated with Q2 question could be illustrated as the subject's perception of a stimulus occurring on the virtual body as occurring on their own body, too. This is also supported by the fact that the amygdala is known to be involved in the processing of fearful stimuli and that other brain areas correlated with Q2 question are correlated with self-attribution. This study reveals that brain activities reflect the user's feeling of ownership of a virtual body in virtual environments.

Spatial Processing in Near and Far Space Using Virtual Reality Methods: an fMRI-Study

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Introduction: Several studies show dissociations between task performance in peripersonal (near) and extrapersonal (far) space (e.g., Halligan &Marshall, 1989; Vuilleumier et al., 1998). It was also shown that spatial processing in near space displays stronger activation in the dorsal stream while in far space stronger activation in the ventral stream was revealed (Weiss et al., 2000). In general, spatial processing is assessed by abstract paradigms (e.g., line bisection) without practical relevance. Furthermore, the neural basis of spatial processing in near and far space was not assessed in virtual reality. Therefore, our objective was to examine the neural basis of spatial processing by using three dimensional presentations of everyday objects. Therefore, virtual reality methods were combined with functional magnetic resonance imaging.

Methods: 12 healthy male right-handed volunteers aged 20-29 (mean = 26, SD = 2,8) performed a judgment task in a 1.5 Tesla Philips Gyroscan Intera MRI System. The stimuli were presented via a Head Mounted Display (FOV 30°). Participants were required to judge if an object (e.g., test-tube) was shifted to the left or right or if it was centered in comparison to a reference object (e.g., wooden shelf) in near as well as in far space. The judgment task consisted of three different conditions, namely horizontal, vertical and diagonal displacement of objects, which were presented in 60cm and 150cm distance in virtual space. Imaging data was analyzed by using SPM2.

Results: For different positions of the objects (shifts to the left, right or center position) over all conditions, no difference in activation patterns was found ($p = .001$). The same applies to different displacement of objects (horizontal, vertical, diagonal). Therefore, these conditions were subsumed for further analysis. Comparing near space with far space resulted in stronger bilateral cuneus as well as lingual and occipital gyrus activations. As for far space, stronger left inferior parietal activations were observed.

Conclusion: The results found in line bisection in reality cannot be transferred to everyday objects in virtual reality. Comparing near with far space left occipital activations which could be due to a larger retinal image of the objects and the restricted field of view in near space. The lack of other activations indicates that objects in near space were processed as simple objects without spatial aspects. Far space compared to near space left stronger left parietal activations which are associated with the dorsal stream of spatial processing. This indicates that objects in far space were processed spatially which could be due to a better immersion in far space. Taken together, differential processing of virtual objects in near and far space was found, but spatial processing only occurred in far space while stimuli in near space were not processed spatially.

Development and Validation of a Tool for Assessing Emotional Response Characteristics in Emotional Situation using Virtual Reality: Experimental Application to Patients with Schizophrenia

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Emotional expression is one of the basic abilities which are needed to live daily life. And emotional expression is necessary to make and manage relationships with other people. Emotional expression skills training is one of the stages of social skill training for psychopathic patients that is necessary for them to return to a normal social life. Conventional emotional expression training or assessment methods have experienced some problems in measuring method since it is hard to measure objectively because patients' assessment depends on therapist ability. In addition, it is difficult to provide emotional or social situations in the same way. Virtual reality (VR) techniques could overcome these shortcomings that occur in conventional studies by providing a method to attain objective measurements. In addition VR techniques could give emotional and social situations in interpersonal relations using dynamic interaction with avatars. In this study, we developed a VR system to measure emotional expression characteristics. VR tasks are composed of three positive and negative situations. These contain situations of family, friend, and coworker in variety of environments such as house, café, bakery, and street. Participants are expressed one's opinion or thinking within provided time after conversation with avatars in each situation in a virtual environment. The developed VR system measured "beginning of reply", "duration of reply", "eye contact during experience", and "eye contact during expression". In "beginning of reply", participants showed faster reply in negative situations than positive situations (normal control: 4.66 sec in positive situation, 3.89 sec in negative situation; patients with schizophrenia: 4.84 sec in positive situation, 3.62 sec in negative situation). And in "duration of reply" and "eye contact during expression", participants showed more reply and eye contact in negative situations than positive situations (normal control: 13.02 sec in positive situation, 19.32 sec in negative situation, patients with schizophrenia: 12.13 sec in positive situation, 14.82 sec in negative situation), (normal control: 54.80% in positive situation, 74.04% in negative situation, patients with schizophrenia: 39.43% in positive situation, 47.98% in negative situation). Also in "eye contact during experience", participants showed less eye contact during experience than expression (normal control: 50.45% in positive situation, 58.23% in negative situation, patients with schizophrenia: 26.09% in positive situation, 32.20% in negative situation). This can be explained in that they did more reply and eye contact to reduce their stress in negative situations because they get more stress in negative situation. And patients with schizophrenia showed a deficit in emotional expression and applied suppression or defense mechanisms because they have weakness in negative stimulus. Considering the result, the developed VR system could offer controllable social and emotional situations. Also, presented parameters indicate expression characteristics of humans in emotional situations, particularly under stressful situations. Therefore, we conclude that the VR system could be used as an emotional expression assessment tool by measuring behavior and emotional expression characteristics in social situations in a natural manner.

