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Editors:

Brenda K. Wiederhold, PhD, MBA, BCIA
Giuseppe Riva, PhD, MS, MA
Alex H. Bullinger, MD, MBA



Interactive Media Institute

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Presenter: Mariano Alcañiz PhD

REAL TIME CHANGING VIRTUAL ENVIRONMENTS: A NEW TOOL FOR VIRTUAL THERAPY

M. Alcañiz, Ph. D., Beatriz Rey, M.Sc.; Javier Montesa, M.Sc.; José Antonio Lozano, Ph.D.; M. Carmen Juan, Ph. D.

Medical Image Computing Laboratory (MedICLab), Valencia, Spain

Research Status: Complete.

Environments used up to now for therapeutic applications are invariable ones whose content cannot be changed by the therapist or by the patient. However, this is a technical issue that can be solved with current technology. In this paper, we describe a virtual environment that has been developed taking into account this factor. The main technical feature of the environment is that its aspect can be controlled and modified by the therapist that conducts the clinical sessions depending on the emotions that the patient is feeling at each moment. The applications of these dynamic changes are not limited to the field of clinical psychology. They open a new arena of possibilities for many other kinds of applications including industry, architecture, medicine, etc. The virtual environment that is described in this paper is a step towards a truly adaptive display.

Contact:
Mariano Alcañiz, PhD
Medical Image Computing Laboratory (MedICLab)
Technical University of Valencia
Camino Vera s/n
46022 Valencia (Spain)
malcaniz@degi.upv.es
Ph: +34 963877517
Fax: +3496 3879510

Presenter: Mariano Alcañiz PhD

ARSPIDERS. A NEW SYSTEM FOR

THE TREATMENT OF ARACHNOPHOBIA

Juan, M.C.¹, Botella, C.², Baños, R.³, Guerrero, B.³, Alcañiz, M.¹, Rey, B.¹, Gil, J. A.¹

¹ MedICLab (Universidad Politécnica de Valencia)
² Departamento de Psicología Básica y Psicobiología (UJI)
³ Universidad de Valencia

Spider phobia could be a great problem for people who suffer from this kind of phobia and they have to visit or to stay in places where these insects could appear. Exposure therapies and Virtual Reality applications have proved to be effective, but till now Augmented Reality (AR) has not been used in this kind of treatments. We have developed the first AR system for the treatment of arachnophobia. Our AR system was developed using ARToolKit software. We have modelled three different types of spiders. These spiders move their legs. Both the model and the basic movements have been modelled using 3DStudio Max. Textures are created using Adobe Photoshop 7.0. Objects have been exported to VRML format. GLUI Library has been used to develop the Graphic User Interface. To include sounds, OpenAL Library has been used. When the patient or the therapist kills a spider using a flyswatter, the system plays a squishing sound like when you kill a real spider. If the patient or the therapist uses an insecticide, the system plays the sound of a spray can like when you use a real insecticide. The user can choose that one or more spiders appear/disappear. Spiders can appear/disappear in increments of 3 or 20. When more spiders have to appear, they appear randomly and half of them are close to the center and they can move towards the outside of the image. The rest of the spiders are far away as possible from the center and they can move towards the center. Four patients have been treated with the system. They met DSM-IV criteria for phobia to small animals specifically, fear of spiders. Three of them were females and one male. The exposure directives of Öst were followed in order to carry out the exposure session. The sessions were about one hour. Subjective units of discomfort scale (SUDS) (0=no anxiety,

10=high anxiety) was used to measure the degree of anxiety during the AR exposure. The anxiety level in some moment of the exposure sessions arrived to 10 and decreased till 0. So, the system stimulated anxiety level of patients. Before the exposure session, patients had to enter to a room where a spider was inside a box. None of them were able to interact with the alive spider. After the AR session, patients were able to interact and to kill by themselves real spiders. So, our system has helped four people to overcome their spider phobia in one hour of AR exposure session. We are going to test our system with more patients. Patients also answered three questions related to the degree of presence experienced in the AR session. All patients scored more than 7 (0-10 scale) in all questions. These scores reflect the high sense of presence and reality judgment that the patients experienced. This first system and its first results demonstrate that AR can be successfully applied to psychological treatments. We hope that new AR applications would be developed in future to treat other kind of phobias.

Contact:
Mariano Alcañiz, PhD
Medical Image Computing Laboratory
(MedICLab)
Technical University of Valencia
Camino Vera s/n
46022 Valencia (Spain)
malcaniz@degi.upv.es
Ph: +34 963877517
Fax: +3496 3879510

Presenter: Micheline Allard PhD

EFFECTIVENESS OF CBT DELIVERED THROUGH VIDEOCONFERENCING AND FACE-TO-FACE FOR PANIC DISORDER WITH AGORAPHOBIA

Micheline Allard, PhD Candidate & Stephane Bouchard, PhD

University of Quebec in Outaouais Cyberpsychology Lab

Cognitive-behavior therapy is a well validated psychological treatment for anxiety disorders. However, less than 15% of people suffering from an anxiety disorder receive CBT or effective medication. One possible explanation is that patients don't have access to CBT thera-

pists. Videoconferencing could be use to increase the accessibility of validated treatment (i.e., CBT) to reach patients. It is important to determine is videoconferencing can be efficient to give a psychological treatment. The aim of the study is to compare the effectiveness of a validated treatment delivered through videoconferencing and face-to-face.

Method/Tools

For the study, 30 participants (15 = condition face-to-face; 15 = videoconferencing) were SCID-diagnosed in a face-to-face interviews. All participants were referrals to a mental clinic in Montreal (remote site 180 km distance from the local site) or in Gatineau (local site). The selection criteria were: 1) principal diagnosis of panic disorder with agoraphobia; 2) duration of illness for more than 6 months; 3) not receiving concurrent psychotherapy; 4) no comorbid diagnosis invalidating the study. All participants received 12 individual weekly sessions of cognitive-behavior therapy. The efficacy measures were completed at pre- and post-treatment and included the Panic and Agoraphobia Scales and the Agoraphobic Cognitions Questionnaire.

Results

For all the measures, the results demonstrated significant improvement ($p < .05$) for all the participants in both conditions (face-to-face and videoconferencing).

Conclusion

These results of the study show the effectiveness of the cognitive-behavioral therapy delivered through face-to-face and via videoconferencing. Those results may have an impact on the availability and the distribution of mental health services for panic disorder with agoraphobia and other anxiety disorders.

Contact:
Micheline Allard, Ph.D. Candidate
Micheline_Allard@hotmail.com
Phone: (819) 771-7761 ext.8419
Fax: (819) 776-8098

Presenter: Angelos Amditis PhD

THE ISLANDS SYSTEM: A MODULAR

NON-CONVENTIONAL E-MENTAL HEALTH SYSTEM TO SUPPORT SERVICES TO REMOTE AREAS

Dr. Angelos Amditis¹, Ms. Zoi Lentziou¹, Dr. Euangelos Bekiaris², Dr. Maria Fernanda Cabrera³, Dr. Alex Bullinger⁴

¹ Institute of Communication and Computer Systems (ICCS)

² Center for Research and Technology Hellas/ Hellenic Institute of Transport (CERTH/HIT)

³ Telecommunication Engineering School, Technical University of Madrid (UPM)

⁴ Center of Applied Technologies in Mental Health (COAT)

This paper is the output of the work performed in all multidisciplinary tasks of the WP, while focusing on defining the technical specifications and operative scenarios for the ISLANDS system in order to develop services to provide modular, non-conventional, remote psychiatric and psychotherapeutic assistance for remote areas.

The ISLANDS project basically aims at:

- Improving the quality of life of the users,
- Enhancing the quality of mental health care and the economic strength of the region
- Overweighting the costs of implementation and service support.
- Reducing inequalities in mental health services and status among European regions.

Building a complicated system like the ISLANDS system was a time consuming and complicated task, since the combination of both the delivery of three different services (i.e. screening, counselling and therapy) to three different target groups (i.e. general practitioners, patients and their carers) and the compatibility between the standards and the situation that exists in three different European areas (Spain, Greece and France) is required. This is the reason why a thorough analysis regarding the specifications and the requirements of the various components and the peripheral devices of the overall system has taken place and an elaborate study for the design of the system architecture has been carried out.

Primarily, the architecture of the ISLANDS system takes the following parameters into account:

- The various current technical ways of es-

tablishing e-mental health and their requirements in relation to the existing equipment in the area of telemedicine in general.

- Cost efficiency issues.
- Liability.
- Risk analysis

The User (i.e. General Practitioner, Patient and/or relative) can have access through the network (i.e. Internet) to the ISLANDS Multi-Access Center. The IMAC has the potentials to allow users to access the remote services whatever access terminal or combination of terminals they may choose to use.

IMAC consists of four parts mainly:

- ◆ the ISLANDS database
- ◆ the ISLANDS router
- ◆ the ISLANDS tools and
- ◆ the Knowledge Management Organiser

It is self evident that in most of the cases the data transmission urgency should be taken into consideration. This means that since the service delivery frequency is dependent on the type of the content, the format and the importance of the transmitted medical data were identified and therefore the technology that should be used was defined to cover the application needs. For instance, screening a patient, which can be considered as a low importance service delivery, can be supported by text. The technology that can be used in that case is possibly the mail. On the other hand, providing guided therapy to the patient, which is a case of high significance and importance, require the transmission of video (audio and visual contact with the doctor). This leads to the conclusion that the technology that could be used to apply this situation is Videoconference or Computer conference.

Presenter: Rosa Maria Banos PhD

USING "TRADITIONAL" STRATEGIES IN A "VIRTUAL WORLD" FOR THE TREATMENT OF PATHOLOGICAL GRIEF

Baños, R.², Botella, C.¹, García-Palacios, A.¹, Quero, S.¹, Lasso de la Vega, N.¹, Guillén, V.² & Osma, J.

¹ Universitat Jaume I Castellon. (Spain).

² Universidad de Valencia (Spain).

During the last decade notable advances in the psychological treatments field have been produced. At this moment an important amount of effective treatments or “based on evidence” treatments (*Task Force on Promotion and Dissemination of Psychological Procedures*, 1995) are available. The cognitive model has had a notable contribution for this important advance to be achieved, however, from a therapy perspective, this model is still far away from understanding and controlling the human change processes. These insufficiencies come from the theoretical shortcomings, that is, there exist discrepancies between the lineal logic of many of the cognitive perspectives and the complexity of human functioning. Within these insufficiencies is worth to point out the scarce attention that has been paid to emotions in therapy for a long time.

One of the objectives of the European project EMMA (*Engaging Media for Mental Health*) is to examine the possibility of using new technologies (virtual reality) with the aim of treating emotions from a different perspective than the traditional one. In the EMMA project we have developed a series of emotional devices which can be customized so they can be full of meaning and contain the fundamental elements that the person has to cope with. That is, our objective is to try to show in a physical way the personal meanings and the emotions associated to those meanings and to examine to which extent this strategy helps the person in the process of change. The purpose is to create a series of “experiences” in therapy that can be used to activate, correct, structure, and restructure previous life experiences that can serve as cognitive-emotional structural frames from which a new way of processing and integrating present, past, and future experiences can be structured. In this work we present the EMMA environment and the clinical treatment protocol for pathological grief in a case study.

Contact:

Rosa Maria Banos, PhD
Universidad de Valencia. Spain

banos@uv.es

Phone +34 963864412

Fax: +34 963864669

Presenter: Rosa Maria Banos PhD

THE ROLE OF PRESENCE AND REALITY JUDGMENT IN VIRTUAL ENVIRONMENTS IN CLINICAL PSYCHOLOGY

Banos, R.M.¹, Quero, S². Salvador, S¹. & Botella, C².

¹Universidad de Valencia (Spain).

²Universitat Jaume I. Castellon (Spain).

Presence and Reality Judgment are two important variables to take into account in the Virtual Reality (VR) field. So far, scientific literature has paid attention to the construct of presence, and several assessment measures are available. However, the concept of Reality Judgment has received less attention, and usually, it has been subsumed into the concept of presence. No too much effort has been dedicated to test whether or not both constructs refer to the same domain. In a previous work, our team developed a 78-item self-report questionnaire that assesses both constructs: sense of presence and reality judgment (Banos et al., 2000). This was applied to 124 undergraduate students from the University Jaume I of Castellón (Spain) and the University of Washington (Seattle). A three factor solution was obtained: a reality judgment factor, an interaction/external correspondence factor and an attention/absorption factor. While the reality judgement items grouped in a single factor, items concerning presence were watered down among the three obtained factors. We believe that the sample employed had influenced remarkably on the results. The scenarios where the participants were immersed did not stimulate any type of emotion (those participants that could have had the slightest problem in any of the environments were excluded), and this fact prevented any emotional involvement or internal correspondence factors from showing up. The following task was to apply the questionnaire to clinical samples to elucidate whether the same or different factors emerged. Preliminary results obtained with clinical and subclinical participants belonging also to Spanish and North American samples showed that in VR applications for Clinical Psychology emotion was playing an important role in the sense of presence and the reality attribution of users (Banos et al., 2001). In this case, the virtual environments were able to elicit emotions in

the participants, so items related to emotions and sensations were the most important. However, an important shortcoming of this study was the small size of the sample (N=112). Therefore, the aim of the present work is to apply the Presence and Reality Judgement Questionnaire to a larger clinical and subclinical sample.

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Contact:
Rosa Maria Banos, PhD
Universidad de Valencia. Spain
banos@uv.es
Phone +34 963864412
Fax: +34 963864669

Presenter: Azy Barak PhD

FACTORS RELATED TO SUCCESS OF HELPING HIGHLY DISTRESSED INDIVIDUALS THROUGH EMOTIONAL SUPPORT ONLINE CHAT

Azy Barak, PhD
University of Haifa

The purpose of the study was to examine the contribution made by dimensions of session impact (experts' evaluation of session process, that includes factors of depth and smoothness, and experts' evaluation of post-session factors of client's mood, that includes positivity and emotional arousal) and of several textual variables (positive and negative emotional expressions; helper's and client's writing length) to the success of emotional support conversations carried out by trained, paraprofessional helpers on an Internet chat with highly distressed individuals. Two studies were conducted at SAHAR, an exclusively

online, Israeli emotional support service for suicidal and highly distressed people who had experienced various negative conditions, including those related to rape and sexual abuse, eating disorders, depression, social anxiety, drinking and drug use, homosexuality, and domestic violence. Study 1 compared 40 successful conversations (as indicated by clients at the termination stage of session) executed through instant messaging and chat tools with 40 other conversations (not indicated as successful by clients), using expert judgments, on session-impact dimensions as well as objective word count for textual variables. Study 2 examined correlations between helpers' evaluation of the sessions' contribution to clients in 60 (other) support conversations and session impact factors and textual dimensions. The findings of Study 1 showed that all four impact dimensions, as well as expression of negative emotions, significantly differentiated between successful and unsuccessful conversations. In Study 2, the results showed that all four impact dimensions positively correlated with helpers' evaluations (yielding multiple $R=.54$), as well as the length of helper's and client's writing. The implication of these studies are that similar to offline counselling sessions, deep, smooth conversations that yield positive responses and arouse clients' emotions in online support are more successful than shallow, bumbling conversations that leave clients emotionally indifferent. Ventilating negative feelings and more expression in writing, by both helpers and clients, seem to be important factors, as well.

Contact:
Azy Barak, PhD
Department of Education
University of Haifa
Haifa, Israel 31905
Phone: +972-4-8249374
Fax: +972-4-8240911
Email: azy@construct.haifa.ac.il

Presenter: Mihaela Ioana Baritz PhD

THE IMPROVEMENT OF THE AUDIO-VIDEO TECHNIQUES AND VIRTUAL ENVIRONMENT USED FOR INVESTIGATION METHODS AND ASSISTED PEOPLE WITH DISABILITIES

Mihaela Ioana Baritz PhD

University of Transylvania Brasov

In this paper we propose an improvement method of audio video techniques and smart environment for optimization and objective methods of investigation in the bio-systems and for the disadvantage people assisting. Taking in account the necessity for development, the new facilities and services it is proposed the accomplish a modulated infrastructure which can generate the optimum systems for different investigations of the health problems, the creation of the smart environments for the medical assistance, the generation of new methods-virtual reality- to prevent the deficiencies installation to the children and adults. The most important objectives of the researches are: the implementation of this health investigation, assisting and information structure into public service by e-Health systems, the evaluation of the research impact on the assurance of the compatibilities demands for Romania integration in European system, and also the using of the methods like virtual reality and biotelemetry, for developing of the news way to assist the people.

Contact:

Mihaela Ioana Baritz PhD
University of Transylvania Brasov
B-ul EROILOR nr. 29,
Brasov, 2200

R O M A N I A
P h o n e : 0 0 4 0 . 2 6 8 . 4 1 6 3 5 2
Email: mbaritz@unitbv.ro

Presenter: Cristina Botella PhD

THE TREATMENT OF EMOTIONS IN A VIRTUAL WORLD. APPLICATION IN A CASE OF POSTTRAUMATIC STRESS DISORDER

Botella, C., Ph.D.¹, Garcia-Palacios, A. Ph.D.,¹ Banos, R., Ph.D.,² Guillen, V.¹, Quero, S., Ph.D.¹, Lasso de la Vega, N.¹ & Osmá, J.¹

¹ Universitat Jaume I Castellon. (Spain).

² Universidad de Valencia (Spain).

During the last decade notable advances in the psychological treatments field have been produced. At this moment an important amount of effective treatments or “based on evidence” treatments (*Task Force on Promotion and Dissemination of Psychological Procedures*, 1995) are available. The cognitive model has had a notable contribution for this

important advance to be achieved, however, from a therapy perspective; this model is still far away from understanding and controlling the human change processes. These insufficiencies come from the theoretical shortcomings, that is, there exist discrepancies between the lineal logic of many of the cognitive perspectives and the complexity of human functioning. Within these insufficiencies it is worth to point out the scarce attention that has been paid to emotions in therapy for a long time.

One of the objectives of the European project EMMA (*Engaging Media for Mental Health*) is to examine the possibility of using new technologies (virtual reality) with the aim of treating emotions from a different perspective than the traditional one. In the EMMA project we have developed a series of emotional devices which can be customized so they can be full of meaning and contain the fundamental elements that the person has to cope with. That is, our objective is to try to show in a physical way the personal meanings and the emotions associated to those meanings and to examine to which extent this strategy helps the person in the process of change. The purpose is to create a series of “experiences” in therapy that can be used to activate, correct, structure, and restructure previous life experiences that can serve as cognitive-emotional structural frames from which a new way of processing and integrating present, past, and future experiences can be structured. In this work we present the EMMA environment and the clinical treatment protocol for posttraumatic stress disorder in a case study.

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Contact:

Botella, C., Ph. D.
Universitat Jaume I. Castellon. Spain
botella@psb.uji.es
Phone: +34 964728881
Fax: +34 964729267

Presenter: Cristina Botella PhD

MIXING REALITIES? AN AUGMENTED REALITY SYSTEM FOR THE TREATMENT OF SPIDERS AND COCKROACHES PHOBIA

Botella, C.¹, Baños, R.² Guerrero, B.¹, Juan, M. C.³ & Alcañiz, M., Ph. D.³

¹ Universitat Jaume I Castellon. (Spain).

² Universidad de Valencia (Spain).

³ Medical Image Computing Laboratory (MedICLab). Technical University of Valencia (Spain)

Augmented Reality (AR) consists of introducing virtual elements in the real world. That is, the person is seeing an image conformed by a visualization of the real world and by a series of virtual elements that are over-imposed in the real world. The main aspect of AR is that virtual elements provide relevant and useful information to the person that does not exist in the real world. AR has a high potential and has been already used in several fields: medicine, army, training, engineering, design, robotic, etc. Up to now AR has not been used in the psychological treatments area. However, AR presents several advantages. Like in the classic virtual reality systems, it is possible to have a total control over the virtual elements over-imposed in the real world and how to interact with them. But, AR has an additional advantage: it facilitates the person's sense of presence (the sense of being there) and reality judgment (to judge the experience as real). This is possible because the environment where the person is placed and what the person is seeing are, in fact, "the reality". In this work the data of a series of case studies in which AR has been used for the treatment of specific phobia (spiders and cockroaches phobia) are presented. Results are very promising. The patients showed a high degree of fear and avoidance in the behavioural avoidance test at pre-test and, these scores not only decreased after treatment, but the patients were able to approach, interact and kill alive insects.

Contact:

Botella, C., Ph. D.

Universitat Jaume I. Castellon. Spain

botella@psb.uji.es

Phone: +34 964728881

Fax: +34 964729267

Presenter: Stéphane Bouchard PhD

RELIABILITY AND VALIDITY OF A SINGLE-ITEM MEASURE OF PRESENCE IN VR

Stéphane Bouchard, Geneviève Robillard, Julie St-Jacques, Stéphanie Dumoulin, Marie-Josée Patry & Patrice Renaud

Université du Québec en Outaouais

Research Status: Completed.

Measuring the subjective feeling of presence in virtual environments usually relies on questionnaires. These instruments are long and, while many items are useful to tap the diverse subtleties and dimensions of a construct, it poses a significant challenge if a researcher wants to measure presence during a VR immersion. This presentation will document the validation process of a single-item measure of presence. The question «To which extent do you feel present in the virtual environment, as if you were really there» was subjected to: a content and face validity study, two test-retest reliability studies, a convergent and divergent validity study, and two sensitivity studies.

Content and face validity

The goal of the first study was to ascertain that the single-item presence is well understood by the general population. A community sample of 49 adults (mostly low to moderate socio-economic status and not highly educated) were immersed for 7 minutes in a virtual environment in a shopping mall. After the immersion, participants rated on a scale from 0 to 10 how well they understood the meaning of the item, as well as the meaning of control items (including items from other popular presence measure). The results showed that the question was very well understood. The clarity of the question was as good as controlled items drawn from a psychological test validated for adults with the reading ability of a grade-five population. The clarity was statistically better than the control items that were designed to be difficult to understand (e.g., items with double-negatives).

Test-retest

A sample of 31 university students completed

the presence question on two occasions during a 7 minutes VR immersion, and another sample of 26 adults completed the presence question after two different VR immersions. The test-retest coefficients were very high (.21 and .83, respectively).

Convergent and divergent validity

The single-item measure of presence correlates significantly with the *Presence Questionnaire*, and much less with *Perceived Realism* and the *Immersive Tendencies Questionnaire*.

Sensitivity

Two studies were devised to assess the sensitivity of the item to experimental manipulations. In the first study, 33 participants were immersed twice in the same virtual under a condition that maximise presence and under a condition that hinder presence. In a second study, 29 snake phobics were subjected to psychological manipulations where anxiety was induced or not by leading them to believe that the virtual environment could contain dangerous hidden snakes. In both studies, the repeated measures ANOVA confirmed the sensitivity of our measure.

Conclusion and novelty

Item-response theory would recommend to be careful in using only one item to measure a construct, while practical factors such as distraction would militates in favour of using the least intrusive measure as possible. The validation process confirmed that a single-item measure of the subjective feeling of presence is well understood, reliable and valid. These results will be very useful for any researcher interested in measuring presence while users are immersed in a virtual environment. The presentation of the results of each study should also be of interest to the audience.

Contact:
Stéphane Bouchard
Université du Québec en Outaouais
Stephane.bouchard@uqo.ca

Presenter: Eileen Brosnan

TRANSFORMING STORIES: A MULTIMEDIA TOOL FOR THERAPEUTIC STORY BUILDING WITH CHILDREN AND ADOLESCENTS

Eileen Brosnan, Research Fellow¹, Dr. John Sharry², Richard Boyle¹, Prof Carol Fitzpatrick³

¹Media Lab Europe

²Mater Hospital, Dublin

³University College Dublin

Background

In child and adolescent therapy, multimedia is most commonly used where the child and therapist use professionally made CD-ROM's of interactive stories, computer games, or internet resources to access information and facilitate communication. This involves listening, watching, and reading. The interactive elements allow users a degree of control over the narrative and direction of a story. This is mainly passive. "Transforming Stories" takes it a step further by using multimedia in therapy in a constructive way, allowing the child to build their own story. In his research in the field of education Papert (1996) highlighted the importance of children making their own artifacts, something that is a real reaction to their world. This premise can also be applied to the therapeutic process.

Method/Tools

Transforming Stories is a database driven multimedia storytelling tool delivered both online and on stand alone platform. The software currently being developed will allow the users to choose a story template and build up the story plot using customisable characters and background scenes, adding in their own voiceover and animation. The authoring timeline is presented in an immediate way using a drag and drop facility for placing story objects and further features such as positioning tools, playback and story editing. There is also a text tool allowing them to integrate their own captions. Other options include building from seed stories where they can change the plotline and add in their own characters and dialogue. Finally they can upload and share their stories to an online community.

In the method, the therapist introduces the idea of making a story and shows examples of what is possible using the software. It can be a story tailored to a problem that needs resolution or a general story that brings about some positive change in the storyline. A key

therapeutic feature is a notebook facility where the child and therapist keep a log of their thoughts on the process and their analysis of the story. This allows for reflection and gives the therapist the opportunity to prompt new ideas for problem solving.

Evaluation

The current research focuses on evaluating the therapeutic use of multimedia authoring tools now being widely used in the classroom setting. This research is based on case study examination of the benefits of using these tools in engaging adolescents and progressing the therapeutic relationship in a small sample of adolescents attending the Mater Child and Adolescent Psychiatry Service, Dublin, Ireland.

The second stage of the research will involve the initial testing of "Transforming Stories" across a range of client groups and professional disciplines including Psychotherapy, Social Work, Psychology, and Psychiatry. This testing will involve a qualitative study.