Cognitive remediation impacts on children with conduct disorder

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Conduct disorder (CD) is often associated with learning disabilities and social difficulties (Green et al., 2002) and it is a risk factor for psychiatric disorder in adulthood (Kim-Cohen et al., 2003). Even though CD is generally explained by psychosocial factors, some authors suggest that it could be associated with specific cognitive deficits (Moffitt, 1993), especially in attention and executive functions (Baving et al., 2005 ; Hogan, 1999). Since research has shown that a cognitive remediation program is efficient with ADHD children who also have an executive dysfunction (Klingberg et al., 2002, 2005), it also appears promising to explore new intervention strategies adapted to CD children.

The main goal of this study is to assess the efficiency of the cognitive remediation program to improve the executive functions in children with CD and to evaluate the impact of such a program on behaviour regulation.

Thirty-six CD children between 7 and 14 years old were recruited from specialized CD classes. Children presenting learning disabilities were excluded from the study. All participants were assigned randomly to one of two groups, a cognitive remediation group (n=17) and a reference group (n=19). Four participants withdrew themselves from the study from lack of motivation.

The cognitive remediation program used computerized working memory tasks. The cognitive remediation program was integrated in children's daily school activities, three times a week (30 minutes) for 10 weeks. Evaluations were conducted pre and post treatment including neuropsychological measures (attention and executive functions) and behavioural questionnaires.

Variances analyses (2 Groups X 2 Time measure) were conducted on each dependant variable. The results showed that the participants in the cognitive remediation group improved their inhibition control comparatively to the participants in reference group. Furthermore, on behavioural questionnaires (teachers version), the results showed an improvement on rules' transgression, inattention and hyperactivity scales, for participants in the cognitive remediation group only. In conclusion, strength and limit of cognitive remediation program with CD children are discussed. Further research perspectives are also presented.

Virtual Reality Visuospatial and Wayfinding Assessment of Healthy Adults and Adults with Mild Dementia of the Alzheimer's Type

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One of the early observable signs of Dementia of the Alzheimer's Type (DAT) can be seen in difficulty finding and navigating around familiar and unfamiliar environments (wayfinding). Visuospatial (VS) perception, the ability to process and interpret visual information about where one is in space, is a cognitive process often assessed and monitored in clients with DAT since VS impairments are thought to contribute to wayfinding difficulties, increased disorientation and a loss of functional independence. Traditional visuospatial paper and pencil tests typically employ 2D representations of 3D objects that must be visualized and mentally processed, rotated or transformed. In rodents, wayfinding and place learning performance is commonly tested using the Morris Water Task, which requires the animal to find their way to a submerged platform in a round pool of "milky" water. However, such wayfinding tests are not practical for use with humans. To address these traditional limitations, two VR environments will be used to assess visuospatial (VS) perception (3D VRVS task) and wayfinding/navigation (VRMWM task) in healthy adults (HA) and adults with mild Dementia of the Alzheimer's Type (DAT). The VRVS task delivers 3D stimuli, viewed on a PC using stereoscopic shutter glasses and

allows manipulation of virtual objects using a tracking/input device. One advantage over existing 2D paper-and-pencil tests is the ability to view and manipulate objects in 3D using a hand held input device that allows for more precise measurement of performance. Pilot tests with this VR system on healthy young and aged adults produced no adverse side effects and results indicated later improvements on 2D paper and pencil mental rotation following brief practice with the 3D VR tests (Rizzo et al 2001). A VR version of the Morris Water Maze (VRMWM), designed by researchers at the Olin Neuropsychiatry Research Center, allows the user to navigate through a virtual water pool on a PC screen to find a hidden platform using a joystick. Precise measurements of time and distance traveled can be recorded and previous research has demonstrated that older adults take longer time and cover more distance when engaged in finding the platform in the VE than younger adults (Astur et al 1998). The aim of the current research is to compare the 3DVRVS and VRMWM tasks with traditional 2D paper-and-pencil tests as cognitive indicators of the early stages of DAT. From January 2007, a total of 30 healthy adults and 30 adults with mild DAT (CDR=1) will be recruited. Each subject will complete the VRVS and VRMWM tasks, nine 2D paper-and-pencil tests and two 'real-world' wayfinding/ navigation tasks. The VRVS tasks will be presented in monoscopic and stereoscopic format and in passive and interactive formats. The 'real-world' wayfinding tasks involve finding a hidden platform in an empty room and finding an unmarked chair in an auditorium from different starting points. Usability issues and preliminary data analyses (regression) comparing results of VRVS, VRMWM, paper-and-pencil and real-world navigation tasks between HA and DAT groups will be presented for the sample collected from January 2007 to May 2007.

Asymmetries of covert attention in virtual space

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Introduction: Based on clinical and experimental neuropsychological findings, 3D-space is divided into several distinct regions. The most commonly examined spatial distinction concerns the left and right visual hemifield, showing an unequal distribution of attention. Healthy subjects demonstrate a pattern of subtle attentional asymmetry, called pseudoneglect: a facilitated processing of left-sided stimuli (McCourt & Garlinghouse 2000). Clinically, asymmetries of attention occur with the syndrome of neglect, which is closely linked to lesions of the right cerebral hemisphere and which result in a prominent visual attention asymmetry in favour of the right visual field. However, little is known about whether analogous attentional asymmetries can be identified in virtual space. The two most important aspects of spatial depth are the peripersonal and the extrapersonal space (Previc, 1998), which are also anatomically dissociated by dorsal visual pathway and ventral visual pathway processing respectively (Goodale & Milner, 1992; Weiss et al., 2000). Additionally, there is evidence for differential processing of the upper and lower visual field within the networks of visual attention as well as respective biases towards the extrapersonal and peripersonal space. (Previc, 1992).

To investigate normal attentional processing of different areas of virtual 3D-space, we addressed whether: (1) Pseudoneglect effects similarly occur in virtual space, and (2) Potential asymmetries depend on the spatial height and depth of the targets.

Method: We systematically tested distribution of covert visual attention along the three spatial dimensions (side, depth and height). The subjects' visual attention was examined by a virtual reality paradigm requiring covert shifts of attention to the left and right visual hemifield as well as the upper and lower halves of the visual field within peripersonal (30 cm) and extrapersonal (270 cm) virtual space. The subjects were required to react to validly and invalidly cued targets. The paradigm was created with the ReactorMan software (Valvoda, Assenmacher, Kuhlen & Bischof, 2004), and displayed with a stereo

projector on a rear projection screen (240 x 180 cm). The subject's head was fixed by a chin rest to avoid head movements. Reaction times (RT) were logged using external hardware to provide data with potential sampling and delay errors below 0.01 ms.

Results: The results show highly significant main effects of validity (longer RTs for invalidly cued targets), side (faster RTs for left-sided targets) and height (slower RTs in the upper visual field). A significant interaction of validity*height*side*depth indicates differential distribution of covert attention in space: Pseudoneglect was present for invalidly cued targets in peripersonal as well as extrapersonal space but it was more pronounced in the upper visual field. For validly cued targets, pseudoneglect was restricted to peripersonal space.

Conclusions: Shifts of covert attention can also be initiated in a virtual environment and can be reliably assessed within different regions of virtual space. In our study, healthy subjects showed varying degrees of pseudoneglect depending on the exact location of the targets within 3D-space. Thus, VR techniques prove to be a promising diagnostic tool to assess basic visuo-spatial attentional functions.

Three-dimensional uni- and crossmodal cueing in spatial shift of attention: a VR study

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Introduction: The main aim of this study is the development of a three-dimensional cube shaped paradigm to assess cueing effects on spatial orienting of attention. Up to now cueing effects have only been assessed in two dimensional space. In three-dimensional space it remains unclear if cues need to have exactly the same spatial position as the target stimulus in order to provoke an optimal validity effect. Furthermore, it has been shown that the spatial shift of attentional focus can not be influenced by spatial cues within the same sensory modality alone but also by cues in different sensory modalities (auditory or somatosensory; Driver and Spence 1998 a,b). It remains, however, unclear, if the auditory space can be subdivided into comparable quadrants to visual space. Spence and co-workers (2004) only differentiated between right and left as well as top or bottom position of cues respectively targets in their crossmodal cueing experiments. In our experiments we want to assess both visual or auditory as well as crossmodal cueing effects for different spatial positions.

Methods: The cube is constructed with cues and targets being presented at exactly the same spatial positions in both the visual and the auditory modalities at a workbench. The auditory condition is realised by a newly developed technique (binaural acoustics; Assenmacher et al., 2004) which by means of two loudspeakers projects sounds to exact locations in space. This set-up can be merged with the visual virtual reality technique and thus is adapted to the relative position of the subject's head in space. The spatial positions in the cube are marked by virtual loudspeakers placed at all eight corners of the cube. Spatial cueing is provided by changing the colour of one of these loudspeakers, whereas the loudspeaker itself topples down to serve as target. There are valid as well as invalid cues (80:20) and the response times (RT) depending on the spatial position of these cues in relation to the target position is measured in msec. Up to now we finished our pretests with 9 volunteers aged 20 – 39 (mean = 26.6, SD = 5.79).

Results: Even with this comparatively small amount of volunteers, the results for the visual targets show a clear validity effect of the valid cues (shorter RT for the valid cues) but no specific effect in any other dimension of the three-dimensional cube. We can also verify the results from Spence and Driver (1994). There are no effects for the auditory targets. Subjects didn't benefit either from visual or auditory cues.

Conclusions: Surprisingly we didn't find any effects for invalid cues in any other dimen-

sion. It is even more surprising that there are no differences between the overage of the RT for each invalid direction (top – down, front – back, left – right). Because of these results we will change the set-up of our experiment and continue the research. Due to different processes of auditory and visual cognition we will exclude both conditions with auditory targets.