Novelty/Discussion

"Transforming Stories" is an innovative new approach to eliciting stories in child and adolescent therapy. Over time the online forum will provide an expanding database of story building material to be drawn from. The planned integration of drawing tools and other authoring features will give increase the creative dimension and allow the users to create uniquely designed work.

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Contact:
Eileen Brosnan
Department of Child and Family Psychiatry

Mater Hospital
Dublin 7, Ireland
Tel: 00353 1 803 4793
Email: eileen.brosnan@tcd.ie

Presenter: Eileen Brosnan

'WORKING THINGS OUT' A THERAPEUTIC INTERACTIVE CD-ROM CONTAINING THE STORIES OF YOUNG PEOPLE DEALING WITH DEPRESSION AND OTHER MENTAL HEALTH PROBLEMS

Dr. John Sharry¹, Eileen Brosnan, Research Fellow², Prof Carol Fitzpatrick³

²Media Lab Europe
¹Mater Hospital, Dublin
³University College Dubli

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It is widely accepted that children and young people enjoy using computers. Seymour Papert (1996) suggests that 'it is timely for school counsellors and child therapists to bridge the digital generation gap and innovate with computers in their work with children of the digital age.' Working Things Out (WTO) was developed in response to the growing need for computer-based resources for adolescents in therapy. It is an interactive CD ROM/DVD developed as a means of engaging adolescents about mental health issues by giving them information in the form of animated personal stories told by other young people dealing with problems such as depression, bullying, eating problems, and self-harm. The CD-ROM/DVD is accompanied by a manual for professionals on how to use the resource.

With the help of therapists, and in collaboration with graphic designers, animators, and multimedia professionals, the 11 young people who participated in the project told their stories, narrated in their own voice, and illustrated by graphics and animation. 'Working Things Out' is currently being used as an educational and therapeutic tool with other

adolescents at risk of mental health problems, both as a way of engaging young people to reflect about mental health issues and as a means of inviting them to tell their own story. The paper describes the background and development of the 'Working Things Out' project, including samples from the stories and a description of how the CD-ROM/DVD can be used in psychotherapy.

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Contact:
Dr John Sharry
Dept of child and family psychiatry
Mater Hospital
Dublin 7 Ireland
Tel: +353 1 803 4793
Email: Eileen.brosnan@tcd.ie

Presenter: Alex H. Bullinger MD MBA

NEXT GENERATION IMMERSIVE VISUALIZATION SYSTEMS

Alex H. Bullinger¹

¹ COAT-Basel / UPK (Center of Applied Technologies in Neuroscience), University of Basel, Switzerland

This paper deals with the ongoing developments towards immersive 3-D displays that require no special eyewear like shutter glasses anymore. Once these devices will have penetrated the market to a larger scale they could easily mark the end to the era of huge rear projection – based installations such as Powerwalls or CAVE – systems. At present only a handful of these 3-D display devices are on the market, most of them still promising more than what they are able to fulfill in the end. But technology development in this sector is moving with utmost velocity and ferocity. By the end of 2005 marketing of

desktop 3-D displays will begin in earnest opening up a vast number of potential applications not only for scientist, engineers and IT specialists but literally for everybody.

Contact:
Alex H. Bullinger
COAT-Basel / UPK
Wilhelm Klein – Str- 27
4025 Basel, Switzerland
boa@coat-basel.com

Presenter: Alex H. Bullinger MD MBA

TREATING ACROPHOBIA IN A VIRTUAL ENVIRONMENT

Alex H. Bullinger¹, Isabelle Angenendt¹, Brenda K. Wiederhold², Franz Mueller-Spahn¹, Ralph Mager¹

¹ COAT-Basel / UPK (Center of Applied Technologies in Neuroscience), University of Basel, Switzerland

² IMI and VRMC, San Diego, USA

Specific phobias are one of the most frequent mental health problems and can lead to years of personal suffering. The most effective treatment is exposure therapy. Our aim was to proof the feasibility and efficacy of virtual environments in treating acrophobia patients using a manually guided exposure therapy. Our pilot study was designed as a crossover intervention with a waiting list condition as a control group. After treatment, our results show that exposure in virtual environments is a feasible technique can provoke anxiety, and leads to a therapeutic effect.

Contact:
Alex H. Bullinger
COAT-Basel / UPK
Wilhelm Klein – Str- 27
4025 Basel, Switzerland
boa@coat-basel.com

Presenter: Maria Fernanda Cabrera PhD

E-MENT@L HE@LTH. THE ISLANDS PROJECT AS A CHALLENGE FOR THE FUTURE

Maria Fernanda Cabrera PhD

Universidad Politecnica de Madrid

It has been already accepted that the improvement in medical care cannot be made merely by adding professionals to healthcare systems, but in addition require restructuring the patterns of health-care delivery. The incorporation into medical practice of relevant technological innovations is an essential part of this reorganisation. This innovation is producing a promising field - e-mental health - whose focus is the use of communication and information technologies to improve the mental health care processes. This area has developed rapidly, accumulating knowledge and proposing innovative affirmations. This is a multidisciplinary field that requires the cooperation among different professionals. The results of this collaboration are represented by the ISLANDS project, an attempt to develop and comprehend the potential of e-mental health, which specific goal was to develop services to provide modular, non-conventional, remote psychiatric and psychotherapeutic assistance for remote areas. The project started with a literature review of the state of the art on remote therapeutic psychiatric and psychotherapeutic interventions, complemented by field work with the realization of questionnaires to patients, families and doctors, and an international workshop, to result in appropriate service delivery scenarios.

The scenarios specified, the different user group needs and the epidemiological findings led to the definition of different remote service categories (diagnosis, counseling, and therapy) for patients, informal careers, and professionals, as well as an overall service layout. These services are supported by interactive and user-friendly tools for service content presentation, namely: an interactive web chat tool, a database of reference case studies, an expert tool for therapy guidance, a tool for service confidentiality, and the necessary communication tools and service delivery platforms. All the above developments are integrated into modular service typologies, taking into account relevant security, legal and ethical issues. Four typical case studies of psychological problems have been selected that can be found quite often in normal populations and are of specific interest: post-traumatic stress disorder, depression, problems of alcohol abuse, and psychotic disorders. The proposed services are being tested in three pilot sites: the French Overseas Departments, the Greek Southern Sporades,

and the Spanish western Canary Islands.

Over the past 24 months, the ISLANDS consortium has focused in the development and deployment of feasible tools for diagnostic, counseling, and therapy purposes. According to the preliminary results of a questionnaire survey, users' acceptance of and satisfaction with the technology were high. Ninety percent of the patients considered that they received the follow-up care they required.

We can conclude that the development of a knowledge-based expert tool to guide the relevant services application aims to avert erroneous application of such services, by inexperienced medical personnel or the users themselves and their relatives.

The project will, it is hoped, provide leadership, enhance information about mental health problems, and undertake research in cost-effective policies to improve the mental disorders addressed.

Contact:

Maria Fernanda Cabrera PhD
Universidad Politecnica de Madrid
Madrid 28040
Spain
Phone: +34915495700 ext. 332
Fax: +34913366828
Email: chiqui@gbt.tfo.upm.es

Presenter: Maria Fernanda Cabrera PhD

OPEN MOBILE PLATFORM FOR EMERGENCY HEALTHCARE APPLICATIONS

Maria Fernanda Cabrera PhD

Universidad Politecnica de Madrid

In the new society, mobility has become a necessity and a competitive advantage, both for citizens and the human capital of companies. Its next step is clearly to become a complete product. In order to become a commodity for European society, mobile solutions must provide five main characteristics: ubiquity, transparency, fundamentality, universality, and value governance. As the new 3G technology is "around the corner," suitable platforms that make possible an interesting business model to access Pan-European mobile services is a "must" that hasn't been

resolved, yet. Facing this reality, the European Union funded XMOB, an IST project that joined research groups, phone operators, consultancy companies, industry, and emergency medical services (EMS) to build a platform aimed to host mobile applications. The benefits and outputs of the platform were validated through the development of a vertical application for the health emergency management.

The mobile emergency services developed focused on the following main challenges:

- Necessity to cover a broad set of devices and channels
- Need to integrate a complex range of involved actors (e.g., insurance call centers, public emergency assistance, patients' historical medical records repositories, hospitals, etc.)
- Provision of complete, customized, and timely assistance in emergency situations based on instant and secure mobile access to standardized patients medical records
- Existence of emergency situations that require the coordination between different countries to provide an accurate attention to the patient

The methodological approach consisted of two steps: to build a reusable horizontal platform and then, following an ASP model, to develop vertical mobile applications for health emergency management. These applications were made of several tools that help the emergency staff and the other actors involved in accessing critical data of patients.

The platform was validated in real life situations and cost-effectiveness and patients' benefits analysis were conducted. The trials were carried out in Madrid and Genoa cities and lasted two months.

The opinion of the users consisted of a self-evaluation with a questionnaire distributed to different staff categories. The questionnaires contained closed-ended questions and respondents were provided space to add written comments. The results were evaluated in scores on two scales, the "Usefulness" scale denoting potential use of the system, and the "Satisfying" scale reflecting pleasantness. The patient's privacy and respect issues were covered.

The most important conclusion, which can be derived from the pilots' comparisons, is the

fact that all user groups were in all cases and in both pilot sites positively oriented towards the developed system. Nevertheless, it should be remarked that all EMS do not need the same functionalities in their pre-hospital emergency management due to specificity of environments (rural/urban, medical/paramedic) so that the main achievement of this platform is to provide a widely open integrated solution. This will enable any citizen to benefit from the same quality of care, anywhere, in pre-hospital emergencies domain.

The benefits of a seamless infrastructure are the foundational components of this platform that improve the efficiency and efficacy of the EMS. This translates into lives saved and morbidity reduced.

Contact:

Maria Fernanda Cabrera PhD
Universidad Politecnica de Madrid
Madrid 28040
Spain
Phone: +34915495700 ext. 332
Fax: +34913366828
Email: chiqui@gbt.tfo.upm.es

Presenter: Yang Cai PhD

GEDANKEN EXPERIMENT OF HUMAN DYNAMICS

Yang Cai

Carnegie Mellon University

Understanding human dynamics is an important step in clinical therapies, such as blood glucose management or weight control. It requires insight into the complex interactions between the components of biomedical systems. This is challenging because of the enormous amount of data and knowledge in this domain. Gedanken Experiment is an intuitive, qualitative thinking process, which have been used by physicists for decades. Our goal is to enable an interactive game-like environment for users with any background, while remaining sufficiently flexible to target medical problems at a level of abstraction, from the conformational changes of a protein to the interaction of the various biochemical pathways in our body. Here, we present an interactive and visual problem-solving environment for the

biomedical domain. We designed a biological world model, in which users can explore biological interactions by role-playing "characters" such as cells and molecules or as an observer in a "shielded vessel," both with the option of networked collaboration between simultaneous users. The system architecture of these "characters" contains four main components: (1) Bio-behavior is modeled using cellular automata. (2) Bio-morphing uses vision-based shape tracking techniques to learn from recordings of real biological dynamics. (3) Bio-sensing is based on molecular principles of recognition to identify objects, environmental conditions, and progression in a process. (4) Bio-dynamics implements mathematical models of cell growth and fluid-dynamic properties of biological solutions. The principles are implemented in a simple world model of the human vascular system and a biomedical problem that involves an infection by *Neisseria meningitidis* where the biological characters are white and red blood cells and *Neisseria* cells. Our case studies show that the system can be used for public health education, biomedical simulation and creative problem solving.

Contact:
Yang Cai
Carnegie Mellon University
Email: ycai@cmu.edu

Presenter: Gianluca Castelnuovo PhD

A NEW GENERATION OF VIRTUAL ENVIRONMENTS FOR THE TREATMENT AND REHABILITATION OF EATING DISORDERS

Gianluca Castelnuovo, Ph.D.^{1-2,4}, Gianluca Cesa, M.S.¹⁻⁴, Andrea Gaggioli, M.S.¹⁻³, Daniela Villani, Ph.D.¹ Enrico Molinari, Psy.D.²⁻⁴, Giuseppe Riva, Ph.D.¹⁻²

¹ Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano

² Department of Psychology, Catholic University, Milan, Italy

³ Laboratory of Psychology, Department of Preclinical Sciences LITA Vialba, University of Milan, Milan, Italy

⁴ Clinical Psychology Lab, Istituto Auxologico Italiano, Verbania, Italy

The cognitive behavioral therapy (CBT) is still considered the best approach in the treatment of eating disorders, but it could present differ-

ent limitations related to costs of typical behavioral procedures or difficulty with cognitive techniques. Virtual Reality has already shown its possible utility in enhancing the CBT for different mental problems. Rationale and protocols about the use of Virtual Reality-enhanced treatments, named Integrated Experiential Therapy (IET), will be explained. The major aim of this presentation is the description of a new paradigm of virtual environments (VEs): new possibilities for different clinical protocols will be discussed. The real novelty of this new generation of VEs is the high level of flexibility and plasticity allowing therapists to save different versions according to the specific users' needs and features. Moreover it is possible to carry on systemic, dynamic or cognitive-behavioural approaches using different aspects and nuances of VEs.

This research is part of the Prof. Giuseppe Riva's NEUROTIV project - Immersive virtual telepresence managed care for the assessment and rehabilitation in neuro-psychology and clinical psychology.

Contact:
Gianluca Castelnuovo, Ph. D.
Applied Technology for Neuro-Psychology Lab
P.O. BOX 18211
28921 Verbania, Italy
Tel. +39/0323/514278- .339
Fax. +39/0323/514338
Email: gianluca.castelnuovo@auxologico.it

Presenter: Gian Luca Cesa MS

INTEGRATED EXPERIENTIAL THERAPY FOR THE TREATMENT OF OBESITY AND BINGE EATING DISORDER: A CLINICAL TRIAL

Gian Luca Cesa, M.S.¹, Gianluca Castelnuovo, Ph.D.¹, Andrea Gaggioli, Ph.D.¹, Daniela Villani, M.S.¹, Giuseppe Riva, Ph.D.¹⁻²

¹ Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Verbania, Italy

² Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy

The main goal of this work is the description of a new Virtual Reality-enhanced treatment named Integrated Experiential Therapy (IET) for the treatment of Obesity and Binge Eating

Disorder. IET for eating disorders and obesity is a relatively short-term, integrated, patient oriented approach that focuses on individual discovery. Integrated Experiential Therapy is an integrated approach ranging from cognitive-behavioural therapy to virtual reality sessions for the treatment of eating disorders and obesity. In this approach VR is mainly used to modify body image perceptions. The use of VR offers two key advantages. On one side, it is possible to integrate all different methods (cognitive, behavioural, and experiential) commonly used in the treatment of body experience disturbances within a single virtual experience. On the other side, VR can be used to induce in the patient a controlled sensory rearrangement that unconsciously modifies his/her bodily awareness (body schema). The treatment is a 4-6-week inpatient treatment and it is administered by therapists having a cognitive-behavioural orientation who work in conjunction with a psychiatrist as far as the pharmacological component is concerned. The individual work regards assessment by means of psychometric tests, weekly supportive psychological talks, 7 sessions for assessment, and therapy carried out using Virtual Reality (VR), and psychopharmacological assessment and control. The psychological group therapy is based on weekly group meetings (closed group of 5/6 persons) of two hours each. The work group aims both at training for development and acquisition of assertive skills, and at training for assessment and consolidation of motivation. Moreover, the subjects participate to both bi-weekly psycho-nutritional groups held by nutritionists and to daily group sessions of physical activity. In order to verify the efficacy of IET we are realizing a clinical trial with a sample of obese patients (with and without Binge Eating Disorder). Subjects were randomly assigned to the experimental group and to the three control groups. Subjects were assessed by one of three independent assessment clinicians who were not involved in the direct clinical care of any subject. All subjects were assessed at pre-treatment and upon completion of the clinical trial. Patients were administered a battery of outcome measures assessing eating disorders symptoms, attitudes toward food, body dissatisfaction, level of anxiety, motivation for change, level of assertiveness and general psychiatric symptoms.

In summary, the preliminary results show that the virtual simulation of demanding real life situations is useful to improve patient's aware-

ness, body satisfaction, eating control, social skills, self-esteem, and motivation to change. In particular, pre-treatment/post-treatment comparison seems to indicate that Integrated Experiential Therapy is more effective than traditional approaches in the treatment of Obesity and Binge Eating Disorder. Complete results will be presented in the conference.

This research is part of the Prof. Giuseppe Riva's NEUROTIV project - Immersive virtual telepresence managed care for the assessment and rehabilitation in neuro-psychology and clinical psychology.

Contact:

Gian Luca Cesa M.S.

Applied Technology for Neuro-Psychology Lab

P.O. BOX 18211

28921 Verbania, Italy

Tel. +39/0323/514278- .339

Fax. +39/0323/514338

Email: gluca.cesa@auxologico.it

Presenter: Sophie Côté, Ph.D. candidate

COGNITIVE MECHANISMS UNDERLYING VIRTUAL REALITY EXPOSURE'S EFFICACY IN THE TREATMENT OF ARACHNOPHOBIA

Sophie Côté¹, Ph.D. candidate & Stéphane Bouchard^{1,2}, Ph.D.

¹ Ottawa University, Ottawa, Ontario, Canada

² University of Quebec in Outaouais, Gatineau, Quebec, Canada

Research status: Completed.

Virtual exposure therapy for phobias is a growing field of interest. Studies have begun to demonstrate its efficacy, which is at least equivalent to in vivo exposure. However, though a majority of studies have addressed efficacy itself, few have attempted to understand the treatment mechanisms underlying this efficacy. In the case of traditional therapy, two models are still the object of a strong debate: the information processing model and the perceived self-efficacy model. Interestingly, this debate is still fuelled by their authors' attempts to prove the predictive superiority of their model by using predicted variables that are in fact different. Actually,

no study has yet directly compared the most likely predictors of change, for virtual exposure.

The goal of this study was to contrast the predictive value of different treatment mechanisms for specific phobias. The hypotheses are the following. Changes in information processing (measured with a pictorial Stroop task) will better predict changes in anxiety during a behavioral avoidance test, while changes in perceived self-efficacy will better predict changes in avoidance behaviors during a behavioral avoidance test.

Twenty-eight adult arachnophobics were assessed for standardized inclusion and exclusion criteria. General outcome and specific processes measures included questionnaires and a pictorial Stroop task. The main outcome and predicted variables were based on a behavioral avoidance test (BAT). Avoidance behavior was measured by participants' capacity to approach a live tarantula during the BAT and anxiety was measured by recording their heart rate during the first minute of the task. All measures were completed before treatment (session 1) and at post-treatment (session 7). After explanations about the cognitive-behavioral rationale for phobias and an initiation to the virtual reality equipment (session 2), participants went through virtual exposure for five sessions (60 minutes each) in various virtual environments with spiders.

Repeated measures ANOVAs on outcome measures revealed that therapy had a positive impact. Analyses made on the pictorial Stroop task showed that information processing of spider-related stimuli is faster after treatment, which also indicates therapeutic success. Psychophysiological data also showed a positive change after treatment, suggesting a decrease in anxiety. In themselves, these results represent new contributions to the field. Hierarchic regressions were about to be made as this abstract was submitted; results will be available in the presentation. These regressions will be used to assess the respective predictive capacities of each key variable for therapeutic change.

This innovative study brings fascinating information about the various and deep impacts of VRE at physiological, information processing and cognitive levels. Therefore, VRE does provoke significant clinical and statistical therapeutic change for people suffering from

arachnophobia. It also brings elements of a better understanding of the distinct contribution of each predictive variable in the psychopathological models for phobias. Interestingly, this information can be applied to both in vivo and virtual reality exposure. Likewise, both clinicians and researchers can benefit from that knowledge, in order to better choose the exposure treatment targets or procedures, according to the type of changes they want to observe in clients.

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Contact:
Sophie Côté
Ottawa University, Ottawa
Ontario, Canada
Phone : (819) 76-8045
Fax : (819) 776-8098
Email : scote067@uottawa.ca

Presenter: David Coyle MSc

ADAPTABLE COMPUTER GAMING FOR ADOLESCENT PSYCHOTHERAPY

David Coyle, MSc¹, Dr John Sharry², Dr Gavin Doherty¹

¹ Trinity College Dublin, Ireland

² Mater Hospital, Dublin Ireland

Research Status: The Virtually Healthy Project is exploring the use of computer gaming

on adolescent mental health care. Details are given of preliminary clinical trials of a custom developed game and of ongoing research directions.

Reports show that, although mental health problems increase during adolescence, the majority of disturbed adolescents do not receive professional mental health care and of those who do fewer still fully engage with the therapeutic process (Offer et al. 1991; US Surgeon General 1999). Adolescents are generally more private and self-conscious than either younger children or adults. Typically therapy is imposed upon them (usually by their parents) and because of this they are less willing to accept it. Play therapists often engage younger children using materials such as puppets, storybooks, and construction materials. Adolescents can be resistant to these methods, not liking to be treated as children. Equally, many react confrontationally or not at all to direct dialogue (Sharry 2004). However adolescents often show a great interest in computer games. A recent UK survey reported that 53% of eleven to fourteen year olds play games four times a week or more (McFarlane et al. 2002). Computer games currently constitute a client-centred approach to adolescent psychotherapy.

Personal Investigator (PI) is a 3D computer game specifically designed to help adolescents with mental health problems. It incorporates a goal-oriented, strengths based model of psychotherapy called Solution Focused Therapy (SFT). Adolescents play the role of a personal investigator hunting for the clues that will help them solve personal problems. By engaging adolescents, in a client-centred way, it aims to build stronger therapeutic relationships between therapists and adolescents. PI is the first game to integrate this established psychotherapy approach into an engaging 3D game. PI differs from previous therapeutic games by encouraging the adolescent to create a written record of their own discoveries. The player creates a virtual detective notebook in which they write down all their goals, objectives, ideas, and thoughts. Upon completing the game, they receive a printout of their notebook. Clark et al. 1984 reported benefits of having a tangible output from a game. A pilot study of the game has been conducted with four adolescents, referred to clinics for issues including anxiety and behaviour problems, attempted suicide, and social skills difficulties. Initial results indicate that

playing PI in sessions is very helpful in engaging adolescents. It can increase the amount of dialogue between therapists and adolescents and help in setting therapeutic goals. The use of 3D had an empowering effect, allowing the adolescent more control over the pacing and direction of the therapeutic process. For full details of the theoretical foundations, design, and pilot study of PI see Coyle et al. 2005.

PI implemented a therapeutic model in an open manner, not tailored to address specific mental health issues or specific adolescent cases. One ongoing aim of the Virtually Healthy project is to create a toolkit that allows non-programming, professional therapists to adapt and create issue specific computer games. The system should be usable by therapists with wide-ranging levels of computer literacy and be adaptable on many levels, from small fine-tuning of existing games to the creation of new games.

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Contact:

David Coyle
Trinity College Dublin, Ireland
Tel: 353-86-8269863
Email: david.coyle@gmail.com

Presenter: Gábor Csukly MD

FACIAL EXPRESSION RECOGNITION IN PSYCHIATRIC DISORDERS USING ANIMATED 3D EMOTIONAL FACIAL EXPRESSIONS

Lajos Simon PhD¹, Gábor Csukly MD¹,
Barnabás Takács PhD²

¹ Semmelweis University, Psychiatric and
Psychoterapic Departement

² DigitalElite Inc.

Research Status: Completed.

The first purpose of our investigation is to create a screening protocol where repeatable and parametric facial stimuli are presented interactively to patients in order to characterize and later identify their respective mental disorders using their measured responses.

We would like to prove that depressed patients may be differentiated based on the degradation in performance of recognition.

We have generated 24 faces (12 male – 12 female) expressing the 6 basic emotions in two different ways (shown below), and 2 neutral faces (1 male – 1 female). We have shown these faces to 117 people. We have accepted a picture if the recognition rate was higher than 70%. Finally we have chosen the best recognized picture of each emotion and used these 7 pictures in the experiment. In our experiments we evaluated 26 depressed patients and used frontal views of the two 3D animated faces and asked the subjects to identify the emotion. We generated the 20-40-60-80-100% (expression level of the emotions) sequence of each validated face (5x7=35 pictures).

ANOVA evaluation of the data shows that depressed patients consistently did not show differentiable degradation in overall performance when compared to the control group. Furthermore we found that the higher the level of education the more significantly higher the recognition rate. We have found significant difference between depressed and

control group points in the recognition of sadness at 100% of expression and in the recognition of happiness at 60% of expression. In each case depressed patients reached higher rates.

Contact:
Gábor Csukly MD
Semmelweis University
Psychiatric and Psychoterapic Departement
Budapest, Hungary
Tel: 36302886737
Email: csugab@yahoo.com

Presenter: Carlos de las Cuevas MD PhD

TELEPSYCHIATRY: PSYCHIATRIC CONSULTATION THROUGH VIDEO- CONFERENCE CLINICAL RESULTS

Carlos de las Cuevas MD PhD

University of La Laguna

Telepsychiatry can be conceived as an integrated system of mental health care delivery that employs telecommunications and computerized information technology as an alternative to face-to-face conventional alternative. Videoconferencing is the central technology currently used in telepsychiatry, since it permits live, two-way interactive, full-colour, video, audio, and data communication. The effectiveness of a telepsychiatry service through videoconferencing was evaluated from a users' perspective. Ninety (30 male, 60 female) subjects completed the Symptom Rating Checklist-90-Revised (SCL-90-R) on three occasions, once before the first teleconsultation and twice during telepsychiatry treatment. Patients and psychiatrist completed the Clinical Global Impression Scale-Severity Index (CGI) after each teleconsultation. Twenty five percent of patients were aged less than 30 years, 44% were aged between 30 and 45 years, 24% between 45 and 60 years, while 7% were aged over 60 years. Anxiety disorders were the more prevalent diagnosis (43.8%), followed by depression (36%), schizophrenia (7.9%), substance disorders (6.1%), and personality disorders (5.6%). The patients' mean SCL-90-R scores decreased significantly over time, indicating less psychiatric distress. Both patients and psychiatrist reported patient clinical significant improvement over time as assessed by the CGI. The mean number of

teleconsultations in patients discharged was 6. Telepsychiatry showed to be an effective mean of delivering mental health services to populations living in remote areas with limited resources.