Virtual Reality Cognitive Performance Assessment Test

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The Army Alpha/Beta intelligence tests from WWI provide a historical illustration of the quest for standardized performance assessment to better guide selection, placement and training decisions. Since that time, psychologists have routinely employed a wide range of performance assessment methods based on pencil and paper tests and subjective behavioral rating scales. As well, simulation technology has often been used to assess task specific performance primarily for ground vehicle and aircraft equipment operation. These efforts represent both of the extreme ends of the assessment spectrum—basic paper and pencil tests/rating scales and high level simulation technology—for the measurement of vastly different criterion performance (general declarative knowledge/implementation vs. specific highly proceduralized skills). The Virtual Reality Cognitive Performance Assessment Test (VRCPAT) project has been envisioned to fill the middle ground between these two poles by creating a battery of VR-delivered performance tests that will serve to generate a normative database for performance evaluation and comparison.

The VRCPAT project focuses on the refined analysis of human testing using a memory module delivered within the context of a VR city scenario built from the *Full Spectrum Warrior* graphic content. Herein we report on data gained from human pilot testing with the VRCPAT memory module—examine the psychometric properties of this VR-based cognitive assessment instrument. We acquired data on the implementation of a virtual reality (i.e. VRCPAT) in a normative sample that also received a traditional paper and pencil battery. Because the VRCPAT was designed to tap very specific neurocognitive systems and not to mirror a traditional paper-and-pencil battery, our goal was not to replace the traditional battery for all neurocognitive domains. We assessed the psychometric properties of the VR and computerized measures. Hence, scores were correlated with demographic and other performance tests measures administered. Standard correlational analyses using a brief demographic survey and pencil-and-paper cognitive tests added to our initial assessment of both the concurrent and divergent validity properties of this form of assessment. We identified the VRCPAT's hierarchical or aggregational structure and established the internal consistency of the VRCPAT's unidimensional facets (memory domain). We also determined the content homogeneity of each of the VRCPAT's unidimensional facets.

We present the VRCPAT's psychometric properties within the context of a systematic refinement analyses that acted as a component of an ongoing dialectic between measurement and substantive research. Results indicate that the VRCPAT is a well developed measure that facilitates substantive advances. The establishment of the VRCPAT's psychometric properties removed the possibility that results reflect correlates of the target construct (memory and/or attention) but are not prototypic of it. We also assessed the level to which all aspects of the target construct (memory) is represented in the VRCPAT's composition.

Prehension in Virtual environments: General Aspects of Grasping without Haptic Feedback and the Effects of Perturbations

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Introduction: Virtual reality applications offer the possibility to simulate reality and they are highly controllable. Therefore, they provide many possibilities for neuropsychological research. Bülthoff, Foese-Mallot and Mallot (2000) describe the benefit of virtual reality on three dimensions: control, realism and interactivity. One aspect of interactivity is the direct manipulation of virtual objects with the hands (e.g. grasping). Prehension movements are controlled by visuo-motor transformations, which are linked to the reach and grasp movements. Psychomotor research assumes two separate components that are independent of each other, the transport component and the grasp component (Jeannerod, 1984). To study the (in-)dependence of those structures perturbation experiments are used, which manipulate extrinsic (e.g. distance, orientation) and intrinsic (e.g. weight, size) object characteristics during prehension. Obviously, in reality we have to face physical limitations of these perturbations. In virtual reality applications almost every object characteristic can be manipulated.

The two conducted experiments should answer the following questions: (1) Is direct grasping an effective interactivity method in virtual reality applications? (2) Is grasping without haptic feedback satisfying for the participants? (3) Can virtual grasping be compared to real grasping? and (4) Which influences do perturbations have on virtual grasp kinematics?

Method: Two experiments involving 24 subjects were conducted. Participants had to grasp virtual cubes at three different positions or in three different sizes. Perturbations occurred randomly in the experimental trials either regarding the position or the size of the object. Haptic feedback was not provided and participants had to rely on visual feedback. The virtual environment was created with the ReactorMan software (Valvoda, Assenmacher, Kuhlen & Bischof, 2004), and displayed with a stereo projector on a rear projection screen (240 x 180 cm). Hand and head movements were recorded with an optical tracking system. Altogether participants accomplished 220 reach and grasp movements (60 calibration trials and 160 experimental trials including 80 perturbations).

Results and discussion: ANOVAs with the independent variables position and size, respectively, and 23 dependent movement parameters (e.g. movement time, average velocity, peak aperture, grasp distance, straightness, etc.) were conducted for each experiment. Results show significant differences within the calibration trials which are consistent with the hypotheses and reflect psychomotor theories valid for reality. Position affects mainly the transport component whereas size has an impact on the grasp component. In the perturbed trials theoretically hypothesized movement paths were found which correspond to movements recorded in real settings. Furthermore, subjective judgements show that participants feel like grasping the virtual objects despite the missing haptic feedback.

Overall we conclude that grasping is a very effective manipulation method in virtual settings and that virtual grasping is quite similar to real grasping. The advantage of this direct manipulation is that no special interaction technique has to be acquired because grasping is an ubiquitous ability.

War PTSD: a VR pre-trial case study

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As a consequence of three wars in Africa (between 1961 and 1974), there are still around 25,000 Portuguese veterans diagnosed with PTSD. Treatment of such patients using traditional techniques has been revealed to deliver inconsistent results. Aiming to assess the ability of VR exposure to reduce PTSD symptomatology, this paper focused on a pre-trial case study with a 60 year old war veteran who was exposed throughout

12 graded sessions to a VR war scenario. Exposure, using a 295 X 225 cm Translucid Screen, took place in a Psychiatric Hospital, where the patient was assisted by his therapist. Prior to the trial, the participant was subjected to a battery of medical exams and, during a period of a week, his sleeping register was recorded using an actigraph. IES and CAPS were administered to corroborate PTSD and psychopathological comorbidity. Throughout trial sessions, EEG and ECG registers were collected, as well as video imagery. Both records showed a reduction in patient activation. During the sessions, the participant assumed a combat position (arms and hands in a position such as if a firearm was being carried), trying to find the enemy within the scenario. When triggers such as ambush and mine deflagration occurred, the patient tried to take cover and started simulating firing. Presence was assessed and reported (ITC-SOPI questionnaire) at the beginning and in the middle of the sessions.

VR exposure: reducing acute stress disorder derived from motor vehicle accidents

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Acute stress disorder (ASD) is psychiatric diagnoses with 13-21% incidence in Motor Vehicle Accident (MVA) survivors. This paper reports on a case study about a subject that had undergone a VR exposure programme designed to reduce ASD symptomatology which developed after a violent MVA. The VR world consisted of a 4 lane highway setup with traffic on both sides that was displayed to the patient through a 295 X 225 cm Translucid Screen. In the first 6 sessions (two sessions/week), the participant, a 42 year old female, was driven through the highway by a therapist. From session 3 to session 4 traffic intensity was raised. From session 6 to the final (session 12), the patient drove herself through the VR world using a Logitech racing wheel, overcoming events such as traffic intensity variation, tunnels and crossings. From HADS and ITC-SOPI questionnaires, very high anxiety and depression scores and high presence levels were reported. Physiological measures such as ECG and EEG showed a reduction in psychophysiological activity.

Physiology-Driven Adaptive Control of Scenarios in VR Based Therapy of PTSD

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Application of virtual reality (VR) to the treatment of psychological disorders experiences significant expansion and is projected to further increase in the future. As various massive traumatic events occur around the globe, their psychological consequences, like posttraumatic stress disorder (PTSD), affect numerous individuals and their societies. While VR based therapy of PTSD has shown its promise in several applications, there are different avenues for further improvements.

This presentation describes research and development of a VR system for PTSD therapy, which incorporates automated adaptation of VR scenarios according to the subject's arousal. Estimation of arousal is conducted via automated interpretation of the subject's psychophysiological biofeedback signals. Properly performed automated adaptation can strengthen the focus of the supervisor (therapist) on the essential parts of the therapy, by minimizing manipulation of the graphical user interface and monitoring of the subject's psychophysiological signals.

Architecture of the system is presented through descriptions of several block diagrams. A distinct diagram describes system functionality and consists of five major subsystems. Stimulation Subsystem deals with rendering of the vir-

tual environment, i.e. delivering visual and audio stimuli to the subject. Subject's Response Subsystem / Artificial Subject performs capturing of the subject's arousal via physiological measurements, or generating artificial physiological response from computer models. Adaptive Control Subsystem handles automated adaptation of virtual environments driven by physiology of a real or artificial subject. Supervisor's Subsystem provides the supervisor with a 2D-3D console to monitor the subject's arousal measures and events in the virtual environment. Supervisor may also use the subsystem to control the work of Adaptive Control Subsystem. Comparative Analyses Subsystem serves to identify appropriate set of physiological indicators of arousal and their boundary values that separate different levels of arousal. This subsystem is also subsequently used for cross-comparison of subject's data between sessions and with existing reference data.

A first version prototype has been designed and developed, consisting of an integrated system with automated physiology-driven changes in the virtual environment. During the development of the prototype, an artificial subject has been used in place of a real subject. Using a simple artificial subject has facilitated testing and verification of the prototype, which would have been more complicated if nondeterministic real subject's physiology had been used. As greater accuracy of models of human physiological reactions to stressful events is needed for later versions of the system, the article presents some ideas regarding design and development of more complex models.

The prototype incorporates rudimentary adaptive logic for introducing events in the virtual environment in response to the artificial subject's physiology. Eventually, the complexity of the adaptive logic will increase considerably, to provide for accurate interpretation of the realistic physiological signals and support versatile VR scenarios. Therefore, the article also describes an approach to managing forthcoming complexity in scenario adaptation.