Contact:
Carlos de las Cuevas MD PhD
University of La Laguna
Urbanización Las Cañas 33
La Laguna, Tenerife
Canary Islands 38208, Spain
Phone: 0034609521405
Email: ccuevas@ull.es

Presenter: Carlos de las Cuevas MD PhD

TELEPSYCHIATRY: PSYCHIATRIC CONSULTATION THROUGH VIDEO-CONFERENCE PATIENTS' PERCEPTION AND SATISFACTION

Carlos de las Cuevas MD PhD

University of La Laguna

A telepsychiatry service, using a videoconferencing system, was established to provide psychiatric consultations for the population of La Gomera, in the Canary Islands. During the first year of routine operation, a total of 90 patients had 90 initial and 224 follow-up teleconsultations. The main reason for the consultation identified in the general practitioner's referral form was to establish a diagnosis (70% of patients); the second most common reason was the management of a previously diagnosed patient (20% of patients). According to the results of a questionnaire survey, patients' acceptance of and satisfaction with the technology was very high. In their first teleconsultation, about a third of them said that they experienced some initial inconvenience, but this disappeared after a few minutes. During the teleconsultations, 90% of patients felt understood and could explain all their worries and fears. Ninety percent of the patients considered that they received the follow-up care they required and felt satisfied with the attention received. Only nine out of ninety patients (10%) stated they liked the 'real' doctor better than the 'television doctor'; forty five (50%) said they had no preference, and thirty five (40%) expressed their preference to telepsychiatry.

Contact:

Carlos de las Cuevas MD PhD
University of La Laguna
Urbanización Las Cañas 33
La Laguna, Tenerife
Canary Islands 38208, Spain
Phone: 0034609521405
Email: ccuevas@ull.es

Presenter: JoAnn Difede PhD

VIRTUAL REALITY THERAPY FOR POSTTRAUMATIC STRESS DISORDER FOLLOWING SEPTEMBER 11, 2001

JoAnn Difede PhD¹, Hunter Hoffman, Ph.D, Judith Cukor, Ph.D., Ivy Patt, Ph.D., Cezar Giosan, Ph.D.

¹Weill Medical College of Cornell University

Research status: This abstract presents the findings of an ongoing study which includes, to date, 21 subjects.

Background/Problem

Posttraumatic Stress Disorder (PTSD) is a prevalent and often persistent mental illness which affects approximately 7.8% of the U.S. population.¹ In the aftermath of the World Trade Center attacks, studies of residents of New York City have found increased rates of PTSD,² with rates among disaster workers possibly higher. Expert treatment guidelines for PTSD recommend cognitive-behavioral treatment with exposure therapy.³ However, due to avoidance symptoms inherent in PTSD, some patients refuse to or are unable to engage their emotions in treatment, thereby limiting its efficacy. The use of virtual reality (VR) provides a greater possibility of generating patient involvement through the multiplicity of sensory cues that it affords. The goal of this study is to evaluate the efficacy of the use of VR in the treatment of PTSD directly resulting from the World Trade Center attacks on September 11, 2001.

Method/Tools

Enrolled subjects meet diagnostic criteria for PTSD and directly witnessed at least part of the attacks of September 11th. Subjects in the treatment group receive treatment based upon a 14 -week protocol that incorporates

exposure using virtual reality with other cognitive-behavioral techniques. The subject views scenes of the World Trade Center attacks through a 3-D headset that progress in severity culminating in two planes hitting the towers and their subsequent collapses, with accompanying sounds of screaming and sirens. Subjects complete self-report questionnaires weekly and are assessed prior to and following the treatment by an experienced clinician. Subjects in the waitlist control are evaluated at baseline and again after 14 weeks, at which time they are offered treatment.

Results

To date, 7 subjects have completed the treatment protocol and 14 have been enrolled in the waitlist condition. This sample was 91% male with a mean age of 43 (SD=9). Notably, in the treatment group 5 of the 7 subjects were disaster workers and 6 of the 7 subjects had failed to respond to imaginal exposure therapy (i.e., had been in prior treatment for their PTSD symptoms but still suffered significantly from PTSD with a mean baseline CAPS score of 78 +/- 24). Data analysis shows that scores on the CAPS decreased by an average of 28 points for individuals in the VR group and decreased by an average of 5 points for individuals in the waitlist control ($p < .05$).

Conclusion

This preliminary data suggests that virtual reality is an effective treatment for PTSD. Novelty/Discussion: This preliminary study is the first to show that virtual reality is an efficacious treatment for individuals suffering from PTSD following terrorism and, to our knowledge, is only the second study of PTSD using virtual reality. Treatment failures using imaginal exposure may be partially due to the inability of the patient to emotionally engage in the exposure work. Virtual reality appears to address this problem by enhancing the patient's capacities with visual, auditory, and even haptic computer-generated experiences, thereby facilitating the patient's emotional engagement in the exposure treatment.

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Weill Medical College of Cornell University
525 East 68th St Box 200

New York, NY 10021

Phone: 212-746-3079

Fax: 212-746-0719

Email: jdifede@med.cornell.edu

Presenter: Mario Doulis

THE AMALGAMATION - PRODUCT DESIGN ASPECTS FOR THE DEVELOPMENT OF IMMERSIVE VIRTUAL ENVIRONMENTS

Professor Mario Doulis, Andreas Simon

University of Applied Sciences Aargau, CH

Interacting in an immersive virtual environment we refer to the real world. The user gets to expect real world behaviour from virtual objects and functions. We explore the idea of bringing aspects of product design to the development of input devices and interaction techniques for virtual environments. We use ergonomics and *product language* to design the physical input device, the virtual representation and the connection between real and virtual parts. This connection, which we call *amalgamation*, is the most important element of the design, since it defines, if the user rather interacts with virtual objects as "virtual products" (via an input device), or rather interacts with an input device as a "real product" controlling virtual content.

Contact:

Mario Doulis

University of Applied Sciences Aargau, CH

Email: m.doulis@fh-aargau.ch

Presenter: Stéphanie Dumoulin

POTENTIAL MECHANISMS UNDERLYING THE EFFICACY OF VR TO REDUCE ACUTE PAIN: A LITERATURE REVIEW

Stéphanie Dumoulin, B.Sc., Stéphane Bouchard, Ph.D. & Vicky Rivard, Ph.D.

Cyberpsychology Lab of the University of Quebec in Outaouais

Research status: Completed.

Pain is now considered a complex subjective phenomenon that involves sensorial, motivational, cognitive, and emotional dimensions. Recent studies have now shown that virtual reality (VR) can be used to control and reduce acute pain; probably because of its potential for distracting attention away from the pain. But many factors may influence the efficacy of VR to help manage pain. The aim of this literature review is to summarize the studies that assessed the efficacy of VR in experimental and clinical pain management in order to highlight psychological variables that may be involved in the mechanisms of pain management using VR.

Method

This systematic review followed a standard and structured research approach. It has the advantages of being rigorous, replicable, and the results can easily be presented in a poster format. Journal databases such as *MedLine*, *PsycINFO* and *Web of Science* were searched with key words such as «pain» or «pain management» were crossed with key words such as «virtual» or «virtual reality». More than 110 articles were found. Most of them were theoretical. But 17 empirical studies using VR to manage pain were found. Six used rigorous experimental protocols and 11 were more exploratory and had no experimental protocol.

Results and Conclusion

Most studies showed an important and statistically significant reduction in pain. Although distraction is considered the key ingredient to explain these results, a detailed analysis reveals that several factors might be involved. These factors could be grouped in three categories: task relevant (e.g., attention required, task complexity, and emotional content), indi-

vidual (e.g., sense of presence, hypnotisability, self-efficacy, and outcome expectations) and pain factors (e.g., pain intensity). We believe that by highlighting explicitly in this poster the variables that may lead to pain management, VR researchers can narrow more effectively their search for treatment moderators and mediators.

Contact:

Stephanie Dumoulin, B.Sc.

tifdum@hotmail.com

Phone: (819) 771-7761-8419

Fax: (819) 776-8098

Presenter: Natalia Fernández

MOTIVATIONAL TRAINING TOOL TO PROMOTE HEALTHY LIFESTYLE USING VIRTUAL REALITY

Natalia Fernández, PhD candidate

Universidad Politecnica de Madrid

One of the main challenges that developed societies face is the prevention of non-communicable diseases such as diabetes or obesity. These diseases are responsible for 60% of the registered global deaths and for 45% of the global burden of disease. Unhealthy diet, together with physical inactivity and smoking, are among the key risk factors for the development of these illnesses. The fact that these are preventable leads directly to the elaboration of prevention strategies that aim to empower and motivate the citizens to be responsible for their own health by, among others, providing them with quality and personalised information. As the purpose is to incorporate healthy lifestyles to the users' daily activities, motivational aspects need to be seriously taken into account. Hence, the way the information is presented to the user must be carefully analysed.

The development of a virtual reality tool helps to motivate the user and also improves the e-learning process. The work presented in this paper contributes partially to solve this situation by offering the users personalised information for their own self-care and furthermore, by motivating them to make use of this information and take control of their decisions regarding their lifestyle through the use of a virtual reality tool.

The tool, based in X3D (eXtensible 3D), a

virtual 3D technology for the Internet, is integrated in an e-learning environment which is also interactive and immersive. A training activity in the system consists of an Internet multimedia session that shows personalised information by means of an attractive visual interface. It is worth mentioning that the tool not only provides citizens specific information adapted to their profile and needs but also the interface is personalised accordingly. The information managed throughout the system, including the virtual scenarios, has been stored using the XML format.

Moreover, in order to perform the personalisation of the tool for every single user, the system has been programmed to be "intelligent." The process is started by obtaining the user profile. This is created the first time the citizen accesses the tool by filling in a structured questionnaire about nutritional, statistical, motivational and physical activity data. By processing this data, the information that suits the user needs and preferences best, is selected from a native XML database. In addition, the information is presented to the users in a different way depending on their motivational state, which is revealed by applying the "Stages of Change" methodology.

In order to measure the user response to the system, a survey is compiled after the first training session. The evaluation of the results allows us to conclude that Virtual Reality is perceived as an interesting and easy to use tool. Besides, the users state that the relation between the scenarios developed and the information provided in each of them was tailored to their needs and the contents were marked as a good educational tool to adopt a healthy lifestyle.

Contact:
Natalia Fernández
E.T.S.I. Telecomunicación.
Ciudad Universitaria
Universidad Politecnica de Madrid
Phone: +34 91 549 57 00 ext. 332
Fax: +34 91 336 68 28
Email: nfernandez@gbt.tfo.upm.es

Presenter: Marta Ferrer-Garcia

ASSESSMENT OF EMOTIONAL REACTIVITY PRODUCED BY EXPOSURE TO VIRTUAL ENVIRONMENTS IN PATIENTS WITH EATING DISORDER

José Gutiérrez-Maldonado, PhD , Marta Ferrer-Garcia, PhD candidate

University of Barcelona, Spain

This paper describes the effectiveness of virtual environments to elicit emotional responses in eating disordered patients. This study is part of a wider research project analysing the influence of the situation to which subjects are exposed on their performance on body image estimation tasks.

Though it seems self-evident that there is a close relation between eating disorders (ED) and altered body image, in the literature on the subject no clear association has in fact been established, and indeed the results of the studies^{1,2,3,4,5} are often contradictory or inconclusive. A number of hypotheses have been proposed to account for these results. Some authors have stressed the fact that body image may be to a certain extent more a state than a trait^{2,4,8} and may change according to situational or emotional variables. Several studies have analysed the possible impact of exposure to specific objects or situations on the stability of the body image.^{6,7,8,9,10,11}

In this study we designed several virtual environments that were emotionally significant for subjects with ED in order to generate different levels of anxiety and variations in mood. Unlike conventional methods (real exposure to the situation, exposure to photographs, exposure via guided imagination, and so on), virtual reality exposes subjects to interactive three-dimensional environments that simulate real situation. These environments have ecological validity but also permit strict control over the variables and the recording of data. Virtual reality offers many of the advantages of the conventional methods mentioned above, and also overcomes many of their drawbacks.

Thirty female patients with eating disorders were exposed to six virtual environments: a living-room (neutral situation), a kitchen with high-calorie food, a kitchen with low-calorie food, a restaurant with high-calorie food, a restaurant with low-calorie food, and a swimming-pool. After exposure to each environment the STAI-S (a measurement of state

anxiety) and the CDB (a measurement of depression) were administered to all subjects.

The results showed significantly higher levels of state anxiety in the kitchen with high-calorie food ($F=13.120$; $p = 0.001$), the restaurant with high-calorie food ($F = 14.954$; $p = 0.001$) and the swimming-pool ($F = 4.230$; $p = 0.049$) than in the neutral environment. Analysing the scores for depression obtained on the CDB, significant differences again appeared between the high-calorie food environments ($F = 7.187$; $p = 0.012$ in the kitchen and $F = 5.933$; $p = 0.021$ in the restaurant) and the neutral environment. In the high-calorie food situations patients with ED showed a more depressed mood.

Virtual reality thus appears to be a valid instrument particularly useful for simulating everyday situations that may provoke emotional reactions such as anxiety and depression, in patients with ED. Virtual environments in which subjects are obliged to ingest high-calorie food provoke the highest levels of state anxiety and depression. Previous studies have shown the capacity of VR to elicit states of anxiety in patients with other pathologies too.^{12, 13, 14}

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Contact:

Marta Ferrer-Garcia
 Departamento de Personalidad, Evaluación y Tratamientos Psicológicos
 Facultad de Psicología. Paseo Valle de Hebron, 171, 08035 Barcelona, Spain
 telephone number: +34933125126
 fax number: +34934021362
 e-mail : martaferreg@ub.edu

Presenter: Raymond A. Folen PhD

**IS VIRTUAL REALITY BETTER THAN
 NON-VIRTUAL REALITY CLINICAL**

APPLICATIONS? A DISCUSSION OF FIVE STUDIES

Raymond A. Folen, Ph.D.

Tripler Army Medical Center, Department of Psychology

Research Status: In Progress

Background/Problem

Virtual Reality (VR) interventions for behavioral health have demonstrated promise for a wide variety of clinical concerns.¹ At the same time, most research to date has lacked control conditions and comparisons with non-VR environments and interventions,² making it more challenging to justify the cost of establishing in-house VR services. Research being conducted at the Pacific Telehealth & Technology Hui Virtual Reality Behavioral Health laboratory compares VR interventions with active treatment controls and standard of care controls, and assesses the efficacy of different display formats. Five controlled comparison study protocols designed to advance the field of VR in behavioral health will be presented and preliminary findings will be discussed.

Method

Two of the research projects, a reactivity to anger stimuli study and a nicotine cue exposure study, evaluate the effectiveness of immersive panoramic video virtual environment (VE) displays in evoking physiological and emotional responses to anger stimuli or smoking cues compared to flat screen video displays of the same content. Outcome measures include standardized questionnaires and physiological measures of heart rate, blood pressure, skin conductance, temperature, and r e s p i r a t i o n . The third study, a biofeedback training study, compares the effectiveness of three biofeedback training modalities for controlling peripheral body temperature. Participants are randomly assigned to one of three training conditions: (1) temperature change presented on a monitor (standard feedback mode), (2) standard feedback presented through a HMD, and (3) immersive VE with pictorial feedback display presented through a HMD. Outcome measures include the maximum temperature difference, time to maximum temperature, time to criterion temperature, duration of crite-

tion temperature, and rate of change. Chronic pain is the focus of the fourth study which compares the effectiveness of three treatment conditions in reducing the perception of chronic pain: (1) therapist guided imagery (standard treatment), (2) audio-taped imagery, and (3) therapist guided imagery enhanced with VR. The outcome measures consist of pre- and post- treatment pain perception, self-efficacy ratings of treatment effectiveness, and physiological measures. The fifth study compares the effectiveness of VR as a pain and anxiety distraction to the standard of care for participants undergoing a cystoscopy examination. Outcome measures include the degree of perceived pain, pre- and post-procedure anxiety, and physiological measures. Results, Conclusions, and Novelty: The five studies will be discussed in terms of protocol design and anticipated unique contributions to the field of VR in behavioural health. Several themes will be highlighted, including (1) the need to establish the incremental benefit of using VR versus alternative display formats, such as in the anger reactivity, nicotine and biofeedback studies, (2) the need for controlled comparisons as exemplified by all of the studies, (3) the need to generalize findings within clinical domains, e.g., generalizing pain analgesia findings for cystoscopy examinations, and (4) the benefits of establishing experimental results that may be transportable to clinical applications, such as the use of VR-enhanced thermal biofeedback training for reducing migraine headaches or anger reactivity study protocols for anger management programs. Preliminary standardized questionnaire and physiological findings will also be presented.

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Contact:
Raymond A. Folen, Ph.D.
Tripler Army Medical Center
Department of Psychology

1 Jarrett White Road
Honolulu, Hawaii 96859-5000
Phone: 1-808-433-5865
Fax: 1-808-433-1466
Email: raymond.fofen@amedd.army.mil

Presenter: Beau J. Freund PhD

PHYSIOLOGIC MONITORING OF SOLDIERS: PRESENT AND FUTURE

Beau J. Freund, Mark J. Buller, William A. Latzka and Karl E. Friedl

U.S. Army Research Institute of Environmental Medicine

Wearable medical sensors can provide real time situational awareness to the soldier, commander, and medic. Key to this system is the algorithms and knowledge displays that link and interprets sensor information. For the first time ever, the U.S. Army has a prototype system that will monitor physiological signals from the soldier and integrate this sensor data through algorithms to predict health status. This Warfighter Physiological Status Monitor-Initial Capability (WPSM-IC) is comprised of a medical hub that hosts a personal area network of physiologic and medical sensors (heart rate, respiration, skin and core temperature, body motion, acoustic/impact, sleep history, fluid intake) and algorithms. The algorithms estimate thermal, hydration, cognitive, life signs, and wounding status from the sensors distributed around a soldier's body, uniform and equipment and from other models, databases, and contextual information (e.g., location, weather, mission, individual data). This system is intended as one component of future warrior system of systems with differential displays of the information to the individual, the unit leader, and the medic, ranging from aggregate data on overall status members of the unit for the leader to specific early triage of a wounded soldier for the medic. This physiological monitoring capability lays the groundwork for data collection for further refinements, as well as testing a wide range of potential useful applications. Further research with this system will expand understanding of limits on human tolerance. Applications may include safety monitoring in hazardous conditions, training to learn and teach soldier limits, closed loop systems for control of equipment (e.g., microclimate cooling, exoskeleton, information displays), and as senti-

nel soldier surveillance systems. This system also provides the backbone for future neurocognitive monitoring enhancements. These may draw from currently available sensors such as voice analysis, pupil responses, saccadic eye movements, slow eyelid closure, electroencephalography, non-invasive biochemical measures (e.g., tear analytes), and nerve conduction velocity. The challenge will be the research studies in realistic and stressful conditions that lead to development of valid predictive algorithms of brain function and behavior. These predictions of the consequences of information overload, psychological trauma, and physiological stress consequences to brain function will be central to future adaptive displays.

Contact:
Beau J. Freund
U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

Presenter: Andrea Gaggioli PhD

THE VIRTUAL REALITY MIRROR: MENTAL PRACTICE WITH AUGMENTED REALITY FOR POST-STROKE REHABILITATION

Andrea Gaggioli¹; Francesca Morganti¹; Andrea Meneghini²; Mariano Alcaniz³; José Antonio Lozano³; Javier Montesa³; José Miguel Martínez Sáez³; Richard Walker⁴; Irene Lorusso⁴; Giuseppe Riva¹.

¹ Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy

² Azienda Ospedaliera dell'Università di Padova, Unità Operativa di Riabilitazione, Italy

³ MedICLab, Universidad Politecnica of Valencia, Spain

⁴ Telecom Italia Learning Services, Rome, Italy

Research status: in progress

The aim of the project is to apply augmented-reality technology to teach motor skills to patients suffering from stroke. To achieve this goal the project adopts an innovative approach based on the use of so-called "motor imagery." Recent studies in neuroscience have provided converging evidence that "imagining" a motor action involves the same brain areas involved in performing the ac-

tion.¹ This supports the idea – already exploited by sports trainers – that training with motor imagery (mental practice) could be effective in learning new motor skills or in promoting motor recovery after damage to the central nervous system. Previous clinical studies have shown that the rehabilitation of post-stroke hemiplegic patients can be made more effective by combining physical practice with mental practice.^{2,3} However, for many patients who suffer from damage to the central nervous system, mental simulation of movements can be difficult, even when the relevant neural circuitry has not been injured. Starting from these premises, we have designed and developed an augmented-reality workbench (called “VR Mirror”) to help post-stroke hemiplegic patients evoking motor images. First, the movement is acquired by the system from the healthy arm. Second, the movement is being mirrored and displayed so that the patient can observe and see as if the impaired arm is performing the movement. Third, the patient is instructed to rehearse in his/her imagination the movement he/she has just observed. Last, the patient has to perform the movement with the affected arm. The system is currently being tested to see if it does help patients to recover more quickly and regain control of arms that have been paralysed following a stroke. Preliminary clinical outcomes will be presented during the conference. The research is supported by the EU project, called I-learning (Immersion/Imagery Enhanced Learning⁴), which is funded under the FET Program (Future and Emerging Technologies⁵).

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Contact:
Andrea Gaggioli

Applied Technology for Neuro-Psychology Lab
Istituto Auxologico Italiano
Via Pelizza da Volpedo 41
Milan, Italy
Phone/Fax +39-02-619112892
Email: andrea.gaggioli@auxologico.it

Presenter: Enrico Gaia Dr. Ing.

VIRTUAL TECNOLOGIES FOR EXTREME ENVIRONMENT EFFECT MITIGATION

Enrico Gaia Dr. Ing.

Alenia Spazio S.p.A. Torino Italy

This paper examines the demands of a manned system operating in an extreme environment where there is the need to enhance or at least maintain crew health, team spirit and cohesion and how new techniques based on Virtual Reality technologies can provide some answers. A typical example is a manned mission to Mars with a crew of 4-8 astronauts where it is mandatory to maintain their psychological health for a mission that is envisaged to last from two to three years. They will have to work and live in an artificial environment with limited resources (for example communication capability with ground, due to the distances involved, cannot be a direct two way system) and living volumes. The paper proposes some possible fields of investigation. It will also consider the fact of how these innovative technologies based on Virtual Reality will have to be developed and tested.

Contact:
Enrico Gaia
Alenia Spazio S.p.A.
Torino, Italy
Phone: +39 011 7180742
Email: Enrico.Gaia@aleniaspazio.it

Presenter: Carlo Galimberti PhD

THE DOMOTIC EVALUATION

Carlo Galimberti, Ph.D¹, Luca Menti, M.S.,
Simona Pegorari, M.S.

¹Università Cattolica del Sacro Cuore-Milano

Domotic introduces remarkable advantages, above all to impaired persons, and elders, but at present the lack of an actual user-oriented design occurs. We planned and put in act an action-research, now in progress, in the framework of the "Domus" project (Tuscany Region council resolution n.977/2003) with the participation, in the first phase, of 10 couples affected by mobility disorders, each one living for five days in a domotic apartment.

The aims are to set up a methodology of analysis of the user-domotic environments interaction and to supply results concerning the interaction of an impaired user with a domotic environment, with the aim both to assess the system and to propose new solutions.

General approach

An anthropological and ethno-methodological approach was followed, in terms of an actual user-oriented design. Into details, the domotic environments design must follow an iterative procedure, foreseeing a continuous loop among design, ergonomic evaluation, and implementation. This ergonomic stance to evaluate not only technical and functional requirements (conformance testing) but also general usability and usefulness of the environment (usability evaluation), considering both the physical and the cognitive affordance.

Methodology

The evaluation phases foresee the analysis of autonomy project, impairments and resources, and interaction with artefacts.

Focusing on the interaction analysis we evaluated usability, efficacy, efficiency, satisfaction, usefulness, and pleasantness.

Methods and techniques were constructive interaction - thinking aloud modality, participating observation, semi-structured interview, video-recordings of all the interactions, and analysis of the reports supplied by the software controlling the electronic domotic environments.

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Contact:

Carlo Galimberti
Dept of psychology -Università Cattolica del Sacro Cuore-Milano
Milan, Italy 20123
Phone: +39272342660
Fax: +39272342280
Email: carlo.galimberti@unicatt.it

Presenter: Carlo Galimberti PhD

BEYOND INTERFACES: AN INTEGRATED APPROACH TO THE ERGONOMIC ANALYSIS OF VIRTUAL ENVIRONMENTS IN PSYCHOTHERAPY OF ANXIETY DISORDERS

Carlo Galimberti, Ph.D¹, Gloria Belloni, M.A., Matteo Cantamesse, M.S., Fabiana Gatti, Ph.D., Maddalena Grassi, Ph.D., Luca Menti, M.S.

¹Università Cattolica del Sacro Cuore-Milano

Research Status: In Progress (analysis of first clinical trial data)

Background/Problem

The present study is part of the FIRB-NEUROTIV project whose main objective is to develop – on the basis of the result and applications coming out from VEPSY Project, funded by EU (Galimberti et al. 2004) – the technical and clinical viability of using Virtual Reality Therapy in clinical psychology by means of portable and shared VR Systems. The project is providing enhancements of Vepsy's tools (Telemedicine and Portable tools) for the treatment of patients, new clinical trials to verify their viability, action plans for dissemination of its results to an extended audience and an integrated approach to ergonomic analysis of 3D Virtual Environments for psychotherapy.

Method/Tools

To face the aspects connected with VR environments' usability for psychotherapeutic applications mean to dare a double challenge from a methodological point of view: from one side, the need to adapt and to inte-

grate on a heuristic basis classic usability evaluation methods to specific artifacts such as 3D Virtual Environments for clinical applications (Galimberti and Belloni, 2003); from the other hand, the problems arisen by integration of expert evaluation of VR environments user-based tests carried out in real context of use (Riva, 2003; Mantovani, 2000). To face these challenges we have chosen to base our analytical stance upon an ethnomethodological approach, a perspective that gives evidence of how people, in specific social situations, are able to solve complex tasks producing shared meanings and achieving their goals during interaction. According to this perspective, the methodological objective consisted also in the identification of the usability requirements of the specific *community of practice* by whom Virtual environments are to be used (Riva and Galimberti, 2001). The virtual environments considered were the Panic Disorders and Agoraphobia VR modules developed in the framework of the FIRB - NEUROTIV project.

Data had been produced by means of different situations:

- functional analysis of VR environments
- observational analysis of videotaped patient-VR environments interactions, therapist-patient interactions and therapist-patient-VR environments interactions during therapy sessions
- Semi-structured interviews to out-patients
- Usability tests performed by out-patients

Different data analysis technique (Galimberti et al., 2004; Krug, 2000), both quantitative and qualitative, are presently applied to data produced.

Novelty/Discussion

- The main goal of the study is to go 'beyond interfaces,' extending ergonomic analysis of 3D virtual environments use in psychotherapy to such topic as:
- their pragmatic context of use
- the culture of use featuring the community of professional users
- side-effects and by-products of their application

Obviously without forgetting the outcomes of traditional usability analysis. The research is thus intended to construct - and not of simple application - new tools for an ergonomic analysis. One of its main features will be to have not

only a descriptive function, but to find out solutions to make the VEs systems more efficient. And this is intended to improve the whole interactive process, abandoning both artifact and user-artifact centered interaction in favor of a '*situated and context sensible*' ergonomic analysis.

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Contact:

Carlo Galimberti
Dept of psychology -Università Cattolica del Sacro Cuore-Milano
Milan, Italy 20123
Phone: +39272342660
Fax: +39272342280
Email: carlo.galimberti@unicatt.it

Presenter: Luciano Gamberini, PhD

PLAYSAFETY: VIRTUAL ENVIRONMENTS AS A PERSUASIVE TOOL TO CONTRAST RISKY BEHAVIORS IN YOUTH

Adriano Purgato and Luciano Gamberini,
Ph.D.

HTLab - Human Technology Laboratories, University of Padova, Italy

Research Status: Complete

This paper, following the idea of Persuasive Technology proposed by Fogg (2003), presents a way to develop a Virtual Reality (VR) educational system, *Playsafety*, capable of having an impact on risky behaviors in young people. The participative design of *Playsafety*, its application in the field and its first evaluation will be illustrated.

Background

Can Virtual Reality work as a means to prevent drug abuse and to persuade people into adopting safe behaviors? The potentials of VR as learning or health care environment have long been investigated (de Jong, 1991; McComas 2002; Riva, 2002). Virtual Environments offer the opportunity to explore social situations and 'try out' different responses to a variety of events (Kerr et al, 2002; Alcañiz M., 2003). As simulations, they also allow to cope with novel situations (Gamberini et al., 2003) and explore cause-and-effect relationships in a safe, non-threatening, and compelling environment (Fogg, 2003).

Method and Tools

A first step in the creation of *Playsafety* was an ethnographic investigation of dangerous night situations. A six-month participative observation was carried out in the clubs of a summer holiday location in Italy. The field notes were organized as '*stories about people and how they keep on their projects*' (Carroll, 2000).

In a second stage, following the scenario-based design approach (Carroll,2000), four different hazardous situations were extracted from the notes and as many VEs were built with 3D Studio Max 4.2 and Virtools DEV 2.5. Environments included a discotheque, a park, a restroom as place for drug and alcohol abuse, and a motorbike ride (safe drive). The heuristic method of expert evaluation (Nielson, 1993; Hix et al.,1993) was deployed to test their usability. Within each environment, two avatars interacted with the user. Participants were free to respond to the situation in many different ways, each one provoking a different modification in the scene.

Finally, the virtual scenarios were tested on-site, during a two sessions-evaluation in sev-

eral clubs. Users were invited to judge the environment and its efficacy through a 24 items questionnaire and a short interview. The evaluation addressed persuasiveness of the artifact, presence feeling, quantity and quality of concepts learned, user's perception of consistency, effectiveness, and usefulness of the product.

Results

In general, users declared to have more competence on drug-related issues and risky behaviours after the VE experience. They declared to understand clearly what designers want to communicate with them (av. 5.50/6 points), to perceive a strong consistency between real situations and virtual worlds (av. 4.75/6 points) and to consider the VE useful to educate people on specific drug effects. Perceived usefulness of the product was particularly high in the age range 24-29 for alcohol abuse ($\chi^2=10.814, p=.013$ with $d.f.=4 \alpha=.05$).

Conclusion

Scenario-based-design seems to be a precious methods to develop VE educational tools for risk prevention: *Playsafety* provides a safe educational experience to young people who potentially could be involved in dangerous contexts. As a persuasive technology working on cause-effect relationships, *Playsafety*, effectively communicates what risk underlies many common situations in youth life.

Novelty

The tool addresses the lack of persuasive products regarding alcohol and safe-driving problems in young people.

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Contact:
 Luciano Gamberini, PhD
 Tel: ++39/049/8276605
 Fax: ++39/049/8276600
 Email: luciano.gamberini@unipd.it
www.psicologia.unipd.it/htlab

Presenter: Pedro Gamito PhD

VIRTUAL WAR PTSD - A METHODOLOGICAL APPROACH

Pedro Gamito, PhD, José Pacheco; Carlos Ribeiro; Cristina Pablo; Tomaz Saraiva

Universidade Lusofona de Humanidades e Tecnologias

Exposure *in vivo* is a well tested and effective treatment in anxiety and phobic disorders. However, it is not viable to expose patients with War Post Traumatic Stress Disorder (PTSD) to real war environments. Being virtual reality exposure the most approximate simulation of a real war situation, we hypothesized that treatments of War PTSD that included virtual reality exposure are better than the current forms of psychotherapeutic intervention, namely exposure in imagination. This paper describes the procedures and presents the up to date development of (VR) war environments as a methodology to implement immersive virtual reality VR as an alternative psychotherapeutic course of action for patients with the diagnostic of War PTSD. The study population of this ongoing research consists of male subjects with the diagnostic of War PTSD according to DSM-IV-TR (APA, 2001) that looked for treatment at Júlio de Matos Hospital in Lisbon, Portugal. Participants were distributed through 6 treatments plus placebo (VR; Drug treatment; Imagination Exposure; VR+Drug Treatment; VR+Imagination Exposure; Drug Treatment+Imagination Exposure). The adequate therapeutic dosage with Sertraline (Zoloft, Pfizer) will be administrated during 16 weeks to the Drug Treatment groups. VR Treatment groups will be using a Head Mounted Device that provides an immersive experience on the following war virtual scenarios: mine deflagration, assisting casualties, waiting for a rescue helicopter, and ambush. CAPS, BDI, STAI, SCL-90, MCM-II for Psychometric measures and TAS, DES, PQ, SUDS, heart rate and blood pressure, ECG, EEG, and ACTH for VR reactions measures are the evaluation procedures selected for assessing the results.

Contact:
 Pedro Gamito, PhD
 Universidade Lusofona de Humanidades e Tecnologias
 Rua Prof. Barbosa Sueiro, 5 2B
 1600 Lisbon Portugal
 Tel: +351966057132
 Email: pedro.gamito@sapo.pt

Presenter: Azucena Garcia-Palacios PhD

OUTCOME PREDICTORS IN VIRTUAL REALITY EXPOSURE FOR THE TREATMENT OF PHOBIAS

García-Palacios, A. Ph.D.¹, Quero, S., Ph.D.¹, Botella, C., Ph.D.¹ & Banos, R., Ph.D.²

¹ Universitat Jaume I Castellon. (Spain).

² Universidad de Valencia (Spain).

Virtual Reality (VR) Exposure has proven to be efficacious in the treatment of phobias. There are an increasing number of controlled studies that support the use of VR as an effective tool in the treatment of several specific phobias like acrophobia, claustrophobia, spider phobia, and flying phobia (i.e., Botella, Baños, Villa, Perpiñá, & García-Palacios, 2000; Emmelkamp et al. 2002; García-Palacios, Hoffman, Carlin, Furness, & Botella, 2002; Rothbaum, Hodges, Anderson, Price, & Smith, 2002; Wiederhold, Jang, Gevirtz, Kim, Kim, & Wiederhold, 2002). The findings support that VR exposure is as effective as in vivo exposure and some of the studies offer long-term efficacy (six and twelve month follow-ups). Another line of research in the study of treatment effectiveness is to investigate the mechanisms of change associated to the success of VR exposure. The data regarding this important issue are very scarce. The aim of this work is to contribute to the study of predictors of outcome in the field of VR exposure treatments. VR has some unique features that may be involved in its efficacy and can play a role as predictors of outcome. One important aspect in VR treatments is the degree of presence that the patient feels in the virtual environment. We could hypothesize that the more presence the patients feel the more they will be involved in the treatment and the more effective it will be. Another set of variables could influence treatment response. There are some psychological differences that may be relevant to the VR experience like hypnotizability, dissociation, absorption, imagery, etc. In this work we are interested in two of these variables: Absorption (the tendency to become involved in a perceptual, imaginative, or ideational experience) and dissociation (the tendency to experience disruptions in the integrated functions of consciousness, memory, or perception of the environment). The aim of this work is to study the possible role of presence, absorption, and dissociation in the treatment response to VR exposure therapy. The sample was composed by sixty patients meeting DSM-IV (APA, 2000) criteria for different phobias like claustrophobia, acrophobia, insect phobia, and flying phobia participating in several investigation testing the efficacy of VR

exposure.

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Contact:

García-Palacios, A. Ph.D.

Universitat Jaume I Castellon. (Spain).

Phone: +34 964729725

Fax: +34 964729267

Email: azucena@psb.uji.es

Presenter: Azucena Garcia-Palacios PhD

VIRTUAL REALITY DISTRACTION VS. POST-HYPNOTIC ANALGESIC EFFECTS ON THERMAL PAIN STIMULATION

García-Palacios, A. Ph.D.

Universitat Jaume I Castellon. (Spain).

Patients frequently report severe to excruciating pain during medical procedures. The medical literature shows post-hypnotic suggestions (PHS) can reduce such procedural pain, and recent preliminary clinical studies suggest that virtual reality (VR) distraction may serve as an even more powerful non-pharmacologic adjunct. The present study is the first to examine the individual and combined effects of post-hypnotic suggestions (PHS) and VR. In the present experimental pain study, 104 healthy volunteers participated in a double-blind between-groups design with four groups: (No PHS, No VR), (No PHS, Yes VR), (No VR, Yes PHS), and (Yes PHS, Yes VR). Each subject provided subjective 0-10 ratings of cognitive, sensory, and affective components of pain. Afterwards subjects received a Stanford Hypnotizability test to measure their receptivity to hypnotic suggestions. Immersive VR distraction had robust effects on pain intensity, pain unpleasantness, and time spent thinking about pain regardless of hypnotizability. In contrast, overall post-hypnotic suggestions had relatively weak effects on pain intensity and unpleasantness but had robust analgesic effects for participants with higher hypnotizability scores. For highly hypnotizable subjects there was a pattern suggesting the possibility that VR + PHS combined may reduce pain more than either technique alone. Implications for maximizing pain relief are discussed.

Contact:

Garcia-Palacios, A. Ph.D.
 Universitat Jaume I Castellon. (Spain).
 Phone: +34 964729725
 Fax: +34 964729267
 Email: azucena@psb.uji.es

Presenter: Ken Graap MEd

VIRTUAL REALITY AND ADDICTION RESEARCH: UPDATES, STATUS, AND LESSONS LEARNED

Patrick Bordnick, MSW, MPH, PhD¹, Ken Graap, M.Ed.², Hilary L. Copp, MSW, Div.¹

¹ University of Georgia - Gwinnett University

² Center Virtually Better, Inc. & Emory University, Department of Psychology

Research Status: Preliminary clinical trials

Background

Since 2001, researchers have developed and tested virtual reality (VR) software and environments across a variety of addictive drugs. Research in addictions has primarily focused on testing the feasibility of VR environments to elicit cued-reactivity (i.e., drug craving and physiological responses). Cue-reactivity involves exposing substance addicted persons to VR drug cues and VR neutral cues while assessing subjective craving and physiological reactivity. Cue reactivity is based on the theory of classical conditioning where drug use is repeatedly paired with environmental stimuli and these stimuli can trigger craving and reactivity. Environmental stimuli are often referred to as cues and may consist of objects (i.e., cigarettes, drug paraphernalia), places (e.g., crack house, bar), people, and scents (i.e., smell of cigarettes or beer). Several controlled experimental trials clearly demonstrate that VR drug environments can elicit craving and physiological responses compared to neutral VR environments in nicotine dependent persons^{1,2} and cocaine dependent person.³ Currently VR environments have been developed for nicotine, cocaine, and alcohol. The marijuana VR environment is being constructed. This presentation will focus on current results and the status of VR environments as well as future directions in the addiction field.

Methods

All studies reviewed and presented are controlled experimental trials with substance dependent samples using strict inclusion and exclusion criteria. Across trials, participants are exposed to both VR neutral stimuli and VR drug related stimuli using a VFX-3D HMD (Interactive Imaging, Rochester, NY) connected to a 2Ghz P-IV PC. VR drug cues consisted of both inanimate (i.e., drug paraphernalia) and animate cues (i.e., social settings where participants are offered their drug of choice) and VR neutral cues (i.e., non-drug related objects or scenes). In addition to the visual cues, recent advances in our lab have led to the addition of olfactory cues into the VR environments. Current data on olfaction in VR cue reactivity will be presented.

Results

Data presented will focus on the comparison of drug craving and autonomic physiological

reactivity between VR drug cues and VR neutral cues. A summary of current data from nicotine, alcohol, and cocaine cue reactivity trials will be presented.

Conclusions

This presentation will provide an overview of VR applications in addiction research and treatment. Past, current and future directions will be discussed along with lessons learned to date.

Novelty/Discussion

This presentation will provide the first overview of VR cue reactivity research to date, including data on controlled alcohol, cocaine, and nicotine trials. The first application of a novel olfactory stimuli presentation system in VR drug research will also be highlighted. Future research and treatment applications will be discussed.

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Contact:

Patrick S. Bordnick, MSW, MPH, Ph.D.
Virtual Reality Clinical Research Center
University of Georgia -
Gwinnett University Center
1000 University Lane, Suite 3020
Lawrenceville, Georgia 30043 USA
bordnick@uga.edu
678-407-5204

Presenter: Ken Graap MEd

THE ADDITION OF SCENT TO IMMERSIVE VR ENVIRONMENTS IN ADDICTION AND SPEECH PATHOLOGY RESEARCH

Ken Graap, M.Ed.^{1,2}, Patrick Bordnick³, Jeremy Brooks¹, Mirtha Ferrer¹, Shelley Brundage⁴

¹ Virtually Better, Inc.

² Emory University, Department of Psychology

³ University of Georgia, Department of Social Work

⁴ George Washington University, Department of Speech Pathology

Research Status: Preliminary clinical trials

Background

Scent is one of the most salient senses for emotional response. The olfactory bulbs project into nerve tracts that synapse into the amygdala. The amygdala is connected bidirectionally to the hippocampus, the center of many memory functions. These connections suggest that specific smells may be associated with accessing emotionally laden memories. Herz & Schooler¹ and Herz,² have investigated the associations of scent and memory providing an empirical basis for scent research in virtual reality (VR). In respondent conditioning, scents can serve as powerful cues that trigger physiological and subjective responses to past conditioned events. Building upon these studies, we are exploring the use of scent in virtual reality (VR). The addition of scent will extend our previous work in phobias³ and enhance our research in addictions⁴ and speech pathology.⁵ This presentation outlines the process of adding scents to several immersive environments being tested in controlled research trials.

Method & Tools

Scent is being utilized in two different and related areas. First, it is being applied to facilitate immersion in VR environments as an ambient stimulus in a job interview designed for use with persons who stutter. Second, scent is being applied directly as a primary stimulus to facilitate craving responses in controlled trials with substance abusing and dependent participants. Examples of such implementations using the EnviroScent machine in conjunction with Virtually Better VR environments will be presented.

Results

Initial data including immersion ratings, and subjected units of discomfort (SUDs) or craving ratings from the trials will be discussed. Qualitative experiences of participants in trials will be discussed.

Novelty

To our knowledge this will be the first time that our Enviroscant Machine will have been used with immersive VR in a clinical setting.

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Contact:
Ken Graap, M.Ed.
Virtually Better
2450 Lawrenceville Hwy
Decatur, GA 30033
Phone: 404-634-3400
Fax: 404-634-3482
Email: graap@virtuallybetter.com

Presenter: Simon J. Graham PhD

AN FMRI STUDY EXAMINING SPATIAL NAVIGATION THROUGH A VIRTUAL ENVIRONMENT: PARTIAL LEAST SQUARES ANALYSIS

Richard Mraz, P.Eng.¹, Nancy J. Lobaugh, Ph.D.^{1,2}, Genevieve Quintin, M.A.³, Konstantine K. Kakzanis, Ph.D., C.Psych.³, Simon J. Graham, Ph.D., P.Eng.^{1,4}

- ¹ Imaging Research, Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario
² Department of Medicine, University of Toronto, Ontario, Canada
³ Division of Life Sciences, University of Toronto, Ontario, Canada
⁴ Department of Medical Biophysics, University of Toronto, Ontario, Canada

Reserach Status: Completed

Several functional neuroimaging studies have studied different specific aspects of human navigation.^{1,2,3} To further elucidate regions involved during performance of spatial navigation and to determine how task performance influences the identified brain regions, this study utilized a novel virtual reality (VR) navigation task during functional magnetic resonance imaging (fMRI). The task enabled both learning and recall of routes to be assessed. The multivariate Partial Least Squares analysis (PLS)⁴ was used to identify time-varying distributed activity patterns in the fMRI data.

Methods/Tools

The experiment involved navigation through a virtual city using an fMRI-compatible virtual reality platform.⁵ The task consisted of a set of 3 learning trials for Path A followed by 1 learning trial for Path B. Each learning trial consisted of two components; passive viewing of the path by video playback, and active navigation using an fMRI-compatible joystick. In subsequent short (5 min) and long (20 min) delay recall trials, Path A was navigated from memory. Twelve, healthy, right-handed subjects participated. Functional MRI experiments were performed at 1.5T (Signa, GE Healthcare). Behavioural metrics included time to completion and distance travelled. For the primary analysis, learning trials were contrasted with recall trials (task-PLS) following motion correction and temporal detrending. Further analysis included a behavioural-PLS in which time to completion was used to determine significant brain-behaviour correlations.

Results

One significant ($p < 0.01$) latent variable characterized differences in brain activity between learning trials and recall trials. Design scores denoted significant differing neuronal involvement between conditions. Activation maps indicated that bilateral frontal regions

and right hippocampus were more involved during learning, while parietal and temporal regions, such as the left parahippocampal gyrus, bilateral precuneus and cingulate cortex, were more active during recall. A second task-PLS analysis focused on the 4 learning trials, identifying a pattern related to the first learning trial for each path. Areas involved in initial learning included right precuneus and the cerebellum. Subsequent trials recruited regions surrounding the lateral sulcus bilaterally as well as the middle and medial frontal gyri. The behaviour-PLS confirmed many of these findings among similar brain regions, identifying patterns that were related to general task performance, to initial learning, and that specifically distinguished learning from recall.

Conclusion

Findings of posterior activations during recall are consistent with the notion that temporal regions are involved in spatial information retrieval, whereas initial encoding of a complex route demands increased precuneus involvement. The predominant activation of frontal and temporal regions in subsequent learning trials can probably be associated with encoding, maintenance, and recall of visual cues, which are critical for successful navigation.

Novelty

Combining VR-fMRI with PLS proved to be a highly sensitive technique for examining regions engaged during spatial navigation.

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Contact:
Simon J. Graham, Ph.D., P.Eng.

Sunnybrook and Women's College Health
Sciences Centre – S650
Toronto, ON
Canada
Phone: 416-480-4104
Fax: 416-480-5714
Email: simon.graham@sw.ca

Presenter: Kay Howell MBA

IMMUNE ATTACK: BUILDING BIO-LOGICALLY BASED IMMUNE SYSTEM SIMULATIONS FOR EDUCATION AND TRAINING

Kay Howell

Federation of American Scientists

Background

A growing literature suggests that simulation, visualization, and gaming can play an important role in deepening understanding of difficult concepts in mathematics, engineering, and science. Learning sciences research suggests that learning by doing with understanding produces better transfer than mere doing alone.^{1,2} Challenge-based simulations can provide students opportunities to receive feedback and revise their thinking, a critical part of the learning process.^{3,4} *Immune Attack* is a simulation game to teach biological concepts related to immunology and wound infection, allowing the student to explore the internal compartments and cells of the human body and visualize immunological processes.

Method/Tools

Immune Attack will combine 3D visualizations of biological structure and function with advanced educational technologies to provide an introduction to basic concepts in immunology for high school students. It is intended to be as fun and compelling as the computer games currently played by many adolescents and young adults. Students are motivated with a series of progressively more difficult challenges in a gaming environment in which success depends on increasingly sophisticated grasp of concepts in immunology. The learning experience will be individualized by use of context-sensitive help and dialogues and continuous assessment tech-

niques to determine when the learner is ready to move to a new level.

The biological models are being developed working closely with prominent immunology researchers and educators. Experienced video game developers are developing the game and assisting in integrating the learning tools. The learning objectives and instructional strategies are being developed in consultation with biology teachers, at both the high school and college freshmen levels, and with learning research scientists.

Evaluation

The game will be used to supplement immunology taught as a part of biology courses given to high school students and will be evaluated in high school biology classes. The project will be evaluated based on the following criteria: 1) Has the project developed biologically correct, visually compelling simulations of the immune system that can be easily navigated by people without specialized technical proficiency? 2) Do the simulations allow revisions and augmentations and encourage use of simulation components in the work of others? 3) Can the simulations be used in conjunction with a variety of assessment, feedback, and augmentation tools? 4) Does use of the game increase students' motivation to learn the classroom material?

Novelty/Discussion

Computer games hold special interest to a generation who has grown up with them, and as such, they show promise as educational tools. Whether this is due to the inherent challenge built into game play, the richness of graphics presented to the user, the opportunity to interact with other users (in web-based games), the story or context in which the game is couched, or some other feature is an important part of this research project. Exploiting the inherent motivational aspects of games and simulations for education and training must be based on a sound understanding of which features of these systems are important for learning and why.

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Contact:

Kay Howell

Federation of American Scientists
1717 K. St., NW, Suite 209

Washington, DC 20036

Ph: 202.454.4685

Fax: 202.6751010

Email: khowell@fas.org

Presenter: Eva Hudlicka PhD

A COMPUTATIONAL MODEL OF EMOTION AND PERSONALITY: APPLICATIONS TO PSYCHOTHERAPY RESEARCH AND PRACTICE

Eva Hudlicka, Ph.D.

Psychometrix Associates, Inc.

Research Status: MAMID cognitive-affective architecture is implemented; Applications to psychotherapy research are planned.

Background

VR applications in psychotherapy are gaining prominence in the research community and acceptance among practitioners. However, a promising technology remains unexplored: computational models of cognition and emotion.

Cognitive models (also termed cognitive- or agent-architectures) aim to emulate cognitive

processing such as attention, perception, and decision-making, and are used by cognitive scientists to advance understanding of the mechanisms and structures mediating cognition. These models are also used in applied settings to improve training and human-system design. Recently, architectures have been developed that explicitly represent emotions: both emotion appraisal processes, and effects of emotions on cognition.

In this paper I first describe a cognitive-affective architecture capable of modeling the dynamic generation of emotions (affect appraisal), and some effects of emotions on cognition. I then describe applications of this architecture to psychotherapy research and practice.

Method / Tools

The MAMID cognitive-affective architecture dynamically generates four emotions (anxiety, anger, joy, sadness) from a combination of external and internal stimuli (e.g., incoming sensory cues, goals, expectations). The architecture then models the effects of these emotions, as well as four traits (extraversion, neuroticism, conscientiousness, aggressiveness), on the cognitive processes and structures mediating decision-making and action selection. For example, anxiety-linked threat-bias is modeled by biasing attentional, interpretive and expectation-generation processes to preferentially process threatening stimuli, and derive higher-threat interpretations and expectations. MAMID is able to model a broad range of 'stereotypes' by representing emotion effects in terms of parameters controlling the architecture structures (memory) and processes (e.g., attention, situation assessment).

Results

Feasibility of the model was demonstrated in the context of a simulated peacekeeping scenario, where separate instances of the architecture controlled the behavior of 'stereotypical' unit leaders ('anxious,' 'aggressive,' 'normal'). The same set of external stimuli triggered distinct emotions in the different stereotypes, and their effects on decision-making then caused differences in observable behaviors. The MAMID architecture is domain-independent, to facilitate transitions to other domains, including psychotherapy.