Virtual Iraq: Initial Data from a VR PTSD Exposure Therapy Application

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War is one of the most challenging situations that a human being can experience. The physical, emotional, cognitive and psychological demands of a combat environment place enormous stress on even the best-prepared military personnel. It has been conjectured that the Iraq War environment, with its unclear battlefront and vague enemy identification status, is the ultimate combat "petrie-dish" for producing significant numbers of returning soldiers in danger of developing PTSD. In the first systematic study of mental health problems due to the Iraq/ Afghanistan conflicts, the results indicated that 15.6 to 17.1 percent of study participants suffered PTSD, significantly higher after duty in Iraq than after duty in Afghanistan or before deployment to Iraq (Hoge et al., 2004), and these estimates were made before the violence escalated even further in the last 2 years. Among the many approaches that have been used to treat PTSD, graduated exposure therapy appears to have the best-documented therapeutic efficacy (Rothbaum, 2001; Bryant et al., 2005). While the efficacy of imaginal exposure has been established in multiple studies with diverse trauma populations (Rothbaum, et al., 2000, 2001, 2002), many patients are unwilling or unable to effectively visualize the traumatic event. In fact, avoidance of reminders of the trauma is inherent in PTSD and is one of the cardinal symptoms of the disorder. To address this problem, researchers have recently turned to the use of Virtual Reality to deliver exposure therapy by immersing clients in simulations of trauma-relevant environments that allow for precise control of stimulus conditions.

Our "Virtual Iraq" treatment environment is based on a creative approach to recycling virtual art assets that were initially built for the commercially successful X-Box game and tactical simulation training tool, *Full Spectrum Warrior*. The application consists of a series of virtual scenarios designed to represent relevant contexts for VR exposure therapy, including city and desert road environments. In addition to the visual stimuli presented in the VR HMD, directional 3D audio, vibrotactile and olfactory stimuli of relevance can be delivered. Stimulus presentation is controlled by the clinician via a separate "wizard of oz" interface, with the clinician in full audio contact with the patient.

This presentation will summarize the results of our research and clinical treatment protocols as they stand at that time. Presently, an open clinical trial to evaluate our system's efficacy for PTSD treatment with military personnel is being conducted at the NMC–San Diego and at Weill Medical College/Cornell, a randomized controlled trial comparing VR alone and VR+D-cycloserine is in progress at Emory University and a usability design trial with returning soldiers is ongoing at Ft. Lewis, Washington. Five other test sites are scheduled to come on line between now and CyberTherapy2007 that address a variety of research questions involving assessment of PTSD, psychophysiological markers of the disorder, impact of multiple trauma events, and an fMRI study. Thus far, four male and female treatment completers at two of the treatment sites have shown clinically significant improvements at post-treatment with these clients now no longer meeting PTSD criteria.

Combat Related Post Traumatic Stress Disorder: A Multiple Case Report Using Virtual Reality Exposure Therapy with Physiological Monitoring[1]

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Posttraumatic stress disorder (PTSD) is one of the most disabling psychological conditions affecting the veteran population, with estimates of 830,000 veterans suffering from chronic combat-related PTSD. In 2001, more than 773,000 veterans were treated for PTSD by VA specialists. The Department of Veterans Affairs has reported that 31% of male Vietnam Veterans and 27% of female Vietnam Veterans have suffered from PTSD at some point after returning from the war.

More recently, the percentage of Army and

Marine Corps personnel who participated in combat during Operation Iraqi Freedom or Operation Enduring Freedom between March and October 2003 who met screening criteria for major depression, generalized anxiety disorder or PTSD, ranged from 11.2% to 17.1%. VA officials have reported 20% of Iraq veterans have sought VA health care for mental health issues. The Veterans' Administration expects these numbers to grow since many discharged veterans, who suffer Post-traumatic Stress Disorder and other mental health illnesses, have not yet sought care. Of 168,000 service members who have served in Iraq and have been discharged as of July 2004, about 28,000 had sought medical care from the VA; of these, about 5,400 sought help for mental health issues and nearly one-in-three of these 5,400 suffered from PTSD.

Several studies have demonstrated statistically significant, yet relatively small effects, utilizing imaginal exposure for reducing PTSD and related pathology in male Vietnam veterans. Other research has suggested that virtual reality exposure (VRE) therapy is an effective new medium of exposure therapy for treating veterans with PTSD. Virtual Reality (VR) integrates real-time computer graphics, body-tracking devices, visual displays, psycho-physiological measures, and other sensory input devices to immerse a participant in a computer-generated virtual environment that changes in a natural way with head and body motion.

Virtual Reality Medical Center has been awarded an Office of Naval Research (ONR) grant to complete a randomized study, at Naval Medical Center San Diego, comparing the effects of VR therapy with Cognitive Behavioral group therapy. The VR system utilized by VRMC relies on both visual and auditory presentation. VRMC has developed a VR package that can run on two computers, one that displays the visual and auditory displays to the patient through VR goggles with built-in headphones and a second system which has the control panel and menu which therapists can use to add arousal elements into the VR environment (e.g., various combat events and combat background sounds, vehicle sounds, various household sounds, sounds of people conversing, music sounds, etc.). A third computer is used to run the physiological monitoring and feedback system. The Cognitive Behavioral Therapy is being conducted by a Clinical Psychologist who is a staff member of the Department of Psychiatry, NMCSD. A component of our ONR Grant and research proposal is to complete a pilot study involving providing VR therapy to 8 patients diagnosed with combat PTSD secondary to a tour of duty in Iraq or Afghanistan. Each pilot study patient will receive 10 sessions of Virtual Reality treatment.