Novelty / Discussion

There is great potential for application of cognitive-affective models in psychotherapy research and practice; both in a "stand-alone" mode, and coupled with synthetic avatars, to produce more realistic virtual characters.

Research MAMID provides a tool for modeling the etiology and treatment of a variety of disorders; e.g., the positive feedback cycle characterizing generalized anxiety disorders and phobias could be modeled by representing the increasing predominance of anxiety-related schemas in the patient's long-term memory, increased sensitivity to anxiety-producing stimuli, and generalization across previously neutral stimuli. Results of cognitive restructuring could be modeled by 'exposing' models to repeated simulated inputs representing therapeutic interventions or changing social contexts, and modeling the gradual emergence of more adaptive memory schemas, interpretations, and behavior. Improved understanding of these processes would provide opportunities for more finely-tuned assessment and treatment.

Clinical Practice MAMID provides a means of controlling the behavior of avatars in therapeutic virtual environments, thereby enhancing their believability. The avatars would represent specific stereotypes (e.g., 'aggressive audience member,' 'shy friend'), allowing the construction of virtual social situations relevant for the patient. The use of affectively-realistic avatars, embedded within simulated situations, would also enhance assessment.

Contact:
Eva Hudlicka
Psychometrix Associates, Inc.
Blacksburg, VA, USA
Phone: (01) 540 552 4803
Email: evahud@earthlink.net

Presenter: Wijnand IJsselsteijn, Ph.D.

TOWARDS A NEUROPSYCHOLOGICAL BASIS OF PRESENCE

Wijnand IJsselsteijn, Ph.D.

Eindhoven University of Technology

In this presentation, we will review recent neuropsychological studies regarding tool

use and body image perception, and highlight their importance for understanding presence.

The experience of presence appears to be a complex perception, formed through an interplay of raw multisensory data, spatial perception, attention, cognition, and motor action, all coupled through a constant dynamic loop of sensorimotor correspondence. Presence research studies the experience of being in a place or being with someone as it is mediated through technology.

The perception of ourselves as part of a space not only depends on a passive perception of spatial layout but also on the ability to actively explore an environment, allowing the perceptual systems to construct a spatial map based on sensorimotor dependencies. By incorporating telepresence technology that supports our bodily perceptual and control movements as part of the ongoing perceptual-motor loop, the correlations between motor actions and multisensory inputs remain intact and a sense of telepresence or 'distal attribution' may occur.

The fact that technology can start working as a transparent extension of our own bodies is critically dependent on the highly plastic nature of our brain, which is continuously able and prone to adapt to altered sensorimotor contingencies. This fact finds its basis in the significant evolutionary benefit of having a negotiable body image to accommodate lifetime development and change, which requires a continuous remapping of bodily boundaries. A radical example is provided by the amazing adaptation processes that occur in the body-image of people with one or more lost or amputated limbs.¹ Although body-image adaptations across the lifespan can afford to take their time, it is the relative speed of these sensorimotor adaptations that enables us to experience man-made technology as, quite literally, part of ourselves - be they a blind person's cane or an advanced telerobotic arm.

In general, the space that surrounds an individual can be meaningfully segmented into near or peripersonal space and far or extrapersonal space. Animal and human brain studies have confirmed this distinction, showing that space is not homogeneously represented in the brain.^{2,3} Telepresence technologies can be viewed as attempts to overcome the boundaries of spatial segmentation. Their success in doing so is evidenced by a clinical

case, described by Berti and Frassinetti,⁴ where a patient, after a right hemisphere stroke, showed a dissociation between near and far spaces in the manifestation of neglect. Using a line bisection task, the neglect was apparent in near space, but not in far space when bisection in the far space was performed with a projection light pen. However, neglect appeared when in the far space bisection was performed with a stick (used by the patient to reach the line) and it was as severe as neglect in the near space. Thus, this study provides evidence that an artificial extension of a person's body (the stick) causes a remapping of far space as near space - essentially telepresence.

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Contact:

Wijnand IJsselsteijn, Ph.D.
Eindhoven University of Technology
Eindhoven, The Netherlands
Phone: +31 40 2474455
Fax: +31 40 2449875
Email: W.A.IJsselsteijn@tue.nl

Presenter: Hee Jeong Jang

INVESTIGATION OF SOCIAL ANXIETY OF PATIENTS WITH SCHIZOPHRENIA USING VIRTUAL AVATAR

Hee Jeong Jang, BA,¹ Jeonghun Ku, PhD²,
Sung Hyouk Park, MS¹, So Young Kim, BA¹
In Y. Kim, MD, PhD², Chan-Hyung Kim, MD,
PhD¹, Jae-Jin Kim, MD, PhD¹

¹Yonsei University College of Medicine
Severance Mental Health Hospital, Gyeonggi-do,
Korea

²Dept. of Biomedical Engineering, Hanyang University, Seoul, Korea

Backgrounds

Patients with schizophrenia show a tendency to avoid social interaction because they feel great anxiety during their social interactions. Therefore, they have trouble making social relationships. This trouble is largely due to the fact that the patients have emotional withdrawal as well as passive/apathetic social withdrawal. These social deficits of patients has been overcome through social skills training programs, which provide them opportunities to experience previously various social situations by role play method.

Objectives

This study was conducted in order to investigate whether an interaction with virtual avatars can evoke patient's social anxiety and the relationship between patient's symptom severity and social anxiety traits.

Method/Tools

Fifteen patients with schizophrenia and fifteen control people were recruited. A male and a female avatar were generated. 2×2×3 (group, avatar's gender and avatar's emotional expression) was used in this experiment. Each avatar has three emotional expressions, which are happy, neutral, and angry. Subjects performed an introduction task in six conditions (gender × emotional expression) in a random order. The task is composed of "approach," "listening to an avatar's introduction," and "introducing oneself to the avatar." After all six tasks were performed, subjects completed a State-Trait Anxiety Inventory (STAI) questionnaire. In addition, patient's symptom severity was evaluated using the Positive and Negative Syndrome Scale (PANSS).

Results

The social anxiety level to avatar's emotional representation was significantly different in both group ($p < .001$). In control group, the level was lowest when subjects coped with an avatar expressing "happy," while the highest anxiety level was shown when they faced to an avatar expressing "anger." However, in patient groups, the level difference was not significant between "neutral" and "happy" avatars. Patients only showed a significantly high anxiety level when they experience "angry"

avatar conditions compared to the other two conditions. In a correlation analysis between patient's anxiety levels and the severity of their symptoms, social anxiety on "happy" and "neutral" avatars was positively correlated with the negative syndrome of PANSS (happy : $r = .539$, $p = .038$, neutral : $r = .533$, $p = .041$). Particularly, the anxiety level by "happy" and "neutral" avatars was positively correlated with two subscales (N1: blunted affect, N4: passive/apathetic social withdrawal) of the negative syndrome of PANSS (N1. happy: $r = .549$, $p = .034$ / neutral: $r = .536$, $p = .039$) (N4. happy: $r = .536$, $p = .039$ / neutral: $r = .658$, $p = .008$).

Conclusion

Through this study, we found that virtual avatar's emotional expressions could cause social anxiety to patients with schizophrenia and that patient's symptom severity was correlated with social anxiety during the time they coped with avatars. These results show that the more severe negative symptoms a patient has, the higher social anxiety they feel. It might be due to their passive, apathetic, and isolated traits. Therefore, they tend to recognize even socially positive emotion as fearful stimuli. This inference could be supported by the relationship between anxiety and subscales of negative symptom of PANSS. In this sense, we could say that a virtual avatar could provide an opportunity for patients to experience emotion induced social situations. In addition, it could be used for training them to cope effectively by experiencing emotions close to reality as well as to find out the clinical characteristics related to patient's symptoms.

Contact:
Hee Jeong Jang
Mind Mapping Laboratory
Institute of Behavioral Science in Medicine
Yonsei University College of Medicine
Email: saccylia@hanmail.net

Presenter: Naomi Josman PhD

VIRTUAL REALITY: INNOVATIVE TECHNOLOGY FOR THE TREATMENT FOR VICTIMS OF TERRORIST BUS BOMBING WITH POST-TRAUMATIC STRESS DISORDER (PTSD)

Naomi Josman¹, Ayelet Reisberg, Eli Somer, Hunter Hoffman, Azucena Garcia-Palacios, Ari Hollander, Russ Shilling, Patrice (Tamar) Weiss

¹ University of Haifa

Research Status: Preliminary clinical trials (case report) currently in progress

Background/Problem

Cognitive Behavioural Therapy (CBT) with exposure involves having patients gradually remember the traumatic event and process the extreme emotions associated with that memory so they can eventually remember the traumatic event in a more healthy way. CBT with exposure is currently the treatment of choice for Post Traumatic Stress Disorder (PTSD). There is strong empirical support for the efficacy of CBT interventions for PTSD for those who seek and complete treatment. Unfortunately, avoidance of remembering the traumatic event is a defining symptom of PTSD, and the majority of people who develop PTSD avoid seeking treatment. Those needing treatment most may be the most likely to avoid or drop out of traditional treatment. CBT with exposure provides patients with opportunities to learn to control their own emotional responses when confronted with stimuli that elicit physiological and emotional activation. In order to develop new, healthier patterns of thinking, feeling, and acting toward the distressing stimuli, CBT requires the practice of new beliefs and actions in the presence of stimuli that elicit the anxiety. CBT and Virtual Reality (VR) provide patients with an ideal context for gradually remembering memories of the traumatic event. VR may help increase emotional engagement and treatment success. VR is proving effective even for difficult patients who have failed to respond to traditional therapy.¹ Surveys suggest that patients with anxiety disorders are much more receptive to VR than to traditional therapy, perhaps because VR has fewer stigmas, is more interesting, and less threatening than traditional therapy.

Method/Tools

The patient we treated met diagnostic criteria for PTSD after directly witnessing a terrorist bus bombing attack in Haifa, Israel, and received a 9–visit treatment protocol that incorporates CBT+VR. Among other things, treat-

ment involves viewing scenes of the terrorist bus bombing attack through a position tracked 3-D VR helmet. The scenes, computer controlled by therapist button pushes, progress in severity, culminating in a bus pulling up to a bus stop in an Israeli town, exploding into smoke and flame with loud sound explosion effects (with vibrotactile augmentation via amplified speakers) with accompanying sounds of screaming and sirens, and a smouldering limb in the street. The subject completes self-report questionnaires and is assessed prior to and following the treatment by two experienced clinicians (one clinician blind to treatment condition).

Conclusion

VR exposure therapy is a promising new medium for treating PTSD from terrorist bus bombing attacks.

Novelty/Discussion

There are currently no controlled studies in the literature on the topic of using VR exposure therapy for treating PTSD. The current project addresses a completely original research topic on a rapidly growing patient population (using VR to help treat PTSD from terrorism). In Israel, there have been dozens of extremely violent deadly terrorist attacks involving civilians casualties and deaths (often including women and children) in the past few years alone. PTSD is a very challenging psychological disorder to treat, yet the social and economic cost of the current trend of leaving so many PTSD victims untreated is unacceptable.

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Contact:
Naomi Josman, Ph.D.
Department of Occupational Therapy
University of Haifa
Haifa, Israel
Tel: +972 4 824-0610
Email: naomij@research.haifa.ac.il

Presenter: Hannes Kaufmann PhD

GENERAL TRAINING OF SPATIAL ABILITIES BY GEOMETRY EDUCATION IN AUGMENTED REALITY

Hannes Kaufmann¹, Karin Steinbügl¹,
Andreas Dünser², Judith Glück²

¹ Institute of Software Technology and Interactive Systems, Vienna University of Technology

² Institute of Psychology, University of Vienna

Geometry education has proven as one powerful means of improving spatial abilities, an important component of human intelligence. In the first part of this paper we summarize our development of a system that uses collaborative augmented reality as a medium for teaching, and uses 3D dynamic geometry to facilitate mathematics and geometry education. Our immersive collaborative educational application, specifically developed for geometry education, serves as the basis of a comprehensive evaluation study regarding its efficacy in training spatial abilities. The main contribution is the description of evaluation design including the test instruments, learning tasks, and practical experiences with using our system for actual training of high school students. Results of a pre-study with spatial ability tests in high schools are presented. They point to interesting gender-specific differences of strategies when solving spatial ability tests, which have not been reported in literature before.

Contact:

Hannes Kaufmann
Institute of Software Technology and Interactive Systems
Vienna University of Technology
Favoritenstr. 9-11/188-2
A-1040 Vienna, Austria
Email: kaufmann@ims.tuwien.ac.at

Presenter: Steven Kerr MSc

AS INTERACTIVE: DEVELOPMENT AND USE OF VIRTUAL ENVIRONMENTS FOR SOCIAL SKILLS TRAINING

Steven Kerr and Sue Cobb

Human Factors Research Group, University Of Nottingham

Research status: Completed

Virtual Environments (VEs) offer the potential for users to explore social situations and 'try out' different behaviour responses for a variety of simulated social interactions. The AS Interactive project was a three-year programme of study to examine the use of virtual environments for social skills training of young people and adults with autistic spectrum disorders (ASDs) and Asperger's Syndrome (AS). The project research team comprised computer scientists, virtual environment developers, human factors researchers, psychologists, and autism training specialists working with individuals from AS social groups and students and teachers from autism specialist schools.

The first consideration of the project was the feasibility of constructing usable social environments using virtual reality technology. Two types of virtual environments were evaluated; single user virtual environments (SVEs) and collaborative virtual environments (CVEs). In the SVE the user was guided through a social interaction task and invited to make choices about what to do and what to say in situations represented within a virtual café and a virtual bus. In the CVE several users, positioned at different PCs, simultaneously shared the same virtual environment, representing a virtual café or an interview scenario. The intended use of the CVE was that a teacher or training advisor could support the user by taking the role of one of the other characters and providing guidance using virtual social interaction.

Observation studies found that SVEs were much more successful than CVEs as the latter was too complex, technologically, to set up in school and users tended not to engage with other avatars in conversation. SVEs however could be used in one to one tuition, which gauged the suitability of the program for individual students and identifying their level of understanding or in group exploration and reflection (where a teacher led a discussion with a small group of students viewing the VE on a projected screen) which was useful for identifying social cues in the VE and understanding the perspectives of others.

The conclusions drawn from this project were that successful VEs for teaching social skills to people with Asperger's Syndrome (AS),

will need sufficient scaffolding inbuilt to support learning whilst also having the flexibility to adapt for unforeseen problems through teacher intervention. Allowing a teacher to individualise the content of the VEs in some way is important, as it should not be assumed that a student has understood the lesson by appearing to exhibit the appropriate behaviour for the given task. Some behaviour might be individual to that user and only someone who knows the user will understand this. This paper aims to discuss the issues behind the design and development of the SVEs and the features which can be used to facilitate the teaching of social skills to people with AS, who have very individualised needs.

Contact:
Steven Kerr
Virtual Reality Applications Research Team
Human Factors Research Group
University Of Nottingham
Tel: +44 (0) 115 9514070
Fax: +44 (0) 115 8466771
Email: steven.kerr@nottingham.ac.uk

Presenter: Jaehun Kim

DEVELOPMENT OF VR SYSTEM TO ASSESS SOCIAL PROBLEM SOLVING ABILITY FOR PATIENT WITH SCHIZOPHRENIA

Jaehun Kim, M.S.; Kwanguk Kim M.S.; Kiwan Han, B.S.; Jeonghun Ku, Ph.D.; Hee Jeong Jang, B.A.; Sung Hyouk Park, M.D.; So Young Kim, B.A.; Chan Hyung Kim, M.D., Ph.D.; Jae-Jin Kim, M.D., Ph.D.; Jang Han Lee, Ph.D.; In Young Kim, M.D., Ph.D.; and Sun I. Kim, Ph.D.

Department of Biomedical Engineering, Hanyang University

Background/Problem

Patients with schizophrenia usually lack social skills and have an inability to communicate effectively with people, confirm and express their feelings, and understand interpersonal boundaries. They may solve their problems in an unsuitable manner or they may have few solutions. In this study, we developed the Virtual Reality system to measure social problem solving ability according to the state of illness of the patient with schizophrenia.

Method/Tools

We developed a project-based VR system because schizophrenic patients feels very anxious when wearing a Head-mounted display. Narrative-based contents were constructed to induce schizophrenic patients into proper goals to assess social problem solving abilities. Survey for selecting 8 complicate social problems among many daily-happening social problems and setting their difficulty was conducted for 50 normal people. The virtual environment and virtual avatar matched with 8 complicated situations were built by using 3D-MAX and were converted into MAP or MDL format for rendering in A6 engine. The behavioural database which consists of 15 avatars, 40 apparels, 70 actions and 6 facial expressions was constructed to make a flexible and dynamic avatar. Also eye-blinking and lip-synching was roughly implemented to make the virtual avatar more realistic and live-like. The VR system was designed to give patients the information that is needed in problem solving because we want to measure the pure social problem solving ability except cognitive aspects such as memory. It was implemented by making an information window in which patients know what time it is, how much money I have, today's schedule, and what I should do. After VR experience in each content, Q&A panels about the complicated situation appeared and patients could select their own solution about given social problems by using an 8-button joystick.

R e s u l t s / C o n c l u s i o n

In this study, we designed a VR system to assess schizophrenic's social problem solving ability except the cognitive ability of schizophrenia. Reaction time responding to the Q&A panel and problem solution in given social VR situation is extracted from the proposed VR system to assess social problem abilities. After having experiences in session, schizophrenia answers following questions: computer experience scale, immersive tendencies questionnaire, virtual reality questionnaire, social problem solving index, positive and negative syndrome scale, KWIS. Now we are gathering data from associated hospital and have a plan to validate usability and effectiveness of proposed VR contents by showing that VR parameters are closely correlated with the traditional assessment

tools e.g. SPSI.

Novelty/Discussion

In this study we develop a VR system for patients with schizophrenia to perceive more realistic and dynamic situations, which could be difficult when constructed from other media such as text, pictures, or video. However additional research of the usability and validation of the proposed VR system is needed and is being conducted in our lab.

Contact:
Jaehun Kim
Department of Biomedical Engineering
Hanyang University
Email: jaehunkim@bme.hanyang.ac.kr

Presenter: Kwanguk Kim MS

INVESTIGATION OF SOCIAL CUE PERCEPTION IN SCHIZOPHRENIA USING VIRTUAL REALITY

Kwanguk Kim, M.S.¹, Jaehun Kim, M.S.¹, Daeun Park, B.S.¹, Jeonghun Ku, Ph.D.¹; Hee Jeong Jang, B.A.²; Sung Hyouk Park, M.D.²; So Young Kim, B.A.²; Chan Hyung Kim, M.D.: Ph.D.²; Jae-Jin Kim, M.D., Ph.D.²; Jang Han Lee, Ph.D.¹; In Young Kim, M.D., Ph.D.¹, and Sun I. Kim, Ph.D.¹

¹ Department of Biomedical Engineering, Hanyang University

² Institute of Behavioral Science in Medicine, Yonsei University Severance Mental Health Hospital

Background/Problem

Impairment in social skills is one of the few criteria that all individuals diagnosed with schizophrenia must meet. Successful social skill requires the coordination of many skills, including social perception that involve the decoding and interpretation of social cues in others. Previous research on the social perception in schizophrenia has focused on the interpretation of emotion from facial expressions. Recently, there have been reports on the potential of virtual reality (VR) in social skills training. In this study, we developed VR for social perception assessment including the interpretation of non-facial expressions. And we hypothesized that schizophrenic subjects would perform significantly more poorly than normal subjects on the VR test.

Method/Tools

For the effective social perception test, VR may be needed to compose various situations and contents. So, we used VR Behaviour & Facial Data Base architecture (VRBFDB) for easy and fast VR composition. This architecture is composed of predefined 93 behaviours and 7 facial expressions data base. In this data base, we selected behaviours and facial expressions according to contents. And, VR of 35 contents is developed. The contents can be divided into two sub-contents "Attention to and interpretation of relevant cue test" and "Emotion Recognition test." "Attention to and interpretation of relevant cue test" is composed of non-verbal social situation, recognition, and verbal social situation recognition, and "Emotion Recognition test" is composed of happy, sad, angry, and surprise facial expression recognition. The 21 contents are selected from 35 contents based on 70% selection of normal subjects. The subjects consisted of 17 patients (12 males and 5 females) and 19 controls (12 males and 7 females). This study measured VR data, questionnaire data, and symptom data. VR data included participant's response results, reaction time, presence, and experience of computer. Questionnaire data included age, education, gender, intelligence (K-WAIS) and so on. Symptom data is measured by PANSS (Positive and Negative Syndrome Scales).

Results/Conclusion

According to analyzed results, schizophrenic subjects perform significantly more poorly than normal subjects on the VR test (difference 0.86). In detail, the difference is 0.90 in "Attention to and interpretation of relevant cue test" and 0.82 in "Emotion recognition test." One result shows that emotion recognition test corresponds with established research on schizophrenia on emotional facial recognition. And, the other result shows that relevant cue test is showing that schizophrenia also has a difficulty to recognize social cues.

Novelty/Discussion

In this study, we developed and used Virtual Reality Behavior & Facial Data Base (VRBFDB) for saving developing times and costs. And we apply VR to finding the differ-

ence between schizophrenic subjects and normal subjects in social cue perception.

Contact:
Kwanguk Kim M.S.
Department of Biomedical Engineering
Hanyang University
17 HAENG-DANG DONG SEONG-DONG GU
Seoul 133-605, Korea
Phone: +82-2-2290-0693
Fax: +82-2-2296-5943
Email: kwang6@bme.hanyang.ac.kr

Presenter: So Young Kim

THE RELATIONSHIP BETWEEN INTERPERSONAL DISTANCE AND SYMPTOMS OF SCHIZOPHRENIA ACCORDING TO DIFFERENT EMOTIONAL CATEGORIES USING VIRTUAL REALITY

Sung Hyouk Park^{1,2}, M.D., So Young Kim², B.A.,
Jeonghun Ku³, Ph.D., Hee Jeong Jang², B.A.,
Won Yong Hahn³, M.S., In Young Kim³, M.D.,
Ph.D., Sun I. Kim³, Ph.D., Chan-Hyung Kim^{1,2},
M.D., Ph.D., Jae-Jin Kim^{1,2}, M.D., Ph.D.

¹Department of Psychiatry, Yonsei University College of Medicine

²Mind mapping laboratory, Institute of behavioral science in medicine, Yonsei University College of Medicine

³Department of Biomedical Engineering, Hanyang University, Seoul, Korea

Schizophrenia is a disease characterized by social impairment. Adequate interpersonal distance is important for good interpersonal relationship and for the social rehabilitation of schizophrenia. There have been few researches about interpersonal distance of schizophrenia. We tried to improve the method of presenting stimuli through virtual reality. We constructed virtual environment and virtual avatar with gradual facial expressions. Fifteen schizophrenic patients and control subjects participated in this experiment. This experiment is consisted of 6 blocks. In each block, subjects were asked to approach the avatar with gradual facial expressions representing one emotional category, to the most comfortable place and introduce themselves. We measured the distance subjects took from the avatars. We explored the characteristics of interpersonal distances of schizophrenia and the relationship among the distances, symptoms of schizophrenia and emotional categories (happy, neutral or angry). There were major effects of group and emotion on distances. There were an

inverse correlation between the distances from avatars with angry emotion and negative symptoms. These results suggest that negative symptoms of schizophrenic patients may have an association with deficit of social skills and that negative symptoms of schizophrenia may have effects on processing of emotions, especially of negative valence.

Contact:
Sung Hyouk Park
Email: inuone@hanmail.net

Presenter: Evelyn Klinger

VIRTUAL REALITY THERAPY FOR SOCIAL PHOBIA: ITS EFFICACY THROUGH A CONTROL STUDY

Evelyne Klinger, ENG., PhD.candidate^{1,6},
Stéphane Bouchard², Ph.D., Patrick Légeron, M.D.³, Stéphane Roy, Psy.³,
Françoise Lauer, Psy.⁴, Isabelle Chemin, M.A.¹, and Pierre Nugues, Ph.D.⁵

¹ ENSICAEN-GREYC, Caen, France

² University of Quebec in Outaouais, Gatineau, Quebec, Canada

³ CBT Unit, Sainte-Anne Hospital, Paris, France

⁴ Stimulus, Paris, France

⁵ LTH Department of Computer Science, Lund University, Sweden

⁶ GET/ENST-Paris, CNRS/LTCI, Paris, France

Research status: Completed control study

The efficiency of virtual exposure for phobic disorders has been confirmed by several studies, especially in the case of the fear of public speaking (FOPS). However, FOPS is a less severe subtype of social phobia and does not reflect entirely the diversity of social situations that could potentially induce anxiety. In an earlier study, we reported a virtual reality (VR)-based clinical protocol designed to assess the efficacy of a Virtual Reality Therapy (VRT) on a larger set of social phobias compared to a validated psychological treatment (group-CBT= Cognitive Behavior Therapy). The virtual environments (VEs) used in the treatment recreate four situations dealing with social anxiety: performance, intimacy, assertiveness, and scrutiny. With the help of the therapist, the patient learns adapted cognitions and behaviors in order to reduce anxiety in the corresponding real situations.

The study is based on a pre-post design where the control condition is a gold-standard treatment. Thirty-six participants, diagnosed with social phobia and meeting the inclusion and exclusion criteria, were matched on either VRT or group-CBT. Both treatments lasted twelve weekly sessions and were delivered according to a treatment manual in the presence of a CB-therapist. In VRT condition, sessions were individual and lasted about 45 minutes, with less than 20 minutes of exposure to the four VEs either for assessment or therapy, while in group-CBT condition two hours sessions were delivered with about eight people, a format which allows creating multiple social situations. In both cases, further exercises were prescribed *in vivo* application of the principles developed during the sessions. The participants were submitted to "pre-post" assessment of the full spectrum of social phobia, from key symptoms to global functioning.

Using repeated measures ANOVAs (2 Conditions x 2 Temps), three families of hypotheses were tested: social phobia (as measured with LSAS score and subscores), social functioning (assertiveness - Rathus and SCIA), and general functioning. Given these hypotheses and the use of a gold-standard control condition, the results include the effect-sizes of the Condition by Time interactions and the estimates these differences' importance. They indicate that both treatments were highly effective to reduce social anxiety and social avoidance and to improve social as well as global functioning, with no significant differences between the two treatments except assertiveness.

Our results clearly show the efficacy of virtual reality in the treatment of social phobia. They also demonstrate that people can react emotionally to virtual humans and their behaviors, even if they are unrealistic representations of humans. A promising explanation can be found in the interplay between believability of a virtual reality and emotions felt by the user immersed in the virtual environment.

These statistical analyses represent a new step in the use of our collected data, and in the comprehension of emotional contexts. Interesting features of our research are the selection of a sample composed of young adults showing clinically significant and lasting social phobia, the use of VEs that tackle diverse social situations, and the assessment of

the full spectrum of social phobia.

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Contact:
Evelyne Klinger
43, rue Appert
44100 Nantes France
Tel: +33 2 40 69 59 21 (home)
Fax: +33 2 40 69 59 21 (home)
Email: klinger@enst.fr

Presenter: Manfred Krapp MD PhD

THE COMPUTER AS A HELPMATE FOR IMAGINATION

Dr. med. Manfred Krapp

C.G. Jung-Institute Zuerich

This paper deals with virtual reality (VR) and Cyberspace from a psychoanalytical point of view, especially regarding the analytical psychology of C.G. Jung. Electronic media have basically changed the relationship between the Ego and the unconscious. The discourse of electronic media is right-hemispherical and *imaginal* and corresponds to the primary process of the unconscious. Flusser emphasises a new faculty of imagination, "computer images simulate brain processes. The images that form there are almost directly projected from the brain to the outside," they are "dreams made exact." This contrasts to the secondary process of the Ego which is characteristic of the left hemisphere of the brain and of alphabetic writing and print with its linear-perspectival discourse (Mc Luhan). The electronic media has relativised time and space in the same way as the border between individuals and between ego and unconscious which become more permeable and flexible.

Based on this point of view I will reflect on the possibilities and limits of VR and Cyber-

space. The space of inner images can be represented very well by the means of hypertext with its manifold refer ability and simultaneity. This is exemplified by a borderline-patient's initial imagery which are analysed by the means of the computer-interpretation-support system ATLAS/ti. It is based on the proceedings of Grounded Theory and was specifically developed for the requirements of qualitative, hermeneutic research. It is based on semantic network representations and realizes in this way the hypertext structure.

Referring to this case the capacity of cybertherapy is discussed, how it could function like art therapy in a broader sense fostering the emergence of inner images, and symbols with their creative potential and self-healing forces. In analytical psychology and art therapy active participation on creating individual metaphors, images and symbols is necessary in order to strengthen the ego and to restore the capacity of symbolisation and imagination. Cybertherapy could be a therapeutic tool for concretizing and structuring the primary process material as it emerges in analytical treatment offering a symbolic and archetypal imagery for the patient.

Contact:
 Manfred Krapp, MD, PhD
 C.G. Jung-Institute Zuerich
 Berlin, 10711
 Germany
 Phone: ++49308911503
 Fax: ++493089096830
 Email: manfred.krapp@t-online.de

Presenter: Jeonghun Ku PhD

RELATIONSHIP BETWEEN SOCIAL RESPONSE TO VIRTUAL AVATAR AND SYMPTOM SEVERITY OF PATIENTS WITH SCHIZOPHRENIA

Jeonghun Ku¹ Ph.D., Won Yong Hahn¹, M.S., Hee Jeong Jang², B. A., Sung Hyouk Park², M.D., So Young Kim², B.A., Kwang Uk Kim¹, M.S., Jae Hun Kim¹, M.S., Jang Han Lee¹, Ph.D., Chan-Hyung Kim², M.D., Ph.D., Jae Jin Kim², M.D., Ph.D., In Y. Kim¹, M.D., Ph.D., and Sun I. Kim¹, Ph.D.

¹Dept. of Biomedical Engineering, Hanyang University, Seoul, Korea

²Department of Psychiatry, College of Medicine, Yonsei University, Severance Mental Health Hospi-

tal, Gyunggi-do, Korea

Background

A virtual avatar has been used for various applications that require communication among persons, or to train or educate people by demonstrating human-like behavior. Recently, much research has shown an enhancement of virtual avatar technology, with the avatar perceived as a real person. As a result, the technology could begin to be used for observing human behavior to a virtual avatar.

Objectives

This paper concerns whether a virtual avatar could be perceived as a real human by patients with a mental illness, particularly schizophrenic patients, as well as whether a virtual avatar could acquire patients' behavioral characteristics during a short conversation.

Method/Tools

For this, we designed a virtual avatar that was standing in a virtual room, with eleven schizophrenic patients assigned the task of approaching the virtual avatar, initiating a conversation, and providing answers to the avatar's questions. To measure behavioral parameters in the virtual environment, we acquired the interpersonal distance and the verbal response time. In addition, we rated patients on the Positive and Negative Syndrome Scale (PANSS) in order to investigate a relationship between patients' symptomatic characteristic and behavioral parameters.

Results

Results of this study revealed that the interpersonal distance was negatively correlated with the negative syndrome scale, which is a subscale of PANSS ($r=-0.687$, $p=0.02$). By contrast, the verbal response time was not correlated with any other subscale of PANSS. However, after analyzing this variable with sub-items of the negative syndrome of PANSS, two positive correlations were found: one with blunted affect ($r=.638$, $p=.035$) and the other with poor rapport ($r=.615$, $p=.044$).

Discussion

The negative correlation between the distance and negative symptom severity observed in this study could represent that they keep closer distance during interacting with an avatar due to patient's symptom severity. Therefore, it also could be said that the severer negative symptom patients have, the harder they recognize or interact with the other expressing emotion in a social interaction. This result is consistent with previous studies that investigated the relationship between schizophrenic patients' interpersonal distance and their symptoms. And, the positive correlation between the verbal response time acquired and subscales in PANSS in this study could be explained by the definition of these subscales. The blunted affect score represents the amount of emotional change, which is characterized as the reduction of facial expression, emotional modulation, and gesture during communication. By contrast, the poor rapport score represents the amount of intimacy to an interviewer or the level of deficit in forming a relationship, which is characterized as distancing a human relationship and the reduction of verbal and nonverbal communication. Therefore, this positive correlation means that the less a patient's emotional response, intimacy, and relationship making with a virtual avatar, the slower they answer the avatar's question. Inferring from these results, we conclude that the virtual avatar could be perceived as a real human by schizophrenic patients, the avatar could facilitate the schizophrenic patients' behavioral characteristics, and the avatar could be used as a tool for assessing the behavioral characteristics of patients with schizophrenia.

Contact:
Jeonghun Ku
133-605 Dept. of Biomedical Engineering
Hanyang University,
Sung Dong P.O. Box 55
Seoul, Korea,
Tel : +82-2-2290-0693
Fax : +82-2-2296-5943
Email: kujh@bme.hanyang.ac.kr

Presenter: Jeonghun Ku PhD

GENERATION AND VALIDATION OF DYNAMIC FACIAL EXPRESSION OF AVATAR

Jeonghun Ku Ph.D., Won Yong Hahn, M.S.,
Hee Jeong Jang, B. A., Sung Hyouk Park,

M.D., So Young Kim, B.A., Kwang Uk Kim,
M.S., Jae Hun Kim, M.S., Jang Han Lee,
Ph.D., Chan-Hyung Kim, M.D., Ph.D., Jae Jin
Kim, M.D., Ph.D., In Y. Kim, M.D., Ph.D. and
Sun I. Kim, Ph.D.

Dept. of Biomedical Engineering, Hanyang University, Seoul, Korea

Background

Facial expression research has been issued on areas such as social psychology, psychiatry, and so on. Particularly, patients with mental illness showed deficits in reading and recognizing facial expression, so that they suffer from their social life due to the deficit. These studies mostly focused on facial recognition ability and were conducted with still images of people. However, the still images as stimuli have limitations, which are lack of controllability and flexibility, and lack of reality due to the inability to give a dynamic image. Actually, dynamic representation of facial expressions is necessary because it is more effective to be recognized.

Objectives

The objectives of this study were to propose a method in order to present dynamic facial expressions having various intensity, to investigate human's perception to avatar's facial expressions divided by gradual strength, to investigate how the perception varies to the strength of facial expression, as well as to investigate how different the perception according to avatar's gender.

Method/Tools

For accomplishing these goals, we generated a male and a female virtual avatar with five levels of strength of happy and anger emotion using morphing technique, recruited 16 healthy and normal subjects and measuring the subject's affected emotion by rating affective arousal and valence. The presentation of expressions of virtual faces was not just to show a still image but to show an animation in order for the subject to recognize the avatar's facial expression more realistically. Therefore, we made a virtual avatar animate so that subjects could see a facial animation changing from neutral into a target expression for one second, subsequently they could see the target expression (one of five levels) for 5 seconds. Then, they scored the emo-

tional valence or arousal for the stimulus while being shown a black screen for 5 seconds. The 24 facial expressions of avatars were provided in random order.

Results

In this study, we were able to investigate the human's perceptual characteristics evoked by a male and a female avatar's facial expression of happy and anger, and avatar's gradual facial expression. In addition, we were able to know that the virtual avatar's facial expression could affect human's emotion and it showed different characteristics varied with avatar's gender and the strengths of the facial expressions as well as those characteristics observed in previous studies using photos or video clips. However, we could also see that virtual face have some limitations because it is not real, so subjects were not influenced as much as they recognized the virtual faces.

Conclusion

This study was meaningful in that it could provide new potential for using or manipulating emotional intensity by controlling a virtual avatar's facial expression linearly using a morphing technique, although a virtual avatar has some limitation to convey its emotion using facial expressions. Therefore, it is predicted to be used for assessing emotional characteristics with emotional deficit through a presentation of dynamic expression having various emotional intensities.

Contact:
Jeonghun Ku
133-605 Dept. of Biomedical Engineering
Hanyang University,
Sung Dong P.O. Box 55
Seoul, Korea,
Tel : +82-2-2290-0693
Fax : +82-2-2296-5943
Email: kujh@bme.hanyang.ac.kr

Presenter: Jeonghun Ku PhD

EMOTIONAL INVOLVEMENT IN PRESENCE DURING INTERACTING WITH VIRTUAL AVATAR

Jeonghun Ku Ph.D., Won Yong Hahn, M.S., Hee Jeong Jang, B. A., Sung Hyouk Park, M.D., So Young Kim, B.A., Kwang Uk Kim, M.S., Jae Hun Kim, M.S., Jang Han Lee,

Ph.D., Chan-Hyung Kim, M.D., Ph.D., Jae Jin Kim, M.D., Ph.D., In Y. Kim, M.D., Ph.D. and Sun I. Kim, Ph.D.

Dept. of Biomedical Engineering, Hanyang University, Seoul, Korea

Background

Technological advances make virtual reality (VR) able to provide social events by being populated with avatars. Several studies represented that the avatar's representation could influence people's sense of social realism. As one of the critical components to evaluate the effectiveness of virtual environment for the social interaction, the concept of presence has been used. However, there are few studies on how emotion works in the 'feeling of presence' during experiences with virtual societies, although emotion plays an important role in social interaction.

Objectives

It focuses on the impact of avatar's emotions (Happy, Angry, and Neutral Emotion) in co-presence, social presence, and tele-presence. Specifically, we hypothesize that presence, particularly tele-presence, will occur within immersive virtual environments as a function of intensity of emotion. Therefore, we tried to evaluate the presence produced by emotional value of virtual avatars in virtual environments in this study.

Media/Tools

A total of fifteen healthy subjects were recruited for this study. 2 × 3 (avatar gender, avatar emotion) mixed ANOVA experimental design was used for this experiment. All six avatars have emotional appearance, behaviour, and voice. Each participant experienced all 6 tasks (avatar gender × avatar emotion) in a random order. Each task was to be introduced with an avatar and then to introduce oneself to the avatar. After participating, subjects should complete a presence questionnaire and answer the arousal (relax: 0 – excitation: 8) and valence (unpleasant: -4 – pleasant: +4) induced by the experience.

Results

In an investigation of self-reported co-presence and perceived other's copresence, the scores of both co-presence scales to

happy emotional avatar were highest, and the scores to neutral emotional avatar were next, and the scores to angry emotion avatar was lowest (main effect : $p < 0.001$). For social presence score, the significant main effect was also observed ($p = 0.003$). And, the score to happy emotional avatar was significantly high to Neutral ($p = 0.001$), and to Angry avatar ($p = 0.007$). The scores of tele-presence to happy emotional avatar ($p = 0.014$) and angry emotional avatar ($p = 0.046$) were more significantly higher than the score to neutral emotion avatar.

In the results of correlation analysis between emotional value (arousal and valence) and presence score, the correlations between valence and self-reported co-presence ($r = 0.873$, $p < 0.001$) and perceived others co-presence ($r = 0.887$, $p < 0.001$) were significant, and the correlation between tele-presence and absolute value of valence ($r = 0.327$, $p = 0.002$) and value of arousal ($r = 0.228$, $p = 0.031$) was also statically significant. Also, the correlation between social presence and absolute value of valence was statically significant ($r = 0.210$, $p = 0.047$).

Discussion

The pattern of self-reported copresence and perceived other's copresence to the avatar's emotional expression was similar. It is probably due to the fact that the questionnaires mostly include factors regarding intimacy and involvement, which are highly related to emotional valence. On the other side, the social presence and tele-presence score showed a high correlation with absolute value of valence. It might mean that humans feel greater presence when the other expresses emotion regardless of positive and negative. Therefore, we could conclude that emotion is an important factor to evoke 'feeling presence' in virtual environments with avatars.

Contact:
Jeonghun Ku
133-605 Dept. of Biomedical Engineering
Hanyang University,
Sung Dong P.O. Box 55
Seoul, Korea,
Tel : +82-2-2290-0693
Fax : +82-2-2296-5943
Email: kujh@bme.hanyang.ac.kr

Presenter: Jeonghun Ku PhD

DEVELOPMENT OF AVATAR FOR MEASURING HUMAN'S SOCIAL EMOTIONAL RESPONSE IN IMMERSIVE VIRTUAL ENVIRONMENT

Jeonghun Ku, Ph.D., Won Yong Hahn, M.S., Hee Jeong Jang, B. A., Sung Hyouk Park, M.D., So Young Kim, B.A., Kwang Uk Kim, M.S., Jae Hun Kim, M.S., Jang Han Lee, Ph.D., Chan-Hyung Kim, M.D., Ph.D., Jae Jin Kim, M.D., Ph.D., In Y. Kim, M.D., Ph.D., and Sun I. Kim, Ph.D.

Dept. of Biomedical Engineering, Hanyang University, Seoul, Korea

Background

Virtual reality (VR) has become a representative method or tool to intervene between human and computer. It has been widely used in various fields including medical field, particularly for treating people with mental disease and training handicapped people. It is because VR has the ability to provide us a well controlled environment as well as a realistic, interactive, and immersive environment. Nowadays, an idea has emerged, which social stimuli also could be generated using VR technique, particularly using avatars. This idea has been realized and utilized for people with social anxiety. However, there is lack of evidence whether a virtual avatar could influence human behaviour and emotion. Therefore, the goal of this study was to develop a virtual avatar and to investigate human's behavioural and emotional response in order to examine the possibility to apply it to patients with schizophrenia.

Method/Tools

A male and a female virtual avatar having emotional expressions (happy, neutral, or anger) were designed. The arousal & valence of each avatar's facial expression was matched to the same level based on results of a previous study. For the experiment, 2×3 (avatar's gender and avatar's emotion) ANOVA experimental design was used. For the experiment, fifteen healthy subjects were recruited. Each participant experienced all 6 introduction tasks (avatar gender \times avatar emotion) in random order. As measurements for this study, behavioural response (interpersonal distance defined as a distance between a subject and an avatar), emotional

(arousal and valence) measurements, and recalled memory score were acquired.

Results

Through this study, we were able to observe that an avatar expressing emotion could influence human behaviour, emotion, and memory. In detail, when the interpersonal distance was compared in each condition, the significant main effect to avatar's gender was observed ($p=0.023$), while the difference according to avatar's gender at each emotional expression was not significant. In addition, further distance was set in case of being presented with an angry avatar regardless of avatar's gender (happy vs angry : $p=0.006$ / neutral vs angry : $p=0.003$). In summary, humans keep the interpersonal distance closer to female avatar than to male avatars and further from an avatar representing angry emotion than to an avatar representing neutral or happy emotion. Furthermore, subjects recalled more correctly in a condition having an angry avatar than in a neutral avatar condition ($p=0.006$). However, in the case of being provided an avatar representing happiness, a higher mean score was shown but was not significant ($p=0.108$).

Conclusion

These results support that the virtual avatar could influence human behaviour, emotion, and memory, in particular, that those characteristics were varied by emotional expressions of the virtual avatar. The characteristics resulting from this study coincided with studies conducted with real people or other instruments. A virtual reality and virtual avatar could draw human behavioural and emotional characteristics and assess those objectively. Therefore, it could provide a potential to be used for assessing human's characteristics as well as assessing and enhancing social ability of a person who has social function deficits, e.g., schizophrenia, using virtual avatars.

Contact:

Jeonghun Ku
133-605 Dept. of Biomedical Engineering
Hanyang University,
Sung Dong P.O. Box 55
Seoul, Korea,
Tel : +82-2-2290-0693
Fax : +82-2-2296-5943
Email: kujh@bme.hanyang.ac.kr

Presenter: Damini Kumar

WEARABLE KINEMATIC AND PHYSIOLOGICAL BIOFEEDBACK SYSTEM FOR MOVEMENT-BASED RELAXATION

Damini Kumar MSc, John Foody; Brian Caulfield; Tomas Ward; Charles Markham

University College Dublin

In this project we are developing an effective feedback system for a human interface with a video game designed to promote mental and physical relaxation. Therapies such as Tai Chi and Yoga have been shown to have many therapeutic benefits in rehabilitation including enhancing postural awareness and reducing chronic pain and hypertension.

We aim to develop a computer game in which the player's performance is determined by their ability to master one of these physical arts and in doing so bring about a state of mental relaxation. We are developing a virtual reality application where whole-body movement, respiration and physiological correlates of relaxation are used as input. Such input will be processed to provide changes to the avatar or its environment in order to affect appropriate biofeedback for the user. The purpose of this biofeedback is such that they may more easily achieve targeted postures and physiological variable ranges commensurate with Yoga/Tai Chi philosophy.

A garment based physiological and kinematics measurement system will provide our primary method of communication with the video game. This lightweight garment will monitor heart and breathing rate, muscle activity, galvanic skin response, and alignment of body segments. To measure the human body motion we have designed and implemented a Universal Serial Bus (USB) based unobtrusive kinematics transducer capable of scalable deployment with minimum instrumentation.

The player must reproduce physical postures displayed by a model on screen whilst maintaining a relaxed and controlled breathing pattern. Feedback is provided by means of reproduction of the player's body image on screen. Quality of movement and posture,

and degree of mental relaxation will determine the player's performance. The game could take the form of a track and field decathlon format. This system could benefit patients suffering from many conditions including hypertension, anxiety disorder, and chronic pain.

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Contact:

Damini Kumar MSc
University College Dublin
School of Physiotherapy, Health Sciences
Building, University College Dublin, Belfield
Dublin 4, Ireland
Tel: 00353861725625
Fax: 00441895812446
Email: damini.kumar@ucd.ie

Presenter: Belinda Lange

THE EFFECTIVENESS OF VIRTUAL REALITY IN REDUCING PAIN AND ANXIETY DURING DIGITAL NERVE BLOCK

Belinda Lange (PhD candidate) BSc, B Physio (Hons), Marie T Williams, Sara Jones

University of South Australia

Background

Applications of Virtual reality (VR) as a distraction technique have included situations requiring medical procedure for an injury/ailment. Common invasive procedures (injections/venipuncture) involve the learner practicing the task. Some health training programs offer students the opportunity to learn invasive techniques on each other prior to performing them in therapeutic situations. The aim of this study was to determine if VR was effective in reducing pain and anxiety in students receiving a digital nerve block from their peers as part of a teaching program.

Method/tools

A randomized controlled trial was used. Podiatry undergraduates were randomly assigned to receive the procedure whilst immersed in VR (Group A=VR) or verbally distracted (Group B=control). Pre and post outcome measures included VAS(pain), State-Trait anxiety inventory (STAI), and simulator sickness questionnaire (SSQ). Blood pressure (BP), heart rate (HR), skin conductance (SC), and malaise scale (MS) were measured pre, during, and post procedure. Within-group and between-group analyses were performed.

Results

There were no significant differences in demographics between groups. No significant difference was found between groups for VAS for pain ($p=0.78$). Compared to baseline levels, SC was significantly higher during the procedure in the control group ($p<0.001$). State STAI significantly decreased in both groups following the procedure (Group A $p=0.01$; Group B $p=0.008$) and no difference was evident between groups (pre ($p=0.124$), post ($p=0.065$) procedure). Two subjects reported symptoms (MS) when immersed in VR. There was no significant difference between pre/post SSQ in the VR group. Diastolic BP was significantly lower ($p=0.034$) and HR significantly higher ($p=0.042$) in the VR group. Novelty/ discussion: To date the majority of studies investigating the use of VR as a distraction technique have concentrated on medical procedures with high pain levels. Pain associated with injections is comparatively low, however often associated with high anxiety levels. No significant difference in subjective pain may be a result of the action of local anaesthetic, numbing the area after needle insertion. The significant increase in SC during the control condition only ($p<0.001$) suggests that, despite the presence of local anaesthetic, anticipatory anxiety was high when the procedure was viewed, compared to distraction with VR ($p>0.056$). STAI results are possibly due to an ordering effect; the majority of group A subjects received the procedure then performed the procedure on another student. Malaise scale results indicate that adverse effects occurred in two subjects. No significant change in SSQ scores for the VR group supports MS findings. However, pre and post SSQ scores were high for both groups, including the control group where SSQ scores should be zero since subjects

were not exposed to VR, suggesting that SSQ may be associated with procedural anxiety and not adverse VR symptoms. Significant BP and HR changes during VR reflect the physical activity involved in the intervention.

Conclusion: While VR did not significantly influence subjective pain scores, lower SC indicates that VR reduced anticipatory anxiety associated with the procedure. The MS may be a more appropriate measure of adverse effects than the SSQ in situations where high levels of anxiety exist.

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Contact:
Belinda Lange
University of South Australia

North Terrace Adelaide
Adelaide, SA 5000
Australia
Phone: 011 61 8 83022083
Fax: 011 61 8 83022766
Email:
Belinda.Lange@postgrads.unisa.edu.au

Presenter: Belinda Lange

SUBJECTIVE, PHYSIOLOGICAL AND ADVERSE EFFECTS OF THE VIRTUAL REALITY ARQUAKE GAME COMPARED TO WATCHING AN ANIMATED MOVIE IN CHILDREN AGED 6-17 YEARS

Belinda Lange (PhD candidate) BSc, Marie T Williams, Ian Fulton, Meredith Craigie, & Bruce Thomas

University of South Australia

Background

The Virtual reality (VR) ARQuake game was developed at the Wearable Computer Laboratory (UniSA) and is currently being used by researchers as a distraction technique for children undergoing painful procedures. This study was designed to understand how children react to VR, when not undergoing painful situations. The aim of the study was to compare the subjective, physiological and adverse responses of children to the VR ARQuake game with an animated movie.

Method/tools

A randomized AB/BA crossover design was used. Subjects aged between 6-17 years were randomly assigned to 14 minutes of VR and a 14 minute section of an animated movie in varying order (Group A=VR/movie; group B=movie/VR). The simulator sickness questionnaire (SSQ) was completed pre and post procedure. Blood pressure (BP), heart rate (HR), skin conductance (SC), and malaise scale (MS) were measured pre, during, and post procedure. Subjects completed a presence questionnaire (PQ) following both VR and movie.

Results

Thirty-six subjects were recruited (21 males and 15 females, mean age 11.89±2.98). Sub-

ject numbers were equal in both groups. No significant difference was found in demographic details between groups. Significant treatment effects were present for the level of enjoyment of the game (PQ) ($p=0.03$) and SSQ ($p<0.0001$). No significant period-by-treatment interaction was present for any outcome measures ($p>0.05$). The level of presence (PQ) was significantly higher during VR ($p<0.004$). No significant difference in SC between VR and movie (>0.051) occurred at any time point. Blood pressure and HR were significantly higher during VR ($p<0.014$), however no significant difference in BP and HR was present post 5 minutes ($p>0.481$). Symptoms (e.g., HMD heavy, dizziness) were reported during VR on the MS by 47% of subjects, compared to 3% during the movie. Mild nausea was reported by 6% of subjects during VR (0% movie). Subjects reported no symptoms 5 minutes post VR.