VRMC has just completed the treatment on the first six patients who were members of this pilot study. These patients were all members of the United States Navy and five of our patients experienced one or two combat deployments to Iraq between January 2003 and August 2006. One of our patients experienced combat deployments to other areas of the world in support of the War on Terrorism. These patients were originally diagnosed with PTSD between in January 2004 and March 2006; all of our patients have initiated treatment with the VRMC program since March 2006. As part of the treatment protocol, these patients' physiological measurements (i.e., heart rate, breaths per minute, skin conductance and peripheral temperature) were taken pre-treatment, mid-treatment and post-treatment. At each assessment period, their physiological measures were assessed at baseline, during a recall stressor, and during recovery from the stressor.

Our presentation will review not only the treatment protocol for VRMC's ONR funded study to treat combat-related PTSD with Virtual Reality, but also we will review the treatment outcome results for the first six patients in our pilot group. Additionally, VRMC will demonstrate our Virtual Reality treatment system involving two computers, one that displays the visual and auditory displays to the patient trough Virtual Reality Goggles with built-in headphones, and a second system which has the control panel and menu which therapist can use to add arousing elements into the Virtual Reality environment (e.g., various combat events and background sounds, weather, and time of day).

Handheld Computerized Neruopsychological Assessment & VR Therapy for PTSD

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In this presentation we introduce a new handheld computerized neuropsychological assessment system, i.e., BrainCheckers. The Combat Stress Assessment subset is being implemented by the Virtual Reality Medical Center, San Diego, CA in a Virtual Reality (VR) treatment program for veterans from Iraq who have Post Traumatic Stress Disorder (PTSD). This system runs on handheld Palm® personal digital assistants (PDA). It includes a library of tests derived from the Automated Neuropsychological Assessment Metrics (ANAM), norms, and new tests such as an Emotional Stoop (E-Stroop) which has been designed specifically for our VR treatment program for veterans from Iraq. Finally, this presentation will include an overview of the BrainCheckers system as it is being used in blast concussion programs in the military.

Introduction

Computerized neuropsychological testing systems generally use desktop or laptop computers and/or the internet to administer tests. These systems are impractical in most operational medicine settings such as an Emergency Room or a desert field environment such as Iraq, and they have not been designed for use with patients who have PTSD. The solution has been a re-engineering of a validated computerized test system, i.e., ANAM for use on handheld computers. The latest generation development in this line is BrainCheckers. It includes of a library of test modules that have been configured into standardized batteries for three specific product lines. They are: 1) a diagnostic Concussion Toolkit for Sports Medicine and Blast Concussion; 2) a Migraine Early Warning Tool/Mental Efficiency and Workload Test (MEWT); 3) and a Combat Stress Assessment (CSA). This presentation will focus on the CSA and results from the VRMC treatment program for PTSD.

A prototype of BrainCheckers (i.e., ANAM Readiness Evaluation System, ARES) was field tested in 2003 in Iraq and proved to be well-suited for use in a hostile and sandstorm environment. Since then, hardware and software engineering has been completed along with concurrent validity research and a normative database. This system is presently being used in a variety of military and Veterans Administration medical settings for evaluation of patients with polytrauma (i.e., multiple catastrophic injuries), brain injury (i.e., blast and mechanical concussion), and rehabilitation settings where efficient, cost-effective, and repeated assessments are essential. Tests in this system assess attention and concentration, working memory, mental flexibility, spatial processing, cognitive processing efficiency, memory recall, mood, and fatigue.

BrainCheckers and VR treatment for PTSD.

As mentioned above, the Virtual Reality Medical Center (VRMC) is conducting a VR Treatment program for active duty personnel who have served in Iraq and who have PTSD. This program is funded by the Office of Naval Research (ONR) and is comparing the effects of Virtual Reality Graded Exposure Therapy (VRGET) therapy with Cognitive Behavioral Group therapy on active-duty personnel. The BrainCheckers CSA is being implemented in this program as an objective index of emotional reactivity and cognitive processing efficacy. Additionally, we have developed an Emotional Stroop specifically for Operation Iraqi Freedom veterans. Preliminary analyses of results demonstrate the sensitivity of the CSA to PTSD related impairment of executive neuropsychological functions and emotional reactivity. Further, it provides a mechanism for assessing the effectiveness of our VR treatment program in a repeated measures paradigm. This presentation will provide individual and group results from our program along with correlations with physiological measures.