Novelty/ discussion

The VR ARQuake game demonstrated higher levels of presence than the movie with subjects reporting significantly higher scores in the PQ (felt like they were really there; felt like they were actually moving; game was more difficult and harder to get used to). These results indicate that VR will be an effective distraction technique during painful procedures because of the higher level of presence and greater level of concentration required. Although greater symptoms were reported on the MS during VR, only 6% reported mild nausea and all symptoms subsided within five minutes. It appears that the MS is a more appropriate indicator of adverse responses to VR than SSQ in children, possibly as a result of the wording on the SSQ. The non-significant SC result between VR and movie supports the MS findings. The significant increase in BP and HR during VR reflect the physical activity involved in interacting with the virtual environment.

Conclusion

This study provides more information about the physiological and adverse effects of VR in children and provides support for the use of the VR ARQuake game in children undergoing painful and anxiety provoking procedures provided a malaise scale is used to monitor nausea.

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Contact:

Belinda Lange
University of South Australia
North Terrace Adelaide
Adelaide, SA 5000
Australia
Phone: 011 61 8 83022083
Fax: 011 61 8 83022766
Email:
Belinda.Lange@postgrads.unisa.edu.au

Presenter: Belinda Lange

VIRTUAL REALITY AS A DISTRACTION TECHNIQUE FOR CHILDREN DURING MINOR MEDICAL PROCEDURES IN A PEDIATRIC EMERGENCY DEPARTMENT

Belinda Lange PhD candidate, Marie Williams, Ian Fulton, Meredith Craigie

University of South Australia

The aim of this study was to determine if Virtual Reality is an effective distraction technique for children undergoing minor medical procedures in a Paediatric Emergency Department compared to watching a movie. Children between 6-17 years undergoing minor medical procedures such as blood sampling, intravenous cannulae insertion and suturing were provided with either Virtual reality or an animated movie excerpt as a distraction technique during the procedure. Pre, post and maximum scores were received for children's self report pain and anxiety and parent's perception of their child's pain and anxiety. Staff members were asked to provide a score for their perception of the child's pain and anxiety. Parental anxiety was also measured for comparison with the child's anxiety levels. The brief behavioral distress scale was used to score the child's

behavior during the procedure. Data collection for this study is still ongoing and is anticipated to be completed by June 2005. To date, twenty-two subjects have been recruited with a target of at least 100 subjects. The two interventions (Virtual reality and animated movie) will be compared using mixed between-within subjects analysis of variance and independent t tests. Baseline pain and anxiety data for these procedures was collected in a separate study, providing information about the pain and anxiety associated with these procedures without distraction. Pilot testing comparing the level of presence and enjoyment of the Virtual reality to watching an animated movie in healthy children not undergoing procedures has also been completed. If Virtual reality is found to significantly reduce pain and anxiety in children during minor medical procedures compared to watching an animated movie, the technique may be employed by the Pediatric Emergency Department as a non pharmacological pain management tool.

Contact:

Belinda Lange
University of South Australia
North Terrace Adelaide
Adelaide, SA 5000
Australia
Phone: 011 61 8 83022083
Fax: 011 61 8 83022766
Email:
Belinda.Lange@postgrads.unisa.edu.au

Presenter: Jang-Han Lee PhD

SPATIAL ABILITY AND NAVIGATION LEARNING IN A VIRTUAL CITY

Richard Mraz, P.Eng.², Konstantine K. Zakzannis, Ph.D., C.Psych.³, Peter J. Snyder, Ph.D.⁴ In Y. Kim, Ph.D.¹, Sun I. Kim, Ph.D.¹, Sandra E. Black, M.D.⁵, Simon J. Graham, Ph.D., .Eng.^{2,6}

¹ Department of Biomedical Engineering, Hanyang University, Seoul, Korea

² Imaging Research, Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

³ Division of Life Sciences, University of Toronto, Toronto, Ontario, Canada

⁴ Department of Psychology, University of Connecticut, Groton, CT, USA

⁵ Department of Medicine-Neurology, University of Toronto, Toronto, Ontario, Canada

⁶ Department of Medical Biophysics, University of Toronto, Toronto, Ontario, Canada

Research Status: Completed

Background & Significance of the Problem

Virtual environments (VEs) can be used to assess spatial memory and navigation skills, although the behaviour elicited is inherently complex. The purpose of this study was to investigate the ecological validity and interrelationship between virtual navigation tasks and several neuropsychological tests.

Methods/Tools

Forty-two participants (mean age: 70.42) took part in the study, of which eighteen were recruited from the Cognitive Neurology Clinic at Sunnybrook & Women's College Health Sciences Centre (S&W) based on diagnosis of mild cognitive impairment (MCI). Subjects completed the Groton Maze Learning Test (GMLT; a hidden maze task developed by one of the authors [P.J.S.]) and several neuropsychological tests, including the MMSE,¹ the Rey Complex Figure Test,² Benton Visual Retention test,³ Trail-Making Test (Forms A and B),⁴ and Digit Span.⁵ Sixteen of the participants (9 normal, 7 MCI) also undertook a VE navigation task.⁶ Behaviour elicited by the VE task was characterized in terms of two components, as estimated by factor analysis: a VE memory index, and a VE movement index.

Results

The VE memory index was significantly associated with the results of a conventional memory test (Rey Complex Figure), and the VE movement index was significantly associated with measures of the Trail Making Test. Compared with normal participants, participants with mild cognitive impairment (MCI) showed a significant reduction in the memory-related measures in the PGRD Maze Learning Test and memory tests (particularly RCFT), and the MCI group deviated significantly from the correct route, particularly in novel environments. Performance in the VE navigation-learning task was significantly associated with measures of visual memory and the executive function in conventional neuropsychological tests.

Conclusion

The results of this study demonstrate that VE technology can be used to assess spatial memory and navigation skills, and that measures of this behavior in a VE are related to those of conventional neuropsychological tests. Our results also demonstrate that the MCI group showed a significant reduction in memory-related measures in the GMLT and the neuropsychological tests. In particular, differences between the groups were evident in the immediate and delayed recall in the Rey Test. However, because of the small sample size, statistically significant results were not found between groups in the VE navigation task.

Novelty

The interrelationship between the VE task, the GMLT, and neuropsychological assessments is important for administration and interpretation of these computerized tests in the future.

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Contact:

Jang-Han Lee, Ph.D.
Department of Biomedical Engineering
College of Medicine
Hanyang University
Seoul, Korea
TEL: +82-2-2290-8280
FAX: +82-2-2296-5943
Email: clipsy@unitel.co.kr

Presenter: Jang-Han Lee PhD

THE APPLICATION OF A VR-TANGIBLE INTERACTION SYSTEM IN SENSORY INTEGRATION TRAINING AND ASSESSMENT FOR CHILDREN WITH AUTISM

Jang-Han Lee, Ph.D.¹, Hyun-Jhin Lee, M.Sc.², Young Sik Lee, M.D.,Ph.D.³, Seongshim Cheong, M.D.,Ph.D.⁴, Kwang B. Park, Ph.D.⁵

¹ Department of Biomedical Engineering, College of Medicine, Hanyang University, Seoul, Korea

² School of Design and Media, Hongik University, Seoul, Korea

³ Department of Neuropsychiatry, College of Medicine, Chung-Ang University, Seoul, Korea

⁴ Seoul Metropolitan Children's Hospital, Seoul, Korea

⁵ Department of Psychology, Chungbuk National University, Seoul, Korea

Research status: Still in progress

Children with autism, as well as children with other developmental disabilities, may have dysfunctional sensory systems. Sometimes one or more senses are either over- or under-reactive to stimulation in these individuals. Sensory processing abnormalities affect all aspects of adaptive, cognitive, social, and academic functioning, and correlate with higher levels of stereotypic, rigid, and repetitive behaviours in autism. Thus, sensory processing abnormalities may be important to address in therapeutic interventions that aim to reduce rigidity and stereotyped behaviours. Sensory integration therapy is based on a theory developed by Ayres (1972), which emphasizes the relationship between sensory experiences and motor and behavioural performance. Intervention strategies involve the use of planned and controlled sensory experiences, including vestibular, proprioceptive, and somatosensory activities, such as swinging, deep pressure touch, and tactile stimulation; that is, the techniques facilitate attention and awareness, and reduce overall arousal of children with autism.

Virtual reality technology is an exciting tool for allowing children with autism to practice behaviours in role-play situations, while providing a safe environment for rule learning and repetition of tasks (Parsons & Mitchell, 2002). However, some ethical and technical concerns surround the use of fully immersive virtual reality technology (i.e., the use of head-mounted displays (HMDs)). HMDs can

be extremely expensive and people may experience 'cybersickness' in the form of nausea, headache, and dizziness, whereas desktop or projection virtual environments tend to be much less likely to induce cybersickness. Moreover, because HMDs place some limitations on the child's interaction with another person, the mixed and augmented reality is more useful for group interactions and sensory experiences.

Therefore, we developed a virtual reality-tangible (VR-tangible) interaction system for sensory integration training and assessment of autism by mixing the virtual environment with the natural physical environment. With this system, children with autism experience vestibular, proprioceptive, and somatosensory activities, such as swinging, spinning, and rotating, and a social skills training program such as eye gaze. In addition, a program that involves breaking virtual balloons with a real stick measures the visuomotor coordination of children with autism. The participants view themselves, virtual balloons, and a real stick on a large screen that displays game-like scenarios. Our VR-tangible interaction system consists of a Pentium IV PC, a projector, a screen (200 × 150 cm), an infrared reflector, and a digital camera.

The performances of normal control groups and autistic groups will be compared in the visuomotor coordination program and the social skills training program. The degree that the sensory integration training leads autistic children to more productive contacts with another individual and environments will also be analyzed.

As the study is still in progress, final results were not available at the time this abstract was written. The use of a VR-tangible interaction system to better understand sensory processing abnormalities of children with autism is relatively rare, even in studies with virtual environments. We hope that this study will clarify sensory processing abnormalities of children with autism and stimulate further studies on sensory integration training and assessment in the field of VR-tangible interaction.

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Contact:

Jang-Han Lee, Ph.D.
Department of Biomedical Engineering
College of Medicine
Hanyang University
Seoul, Korea
TEL: +82-2-2290-8280
FAX: +82-2-2296-5943
Email: clipsy@unitel.co.kr

Presenter: Jang-Han Lee PhD

SEX DIFFERENCES IN HEALTHY ELDERLY ADULTS FOR COMPLETING 2-DIMENSIONAL HIDDEN MAZE AND 3-DIMENSIONAL VIRTUAL REALITY NAVIGATION LEARNING TASKS

Jang-Han Lee PhD¹, Richard Mraz, P.Eng.²
Konstantine K. Zakzanis, Ph.D., C.Psych.³
Peter J. Snyder, Ph.D.², In Y. Kim, Ph.D.¹
Sun I. Kim, Ph.D.¹, Sandra E. Black, M.D.²
Simon J. Graham, Ph.D., P.Eng.²

¹Hanyang University, Seoul, Korea

²Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

³University of Toronto, Toronto, Ontario, Canada

⁴University of Connecticut, Groton, CT, USA

Background & Significance of the Problem

Sex differences in navigation and maze learning are well known, with men often outperforming women on route-learning, spatial perception, and visualization.¹⁻⁴ Some suggest that these differences stem from evolution, while others attempt to further elucidate these differences by new experimental methods. The present study used a series of non-verbal, visually-guided navigation tasks to investigate gender differences in healthy, elderly adults.

Methods/Tools

The three distinct test components were 1) the Groton Maze Learning Test (GMLT), 2) traditional neuropsychological tests, and 3) a 3D VE navigation-learning task. The GMLT is a computerized measure of a participant's

ability to acquire and use efficiently an internal spatial map of a hidden 2D maze. Neuropsychological tests included the MMSE,⁵ the Rey Complex Figure Test,⁶ Benton Visual Retention test,⁷ Trail-Making Test,⁸ and Digit Span.⁹ The 3D VE navigation task¹⁰ involves learning and recalling routes through a virtual city. Twenty-five healthy elderly volunteers participated.

Results

Sex differences were found in learning ability with the 2D maze test and the VE navigation. Men excelled at maze-learning ability, especially after the middle trials, although men and women did not differ in performance on the first learning trial for this test. These results suggest that men more easily acquired spatial ability and learning than women, and that men also reached their peak performance ability more rapidly than women in the maze-learning test.

Men significantly outperformed the women only on the first trial of the VE navigation task. There were no sex differences after a second trial, perhaps due to the relative ease of the VE navigation task since no subjects deviated significantly from the path following the second learning trial.

Performance on the GMLT was related to performance on both the memory-related neuropsychological tests and the VE task.

Conclusion

Men outperform women on the 2D and 3D navigation tasks. Future studies should investigate sex differences between topographic and Euclidian cues in VE navigation learning and how these strategies and age affect spatial memory and navigation learning in normal people.

Novelty

This study suggests that the VE task has ecological and comparative validity for measuring spatial ability and navigation.

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Contact:

Jang-Han Lee, Ph.D.

Department of Biomedical Engineering

College of Medicine

Hanyang University

Seoul, Korea

TEL: +82-2-2290-8280

FAX: +82-2-2296-5943

Email: clipsy@unitel.co.kr

Presenter: Elizabeth Lewis M.R.C.Psych

WHAT ASPECTS OF VIRTUAL ENVIRONMENTS MAKES THE EXPERIENCE “REAL” FOR AGORAPHOBIC PATIENTS?

David.G.Walsh¹, Elizabeth J. Lewis²

¹ St. Stephen's Hospital, Cork, Ireland., Department of Psychiatry, University College Cork.

² St. Stephen's Hospital, Cork, Ireland. Department of Child Health and Paediatrics, University College Cork

Research Status: Research in progress

Agoraphobia with or without panic disorder is a disabling mental health problem with an estimated population prevalence of 6%. It is frequently seen in both primary and secondary mental health settings. Currently, although the evidence base for behaviour therapy for agoraphobia is extensive, the service delivery is poor. It is estimated that 25% of phobic patients refuse “in vivo” exposure

therapy or drop out. Consequently behaviour therapy is often difficult to provide in this area.

Preliminary studies have shown a role for virtual reality (VR) in the treatment of agoraphobia. Vincelli et al. showed significant reductions in the number of panic attacks, level of depression and both state and trait anxiety following VR treatment with Experiential Cognitive Therapy (ECT).¹ Botella et al showed VR exposure therapy as effective as in vivo exposure in a number of outcome measures including fear, avoidance and panic symptoms.²

In this study of 5 agoraphobic patients we investigated what aspects of virtual environments induce presence in agoraphobic patients using *VRMRI Virtual World* software by Psychology Software Tools, Inc. This software provides 13 inter-connected VR environments which include: an urban area, apartment, theatre complex, restaurant, bank, urban subway station, village subway station, village area, house, doctor's office, airport subway station, and two airports).

We examined which environments induced presence with associated subjective distress and physiological anxiety and whether the addition of background sounds pertinent to each environment influenced presence and distress levels.

Procedure

5 subjects with DSM-IV criteria either for agoraphobia without history of panic disorder or panic disorder with agoraphobia were initially exposed to a neutral VR environment to acclimatise to VR. Thereafter patients navigated virtual environments with or without the addition of background sound over a 3 minute period unless anxiety symptoms necessitated termination of exposure.

Ratings of presence (Item from Presence Inventory), subjective distress (SUDS) and physiological anxiety (Heart Rate measurements) were recorded once per minute during exposure to each environment and verbal feedback from each patient following each exposure was recorded.

Results

This study is ongoing. Results will be pre-

sented at conference together with VR environments.

Novelty

VRET for agoraphobia is at a developmental stage. Information from this study will assist in tailoring VR software and treatment programs.

Contact:
Dr David Walshe
St Stephens Hospital
Sarsfield Court
Cork
Tel: 00-353-21-48214211
Email: davidgmw@yahoo.com

Presenter: Elizabeth Lewis M.R.C.Psych

IS VIDEO HOMEWORK OF BENEFIT WHEN PATIENTS DON'T RESPOND TO VR THERAPY FOR DRIVING PHOBIA?

David.G.Walshe¹, Elizabeth J. Lewis²

¹ St. Stephen's Hospital, Cork, Ireland., Department of Psychiatry, University College Cork.

² St. Stephen's Hospital, Cork, Ireland. Department of Child Health and Paediatrics, University College Cork

In our *Virtual Therapy Clinic*, based in Cork, we have specialised in developing and evaluating virtual reality environment treatment (VRET) programmes for driving phobia in motor accident victims. Findings have been reported supporting this treatment modality.¹

³ This patient group often has co-morbid psychiatric conditions including major depression, posttraumatic stress disorder, panic disorder, and substance abuse which complicates treatment.

Our standard driving programme involves 8-12 VR sessions, using computer games with graded driving *in vivo* homework tasks following progress in virtual exposure.

Presently we are focusing on two clinical concerns. Patients who do not desensitise/reprocess their travel fears despite multiple virtual exposure sessions and the number of treatment sessions required for successful

VR treatment.

Aim

To assess whether the addition of video homework tasks involving exposure to watching video clips of driving situations encountered in VR therapy will bring about desensitization and thereby symptom resolution in patients resistant to VR exposure therapy.

Procedure

3 patients, with a diagnosis of DSM-IV Specific Phobia-driving, resistant to a VR driving programme undertook a "video homework" programme. A video tape containing a 10 minute clip of anxiety provoking driving situations derived from the most recent VR session was assigned as homework. These clips were recorded directly from the VR driving scenes presented in therapy. Each patient was requested to watch the video clip for 30 minutes daily in a darkened room with earphones and record Subjective Units of Distress (SUD) ratings daily until anxiety level fell to SUD rating of 2 or less. As the patient progressed to more distressing driving scenarios in VR therapy the video clip was updated accordingly.

The Fear of Driving Inventory (FDI) and the Posttraumatic Stress Disorder Symptom Scale (PTSS) were documented at entry and reassessed on completion of the study.

Results

This study is ongoing. Results will be presented at conference together with assigned video clips.

Novelty

This is a novel development in VRET with potential clinic benefit.

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Contact:

Dr David Walshe
St Stephens Hospital
Sarsfield Court
Cork

Tel: 00-353-21-48214211

Email: davidgmw@yahoo.com

Presenter: J. Harvey Magee

A PRIMER ON TATRC'S MEDICAL MODELING & SIMULATION PORTFOLIO: THE SERIOUS SIDE OF FUN

J. Harvey Magee

Portfolio Manager, Medical Modeling & Simulation (MM&S)
Telemedicine and Advanced Technology Research Center (TATRC)
HQ U.S. Army Medical Research and Materiel Command

As we enter the 21st century, the worlds of military and civilian medical training struggle with critical questions. For the military, how do we train medical personnel in peace for the realities of war? For the civilian sector, how do we train medical personnel in a way that results in increased patient safety...or reduced patient errors? Reports from the U.S. General Accounting Office and the Institute of Medicine have dealt with these challenges.

Why serious? Here are a couple of examples. First, health care the power to heal or harm patients. How we train to deliver care is serious too. What if residents actually deliver health care the way we teach them to? Second, the human body is infinitely challenging...and constantly changing. Everybody (literally every body) is different. How much realism is necessary to simulate it? What objective performance metrics are most appropriate? Simulated environments impact people, but in what ways?

In 2000, TATRC MM&S leaders (Dr. Moses, Mr. Magee), facilitated a 70-person strategic planning workshop. At its conclusion and in conjunction with “end users” of simulation-based training systems, a strategy was developed. Based on that strategy, collaborations of academic, government, and industrial research groups began to take shape, and networks of relationships formed. Leaders stepped forward, and funding sources were identified to propel research in four general categories of medical simulation research: PC-based interactive multimedia, digitally enhanced mannequins, part-task trainers, and Total Immersion Virtual Reality. Key defining events and workshops have been funded over the past five years in support of that strategy. Annual refinements of the strategy have been made, always in conjunction with “end users.”

Fueled by congressionally designated funded and managed by TATRC, the Center for Integration of Medicine and Innovative Technology (CIMIT) Simulation Group (PI: Dr. Steve Dawson) embraced the challenge to develop and integrate key enabling technologies into systems of simulation-based training. Examples are real-time *in vivo* tissue property measurement, tissue-tool interactions, graphics and visualization, learning systems, metrics development, learning transfer and assessment.

Examples of current projects include advanced ureteroscopic surgical simulation (TURP procedure), virtual cricothyroidotomy, VIRGIL™ Chest Trauma Training System, Central Venous Catheterization, Exsanguinating Hemorrhage, “VR-Demo”, Dynamic Injury Creation Simulator.

What degree of validation is necessary to demonstrate transfer-of-training effectiveness? What open source standards require development enroute to the eventual need for systems to be interoperable with either other medical simulation systems or more comprehensive training systems?

In summary, the presenter will predict some benefits of medical simulation, and offer some closing thoughts for success for the MM&S community...and the world.

Presenter: Ralph Mager MD

VIGILANCE AND PERFORMANCE

MEASUREMENTS IN A REAL-CAR BASED DRIVING-SIMULATOR

Dr. Ralph Mager

COAT Basel, Switzerland

Objective

The goal of the present study was to evaluate physiological measures and objective performance parameters during driving in a real-car based driving simulator. Arousing auditory stimuli were applied to compare data prior and after intervention to test the sensitivity of the system.

Design and Methods

Overall 41 subjects were selected matched for age and driving experience. To create realistic traffic scenarios in a laboratory environment a passenger car simulator was used emulating the functionality of a modern car. Electroencephalographic (EEG) activity, skin conductance, respiratory and cardiac parameters were continuously recorded during driving. Analysis was focused on time intervals prior and after application of a warning stimulus intervening a monotonous driving session. Simultaneously objective driving-parameters were derived from the simulator (time to lane crossing, lateral position and others).

Results

The intervening stimuli induced significant group effects in respect to EEG activity and skin conductance. There was a decline of the stimulus induced changes within several minutes. Other physiological parameters like respiratory or cardiac parameters were unaffected. Data revealed a strong inter-individual variability. This applied also to the performance parameters provided by the simulator. Time to lane crossing and the lateral position of the car were determined in different scenarios and separated for various types of tracks.

Conclusion

The present study revealed significant physiological group effects in response to intervening stimuli during driving in a real-car based simulator. EEG effects, simulator data

and first applications in psychiatry are discussed.

Contact:
Dr. Ralph Mager
COAT Basel
Basel, 4025
Switzerland
Phone: 0041613255242
Fax: 0041613255492
Email: ram@coat-basel.com

Presenter: Mark Matthews MSc

WIRELESS THERAPY: MOBILE GAMES AS A MEANS OF ENGAGING ADOLESCENT CLIENTS

Mark, Matthews BA, M. Sc.¹, Dr. Gavin Doherty¹, Dr. John Sharry²

¹ Trinity College Dublin, Ireland

² Mater Hospital, Dublin, Ireland

Research Status: Currently in progress.

Therapists have difficulties engaging adolescent clients in therapeutic activities between sessions. These activities usually require clients to prepare materials in advance of sessions or chart their feelings between them. Typically there is a very low rate of task completion in these activities. This might be attributed to the use of outmoded materials or methods which are not concurrent with adolescent interests.

Research suggests that client-centered materials have a greater chance of success in engaging adolescent clients. Mobile gaming represents such an approach, allowing access to adolescents' personal space, but affording adolescent users persistent and continual access to therapeutic materials. Most importantly it takes advantage of an existent widespread network in use by adolescents and therefore requires no extra hardware costs. The proposed system will allow therapists to send personalised game missions to clients' phones at specific agreed times between sessions. After each level the client will receive a positive personal message from the therapist. The proposed game will be similar to the shoot-em-up genre of mobile game. During a session clients'

phones will synchronise with therapists' computers during sessions and allow therapists and clients to view and discuss the game information.

Trials of this system will be run in the Mater Hospital and several of its associated clinics in Dublin. Research conclusions will be made as a result of pre- and post- questionnaires for therapists and clients, detailed interviews with therapists, client attendance records, and log data from client's mobile games. A comparative study of mobile games versus current materials and approaches will also be undertaken.

It is hoped that this research will ascertain whether mobile games can: effectively incorporate therapeutic elements, improve the therapeutic alliance, help increase adolescent engagement in therapeutic activities between sessions with a therapist as well as in actual sessions, increase the amount of time clients give between sessions to working on their issues, increase client task completion rate, and reduce stigma attached to therapy through positive associations with gaming.

The proposed research aims to evaluate the potential of mobile therapeutic games to overcome difficulties faced by therapists in engaging adolescents in therapeutic activities between therapeutic sessions. It also aims to discover whether this approach might save therapist session time by bringing therapy outside of sessions and into adolescents' everyday life.

There have been studies of the potential educational uses of mobile games to facilitate cooperative learning and to examine their potential as tools for supporting learning. There has been little research into the therapeutic use of mobile technology. Some studies have examined the use of text messaging in client aftercare, while others have tentatively explored the use of mobile devices to structure client narratives. To date, there has been a lack of research exploring the effects mobile therapeutic games could have on adolescent engagement in therapy.

Contact:
Mark, Matthews
Trinity College Dublin
Ireland.
Ph: +353-1-6081765

Fax: +353-1-6772204
 Email: matthemj@tcd.ie

**Presenter: Elizabeth L. McGarvey EdD
 INTERACTIVE COMPUTER IMAGINING
 TO FACILITATE COPING WITH CHE-
 MOTHERAPY-RELATED ALOPECIA
 DISTRESS**

Elizabeth L. McGarvey, EdD, Adrienne Keller, PhD, David Brenin, MD, Lora Baum, PhD, Brian Clark, Scott Acton, PhD, B. Eugene Parker, Jr, PhD

University of Virginia, Charlottesville, VA, USA

Background/Problem

As many as 47% to 58% of women with cancer report alopecia as the most disturbing anticipated aspect of receiving chemotherapy.¹ This project develops and evaluates the effectiveness of a computer imagining system that presents virtually real images of a woman going through the stages of hair loss/ re-growth as part of a strategy to provide psychosocial support to reduce distress associated with chemotherapy-related alopecia.