Virtual Reality Exposure Treatment of PTSD in U.S. Warfighters

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Continuing exposure to the threat of death and serious injury places U.S. warfighters deployed to combat theaters at high risk for developing PTSD. In a recent survey, an estimated 18-20% of soldiers and Marines returning from Iraq reported PTSD symptoms. For some, recovery from these symptoms will occur naturally over time. For others, the symptoms may persist, and if left untreated, can lead to potentially severe adverse consequences to their mental and physical health, family and social relationships, employment, and economic status. Drug or alcohol substance abuse, depression, and other disorders often accompany PTSD.

Cognitive behavior therapies (CBT) employing exposure therapy techniques have been effective treatments for civilians, veterans, and military women suffering from PTSD. CBT with exposure therapy involves repeatedly confronting the traumatic memories, and processing the associated negative thoughts and emotions with the guidance of a trained therapist in a safe, therapeutic environment. The treatment process enables patients to gradually become more comfortable with remembering what happened, and to develop more adaptive, less avoidant patterns of feelings, thoughts, and behaviors.

Unfortunately, most PTSD patients do not seek treatment, and not all who receive exposure therapy respond to this treatment approach. Avoidant behavior is characteristic of the disorder, and interferes with some patients' ability to vividly recall their traumatic memories or to become emotionally aroused when confronting their memory of the traumatic event they experienced. Emotional engagement during exposure is important to achieving habituation and successful treatment outcomes.
Virtual reality (VR) computer simulations have been successfully used in exposure treatment to overcome anxiety disorders, particularly phobias. Preliminary research suggests that immersive VR may be a powerful adjunctive tool in CBT treatment for combat-related PTSD. Immersion in a computer-generated simulation of the war zone allows a warfighter to return to the combat environment of the traumatic event in the safety of a therapist's office. VR simulations are sensory-rich with visual, auditory, kinesthetic, and sometimes olfactory stimuli that help the patient to become emotionally aroused and to process the unwanted thoughts and emotions associated with their memories of the traumatic event. Currently, there are no published randomized, controlled studies of VR exposure treatment of combat-related PTSD in active duty military personnel.

This presentation will report on a randomized, controlled study currently in progress that is investigating the efficacy of VR exposure in treating PTSD in U.S. warfighters returning from Iraq. A virtual environment with graded cues to stimulate memories of traumatic combat incidents was developed for use in an exposure treatment protocol. Warfighters with diagnosed PTSD are randomized into either an immediate VR exposure treatment (VRE) condition or a minimal attention or delayed treatment (MA) condition. Psychologists trained in treating combat-related PTSD administer a 10-session VRE treatment protocol after extensive training on the protocol and the VR system. Outcome measures include the Clinician Administered PTSD Scale, PTSD Diagnostic Scale, Combat Exposure Scale, Beck Depression Inventory, Trauma-Related Guilt Inventory, and Quality of Life Inventory. Significant reductions in PTSD and related symptoms, and an improved quality of life are predicted.

Virtual Reality in Operational and Garrison Psychology: A Review of the Applications of the VR Iraq at Fort Lewis

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Virtual reality (VR) technologies have been used for a number of years in the treatment of a variety of anxiety disorders including panic disorder and simple phobias. More recently, VR has been used to target the assessment and treatment of post-traumatic stress disorder (PTSD). The acquisition and maintenance of PTSD is believed to be based upon a combination of classical and operant conditioning. As a result, several treatment approaches draw their interventions from these learning theories. Exposure based therapies are empirically supported treatments that typically utilize imaginal exposure to habituate patients to distressing memories, cues and reminders. VR provides a potential enhancement to exposure therapy by immersing the patient within an environment that resembles that of the traumatic event(s), but with the capability to systematically control the intensity of the experience. As some patients are unable or unwilling to effectively recall traumatic events to facilitate habituation, VR provides a significant advancement. Psychologists at Fort Lewis, in collaboration with the Institute for Creative Technologies at the University of Southern California and the Army Behavioral Health Technology Office, have been piloting a VR Iraq with active duty service members. Two environments are currently available - a convoy scenario and a dismounted patrol. These environments are presented in a head mounted display system and can be customized to expose the user to a wide range of auditory and visual stimuli, including small arms fire, rocket propelled grenades, vehicle borne improvised explosive devices, air support helicopters and airplanes, and mortar attacks. In addition, vibro-tactile stimulation dramatically enhances its realism through the use of bass shakers attached to a simple platform that the user can stand or sit upon. This presentation will review recent and current projects at Fort Lewis to facilitate the development of the VR Iraq and utilize the technology with military personnel. Four projects will be reviewed. First, the results of a deployment of the technology to Iraq will be discussed including the potential clinical applications of the VR Iraq in an operational environment. Second, the findings of a user-centered design feedback survey with active duty Army personnel will also be reviewed, highlighting the strengths and limitations of the current VR Iraq prototype. In addition, a process for credentialing mental health providers to conduct VR treatment of PTSD has been developed at Madigan Army Medical Center. The development process and content of the credentialing requirements will be reviewed. Finally, there will be a review of case examples of the use of the VR Iraq in the treatment of combat related PTSD, including lessons learned that may have applicability to other clinicians. These projects have informed the development of the VR Iraq and will continue to highlight significant refinements to an already promising clinical tool.