Methods

Following Phase I development of a prototype of a computer imaging system, further development of a user-friendly, touch screen, interaction system that shows hair re-growth and images sufficient for use to provide psychosocial support to women with cancer is now under development. The project has a number of tasks prior to the final evaluation of the system: Task 1: Following Phase 1 focus groups with a sample of patients provided feedback on the usefulness of such a system. Alopecia-related distress was also further studied. Task 2: A sample of health care professionals were interviewed to provide feedback on the accuracy of the images and usefulness of the system. Task 3: Complete and refine the computer imagining system. Task 4: Conduct a randomized clinical trial comparing quality of life between patients with chemotherapy-related alopecia who use the computer imagining system to those who receive standard care.

Results

Tasks 1 and 2 have been completed. The system is under Phase 2 development as part of Task 3. Themes associated with chemotherapy-related alopecia include *shock, embarrassment, feeling unprepared, and anxiety about self and others perceptions*. On a scale of 1 = not all easy to 10 = extremely easy to use, a non-clinical sample rated the prototype system no lower than a mean of 8.66 (SD=1.28) on ease of use in 4 areas. Health care professionals in oncology rated the realism of images on a similar scale with the lowest score received a mean of 8.94 (SD= .93). Phase II is currently underway with a 2006 completion date.

Conclusion

Interactive computer imaging systems using virtual images have a viable place in treatment for distress in cancer patients suffering quality of life issues due to alopecia.

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Contact:
 Department of Psychiatric Medicine
 University of Virginia
 P.O. Box 800623
 Charlottesville, VA 22908-0623
 Tel: 434-924-5522
 Fax: 434-982-3764
 E-Mail: rel8s@virginia.edu

Presenter: Sarah D. Miyahira PhD

THE MATURING OF VIRTUAL REALITY RESEARCH IN BEHAVIORAL HEALTH: A META-ANALYSIS AND REVIEW

Sarah D. Miyahira, Ph. D.

Pacific Telehealth & Technology Hui: A DoD/VA Joint Venture

Research Status: In Progress

Background/Problem

Since the early 1990's, the research on virtual reality (VR) applications for behavioral health has progressed from exploratory case studies and feasibility studies to comparisons with wait-list and active treatment control groups. This maturation of the field has set the foundation for conducting meta-analytic and review studies of the research findings to date. The current investigation presents a comprehensive review of the published VR research in four clinical domains: (1) anxiety disorders, (2) eating disorders, (3) pain analgesia, and (4) addictions. In addition, a meta-analysis of randomized controlled studies of VR applications in behavioral health provides a summary of effect sizes, making it possible to draw stronger conclusions regarding the efficacy of VR interventions than significance testing results alone. As such, this study builds and expands upon recently published reviews of VR for anxiety disorders¹⁻³ and eating disorders.⁴ The results of this investigation should be highly relevant and disseminable for researchers in the area of VR and the more general area of behavioral health.

Method

The investigation consists of a systematic review of the research to February 2005 as well as a meta-analysis of the literature. Utilizing PsychInfo and Medline, all of the published and abstracted studies in the four clinical domains described earlier were identified and reviewed. Each study was categorized as (1) a case study/uncontrolled study, (2) a wait-list/attention placebo controlled study, or (3) an active treatment/standard care controlled study. The meta-analysis combines the effect sizes from all controlled studies to produce general indicators of the efficacy of VR interventions for behavioral health.

Results

The review component of the investigation has been completed of VR studies related to behavioral health published through December 2004. Thus far, the data indicate that 73 outcome studies have been published across the four clinical domains with 19% (14) being wait-list or attention placebo studies, and 18% (13) active treatment or standard care controlled trials. A more detailed review of each clinical domain was done to assess the scope of the research conducted within the specific domain. Preliminary effect sizes computed

for select studies were large in magnitude, and a meta-analysis will be performed with the identified controlled VR studies, including those published in early 2005.

Conclusions

The findings to date suggest that VR for behavioral health is a maturing field that holds considerable promise with continued research. Most of the published studies are either case studies or uncontrolled feasibility studies, particularly for novel uses of VR in behavioural health. Additionally, some clinical domains have had relatively minimal attention (e.g., addictions) as compared to others (e.g., anxiety disorders). Preliminary calculations of effect sizes indicate high efficacy of VR, which is not only encouraging for the field, but supports the need for more controlled studies across clinical domains. It is essential that there be a better balance between innovation and validation to establish VR as an effective intervention for behavioural health.

Novelty

To our knowledge, this is the first statistical meta-analysis of VR for behavioral health. In addition, this review includes studies and clinical domains that were not included in previous reviews.

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Contact:

Sarah D. Miyahira
 Pacific Telehealth & Technology Hui: A DoD/
 VA Joint Venture
 1 Jarrett White Road
 MCPA-PO, Tripler AMC
 Honolulu, Hawaii 96859-5000
 Phone: 1-808-433-1912
 Fax: 1-808-433-1920
 Email: sarah.miyahira@med.va.gov

Presenter: Andreas Mühlberger PhD

SUBJECTIVE AND PHYSIOLOGIC REACTIONS OF FLIGHT PHOBICS DURING VR EXPOSURE AND TREATMENT OUTCOME: WHAT ADDS MOTION SIMULATION?

Andreas Mühlberger, Ph.D., Georg Wiedemann and Paul Pauli

Department of Psychology, Biological Psychology, Clinical Psychology, and Psychotherapy, University of Würzburg, Würzburg, Germany

Background/Problem

The efficacy of virtual reality (VR) exposure for the treatment of fear of flying was confirmed in more than 8 controlled clinical trials. Important goals of future studies are the evaluation of underlying treatment processes and the identification of crucial treatment components, both in order to optimize the treatment. The present study was designed to examine the effect of motion simulation on subjective and physiological fear reactions as part of a VR exposure that also included visual and acoustic stimuli. Our hypotheses were that motion simulation results in stronger initial subjective and physiological fear reactions, and as a consequence is associated with stronger habituations of fear responses within VR flights and between VR flights. Furthermore, we assumed that motion simulation enhances treatment efficacy as measured in the fear of flying scale (FFS).

Methods and Tools

Twenty five participants with flight phobia received a virtual reality exposure treatment including written information about fear of flying and how to cope with it (information booklet), one hour of cognitive therapy, and VR exposure (four flights). However, VR exposure included for twelve participants mo-

tion simulation while thirteen participants received VR exposure *without* motion simulation.

Virtual flights consisted out of different flying phases (start, flying, turbulences, landing) and were simulated using a head mounted display (HMD), a head tracking device and a motion platform to simulate accelerations and provide proprioceptive stimuli.

Results

Overall, subjective fear ratings as well as skin conductance responses confirmed substantial fear of both groups during VR exposure. However, these responses were substantially stronger and habituated slower in the VR motion group compared to the VR no-motion group. Nevertheless and in contrast to network theories – which suggest that stronger activation of fear networks should result in an enhanced treatment outcome - we found no differences between groups in treatment outcome. There was no trend of a superior treatment outcome for the VR-motion compared to the VR-no-motion group.

Conclusions and Novelty

The present study helps to better understand VR exposure treatment and gives hints for future research to evaluate the treatment process. Based on our results it may be speculated that treatment outcome is more related to the amount of habituation during exposure than to the strength of the initial fear response.

Contact:
 Andreas Mühlberger, Ph.D.
 Department of Psychology
 University of Würzburg
 Marcusstr. 9-11
 97070 Würzburg, Germany
 Tel.: +49 (0)931-312843
 Fax: +49 (0)931-312733
 E-mail: muehlberger@psychologie.uni-wuerzburg.de

Presenter: Sarah Parsons PhD

USE, UNDERSTANDING AND LEARNING IN VIRTUAL ENVIRONMENTS BY ADOLESCENTS WITH AUTISTIC SPECTRUM DISORDERS

Sarah Parsons, Ph.D

School of Education, University of Birmingham

Background

The potential for using Virtual Environments (VEs) with children with autistic spectrum disorders (ASDs) has been recognised by some authors. The central premise is that interactions in VEs may be less threatening for children with ASDs compared to the 'real world' because many of the confusing inputs of real world interaction can be directly controlled and/or manipulated. The present research investigated whether single-user VEs could support the learning of social skills by adolescents with ASDs.

Method

A series of quasi-experimental studies was carried out to investigate three main research questions; would adolescents with ASDs be able to use the VEs appropriately, understand VEs as representational devices, and/or learn new information from VEs about social skills?

Single-user VEs were developed to show different social contexts, such as a bus and a café, and participants completed a number of tasks such as finding a place to sit, navigating to the counter to buy food/drink and queuing. Non-autistic comparison groups were included where possible and participants were also interviewed about their experiences and understanding. All sessions were videotaped for later analysis, such as time taken to complete the tasks, navigational paths, and verbal responses. Independent measures of verbal (VIQ) and non-verbal (PIQ) understanding, and Executive ability were also taken.

Results

In Study 1, participants with ASDs were not significantly different from a PIQ-match group in time taken to complete VE-based tasks, and the majority understood the VE as having basic representational qualities. Study 2 showed that a majority of participants with ASDs behaved in a similar way to non-autistic comparison groups by treating the VE like a game in most situations. A third of the ASD group (4 out of 12) showed substantial 'off-task' behaviour, which was linked to low VIQ and weak executive abilities. Study 3 looked

at learning directly and found that participants improved in their awareness of social conventions, both in terms of performance in the virtual café and in judgments and comments made in relation to some video clips (which served as approximations of real life judgments). Study 4 involved case studies with two participants and showed that both appeared to learn the target social conventions and commented on how the VE could be relevant to their lives.

Conclusion

The overall findings suggest that some adolescents with ASDs can use, understand and learn social skills/conventions presented in VEs. The main challenge now is to reflect on these findings in order to shape future work. Specifically, there is a need to consider the role of the facilitator in 'scaffolding' participants' use of the VEs. To what extent can facilitation be separated from the effect of the VE itself? If the aim is to provide educational support, is a separation of factors desirable anyway?

Novelty

This series of studies represents a systematic and detailed addition to the scant existing literature on the use of VEs by children with ASDs. The investigation into representational understanding, inclusion of carefully matched comparison groups, and consideration of clearly specified social learning objectives are particularly noteworthy aspects of the research.

Contact:

Sarah Parsons Ph.D
School of Education
University of Birmingham Edgbaston
Birmingham UK B15 2TT
Phone: +44 (0) 121 414 4819
Fax: +44 (0) 121 414 4865
Email: s.j.parsons@bham.ac.uk

Presenter: Paul Penn PhD

VIRTUAL REALITY IN MEMORY ASSESSMENT AND REHABILITATION: PROGRESS TO DATE AND FUTURE POTENTIAL

Paul Penn. BSc (Hons), Ph.D., Barbara Brooks. BSc, Ph.D., David Rose. BSc, Ph.D. FBPsS

University of East London. UK

From its inception in 1994, the Virtual Reality Research Group at the University of East London recognised the enormous potential of virtual reality (VR) as a highly flexible, rigorously controllable, yet non-invasive method of directly assessing and manipulating brain activity in order to reduce the impact of brain damage. Studies have been conducted to address whether individuals who have suffered brain damage can use VR,¹ whether what is learned in VR transfers to the real world,² and the implications of active interaction vs. passive manipulation within virtual environments.³ Experiments have encompassed individuals who have suffered brain damage as a result of vascular,¹ traumatic,⁴ degenerative,⁵ and developmental factors.⁶

Memory impairments are one of the most disabling consequences of brain injury.^{7,8} They can be problematical to assess, as conventional "paper and pencil" neuropsychological tests of memory and cognitive function do not adequately cover important aspects of everyday memory, such as prospective memory (remembering to perform actions in the future) and incidental memory (the encoding and recall of memories without any instructions from a third party).⁹ Paper and pencil tests have also been heavily criticized as lacking "ecological validity."¹⁰ Unfortunately, it can be very difficult to achieve ecological validity without compromising experimental control.

Virtual environments provide an elegant solution to the problem of developing memory tests and rehabilitation strategies that are valid from both empirical and ecological standpoints. In spite of this, it is probably fair to argue that research into memory assessment and rehabilitation in VR has been under-exploited. However, some progress has been made; for example, researchers have developed VEs to: assess incidental and spatial memory via active interaction and passive observation^{1,11}; enhance the restoration of memory function in individuals with dementia¹²; facilitate in the reorganisation of memory skills to use unimpaired functions in order to train patients with amnesia to navigate around a rehabilitation ward^{13,14}; encourage the development of spatial memory in children

whose physical disabilities restrict their mobility^{15,16,17}; and motivate patients with traumatic brain injury (TBI) to participate in exercise in order to stimulate memory remediation.¹⁸ There has also been some preliminary research on prospective memory in patients who have suffered a stroke¹⁹ and older individuals.²⁰ Finally, using VR together with fMRI offers exciting opportunities to address the neurophysiological basis of different types of memory.²¹ These, and other possibilities, are discussed.

This paper evaluates the current state of research on the applications of VR to memory assessment and rehabilitation, proposes some directions for future research, describes some recent work on VR and prospective memory being conducted at UEL, and suggests a strategy for turning our research findings into real benefits for patients.

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Contact:

Paul Penn Ph.D
 School of Psychology.
 University of East London. UK.
 Telephone: +44(0) 208 223 [4424|4425|4500]
 E-mail: P.R.Penn@uel.ac.uk

Presenter: Thomas Penzel PhD

NEW SENSOR DEVELOPMENT FOR THE DETECTION OF SLEEPINESS IN THE WORK AND TRAFFIC ENVIRONMENT AND SLEEP LABORATORIES

T. Penzel¹, H.F. Becker¹, I. Lekka², E. Bekiaris³

¹ Hospital of Philipps-University, Dept. of Internal

Medicine, Pneumology, Marburg, Germany
² Aristoteles University of Thessaloniki, Greece
³ Centre for Research and Technology Hellas, Hellenic Inst. of Transportation, Thessaloniki, Greece

Research status: In Progress

Background

Sleepiness in the work and traffic environment can cause severe accidents. Sleepiness is either the consequence of sleep loss or sleep deprivation or of a sleep disorder. Car accidents have more fatal outcomes at night than during the day. Drowsy or sleepy drivers and workers at monitoring tasks do have a slower response to react adequately to alarms or dangerous situations. Therefore there is a need to monitor sleepiness in such circumstances.

Methods: A European project uses existing technologies and sensors to develop new integrated systems in order to detect a lower vigilance at an early stage. Definitions for the different levels of sleepiness were developed based on monitoring of brain function¹ and autonomous nervous system functions.² The most sensitive parameters will be chosen in order to monitor sleepiness without impairment of the driver or worker. An alarm or other adequate feedback will be developed in order to create awareness to the driver or worker. The same sensors are also used for the medical applications in order to diagnose sleep disorders. The specific challenge is to detect sleep disorders at an early stage in order to initiate prevention programs.

Results

A set of important signals for the identification of sleepiness has been identified. The electroencephalogram, the electromyogram, and heart rate are sensitive signals. Among all sleep disorders the most prevalent sleep disorders are addressed. These are insomnia, sleep disordered breathing, periodic limb movements during sleep, and narcolepsy. Application scenarios for work environment as well as for diagnostic and treatment approaches were defined.

Conclusions

The definitions reached up to now allow to specify systems for use in the work and traffic field as well as in the medical environment.

The new developed sensors and analysis algorithms are then applied in sleep laboratories and intensive care medicine with monitoring demands. Wireless data transmission based on body area network technologies is of major importance for these applications.

Novelty

Existing applications in sleep diagnosis are based on wired technology and are restricted to hospital based sleep laboratories. The new systems will allow a medical diagnosis in outpatient settings with the same signal quality as reached in the hospital until now. The systematic approach to signals and parameters will enable the development of improved algorithms for diagnosis. Sensors technology developed for automotive purposes can be reused in medical diagnostic environment.

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Contact:
 Thomas Penzel
 Hospital of Philipps-University
 Depart. of Internal Medicine
 Marburg, D-35033
 Germany
 Phone: +49-6421-2866435
 Fax: +49-6421-2865450
 Email: penzel@med.uni-marburg.de

Presenter: Alessandra Preziosa

MOBILE NARRATIVES TO IMPROVE THE QUALITY OF LIFE: AN EXPERIMENTAL RESEARCH

Preziosa, A., A. Grassi, D. Villani, F. Mantovani, Ph.D, J. Waterworth Ph.D, J. Freeman Ph.D, G. Riva

Applied Technology for Neuro-Psychology Lab
 Istituto Auxologico Italiano

Abstract

The market of mobile phones is increasing quickly and now account for shipments of over 400 million units per year. The mobiles of new generation bring much functionality, as PDA, cameras, gaming devices, or media players. These innovations will grow in the next years, so a new generation of hardware-accelerated mobile devices will soon be joined by a suite of emerging 3D software standards that gives developers the ability to create interactive content and applications that haven't been possible before.

In this context, mobile narratives are emerging as possible applications. Mobile narratives are interactive multimedia experiences implemented on mobile devices, in which the narrative component is a critical aspect to create a feeling of presence and engagement.

The mobile narratives, through the link between the feeling of presence and the emotional state, may be used to improve the mood state in the users. In particular, mobile narratives may be used for both modifying the user's mood and helping him to relax, enhancing his well-being.

Relaxing is a difficult activity, especially in everyday life. Many of us are usually involved in stressful situations far away from the context required by the classical relaxation techniques. In this study - supported by the Italian "NeuroTiv" MIUR FIRB research project¹ we developed a mobile narrative for UMTS phones to be used by commuters to improve their well-being. The narrative, based on a trip in a desert tropical island, relaxes the user through different audio-visual experiences. They include the exploration of the island and different relaxation techniques based on the Progressive Relaxation protocol developed by Jacobson.²

The experimental sample is composed by 90 commuting students, aged between 20 and 24, randomly divided in 3 different conditions: the experimental group, which experienced the mobile narrative during their daily train trip; a first control group, which experienced a relaxing new age DVD during their train trip; and a second control group, which experienced the train trip only.

Each subject was submitted before and after the experience to the following questionnaires the PANAS (*Positive and Negative Affects*

Schedule)³ and the STAI (*State Trait Anxiety Inventory*).⁴

The final results will be presented at the Cybertherapy 2005 conference.

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Contact:
 Alessandra Preziosa
 Applied Technology for Neuro-Psychology Lab
 Istituto Auxologico Italiano
 Via Pelizza da Volpedo 41
 Milan, Italy
 Ph./Fax +39-02-619112892
 Email: a.preziosa@auxologico.it

Presenter: Patrice Renaud PhD

THE RECORDING OF GAZING RESPONSES IN VIRTUAL IMMERSION: A NEW CLINICAL TOOL TO ASSESS SEXUAL PREFERENCES IN PARAPHILIAS

Patrice Renaud, Ph.D.¹, Jean Proulx, Ph.D.², Joanne L. Rouleau, Ph.D.², Stéphane Bouchard, Ph.D.¹, Gina Madrigano, Ph.D.³, John Bradford, M.D.³, Paul Fedoroff, M.D.³

¹ Département de psychoéducation et de psychologie, Université du Québec en Outaouais

² Université de Montréal

³ Forensic Program, Royal Ottawa Hospital

Research status: In progress

Sexual preferences are usually assessed either by resorting on sexual responses recorded with a penile plethysmograph or by using visual reaction time from stimuli with

sexual content. However, numerous shortcomings come with penile plethysmography and visual reaction time, and notably voluntary erectile control and not paying attention to stimuli, which are important threats to the internal validity of these assessment procedures. In order to get round these limitations, we developed a method that controls gazing activity relative to sexual avatars. A study is conducted using our method that is aiming at assessing sexual preferences with sex offenders and control subjects interacting with sexual avatars.

Background

Sexual preferences are usually assessed either by resorting on sexual responses recorded with a penile plethysmograph or by using visual reaction time from stimuli with sexual content. However, numerous shortcomings come with penile plethysmography and visual reaction time, and notably voluntary erectile control and not paying attention to stimuli, which are important threats to the internal validity of these assessment procedures. In order to get round these limitations, we developed a method that controls gazing activity relative to sexual avatars. A study is conducted using our method that is aiming at assessing sexual preferences with sex offenders and control subjects interacting with sexual avatars.

Methods

Our method relies upon a technological setting including what is usually necessary to present virtual environments in immersion plus equipments dedicated to eye-movements tracking from within a head mounted display (HMD). A special mounting built from a monocular infrared eye-tracking system combined within a binocular HMD is used to track eye-movements. Head-movements are recorded from a magnetic tracking system rendering the 6 degrees-of-freedom (DOF) of translation and rotation. Our method performs gaze analysis by the way of virtual measurement points (VMP) placed on virtual objects for the analysis of eye-movements in relation to specific features of these objects. Gaze radial angular deviation (GRAD) from the VMP is given by the combinations of the 6 DOF developed by head-movements and the x and y coordinates rendered by the eye-tracking system. The VMP is locked to virtual objects and moves jointly with them. While the variations in the 6 DOF

developed by head-movements define changes in the global scene presented in the HMD, the 2 DOF given by the eye-tracking device allow the computation of the exact position of the line of sight relative to the VMP. As other physiologic signals, we also measure the subject's distance from the VPR, the pupil size diameter, the blinking response and the erectile response recorded with a penile plethysmograph. The 3D stimuli that we used are animated naked human models.

Results

Preliminary results from sex offenders and control subjects will be presented. These results will consist in analyses performed on time series coming from oculomotor and other physiologic responses recorded in immersion.

Novelty

The novelty of this method for assessing sexual preferences was acknowledged at the last Conference of the Association for the Treatment of Sexual Abusers held October 2004 in Albuquerque (NM). These results inscribe themselves in the extension of our past studies whose goal was mainly to make sense of the perceptual and motor dimensions of virtual immersion.¹⁻⁵ They also pave the way to interactive behavior and perception modification therapies based on eye-tracking recorded in VR.^{6,7}

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Contact:

Patrice Renaud, Ph.D.
Laboratoire de cyberpsychologie
Université du Québec en Outaouais
Institut Philippe-Pinel de Montréal
C.P. 1250, Succ. B
Gatineau (Québec) Canada, J8X 3X7
Tel. : 819 595 3900
Email: patrice.renaud@uqo.ca,

Presenter: Giuseppe Riva PhD

VIRTUAL REALITY IN EATING DISORDERS AND OBESITY: STATE OF THE ART AND FUTURE DIRECTIONS

Prof. Giuseppe Riva, Ph.D.

Applied Technology for Neuro-Psychology Lab
Istituto Auxologico Italiano

The first study describing the possible use of virtual reality in the treatment of eating disorders and obesity was published in 1995. Since then, different researchers have been studying the possible advantages of virtual reality as experiential technique able to modify the body image, self-efficacy and emotional control of the patient.

This presentation will review the state of the art in this research field. In particular, it will discuss the result coming from different controlled trials comparing this approach with competing techniques.

Further, the presentation will address the future directions of this method focusing on the possible opportunities coming from Internet and mobile devices.

Presenter: Albert "Skip" Rizzo PhD

GAMES FOR HEALTH: GAME-BASED VIRTUAL REALITY APPLICATIONS FOR MENTAL DISORDERS & REHABILITATION

Albert "Skip" Rizzo¹, Jarrell Pair, Galen Buckwalter, Jeff Gold, Carolee Winstein, Margaret McLaughlin, Ken Graap, Brenda Wiederhold

¹ University of Southern California Institute for Creative Technologies

The rapidly growing popularity of digital gaming has driven advances in game-based technology that has now added new momentum to the vision of creating immersive and interactive experiential opportunities for a wide range of human needs beyond just the entertainment value that come from playing games. In addition to the readily intuitive application of game-based learning for education and training purposes (Prensky, 2001), the mental health and rehabilitation fields stand to substantially benefit from advances in this area. The integration of game technology and experiences with VR-based approaches for clinical assessment, treatment, and rehabilitation offers powerful options that could revolutionize standard practices in these fields. Thus far, the integration of gaming features into a VE has been reported to enhance motivation in adult clients undergoing physical and occupational therapy following a stroke (Jack et al, 2001; Kizony, Katz & Weiss, 2003) and to reduce acute pain during medical procedures (Hoffman et al., 2000). As well, Strickland (2001) reports that children with autism were observed to become very engaged in the VR safety training applications that she has developed which incorporate game features. Further anecdotal observations suggest that children diagnosed with Attention Deficit Hyperactivity Disorder

often have a fascination for the type of stimulus environments that are presented in computer/video games (Greenhill, 1998). Parents are often puzzled when they observe their children focusing on computer games intently, while teacher reports indicate inattention in the classroom. Additionally, in the presenter's previous clinical experience, it was anecdotally observed that certain young adult traumatic brain injury clients, who had difficulty maintaining concentration on traditional cognitive rehabilitation tasks, would easily spend hours at a time playing the computer game "SimCity." These observations suggest that designers of clinical assessment and treatment tasks could benefit from examining the formulas that commercial game developers use in the creation of interactive digital games. These formulas govern the flow and variation in stimulus pacing that provide linkage to a progressive reward and goal structure. When delivered within a highly interactive graphics-rich environment, users are commonly observed to become extremely engaged in this sort of game play. This presentation will describe a variety of ongoing projects at USC that integrate game technology with VR-based applications for the assessment, treatment and rehabilitation of cognitive, psychological, emotional, and physical disorders. These projects have focused on the development of applications for:

1. Attention process assessment in children with ADHD
2. Pain distraction in children undergoing painful medical procedures and chemotherapy
3. Exposure therapy in returning Iraq War veterans with PTSD
4. Motor rehabilitation for persons with central nervous system dysfunction (i.e. stroke, brain injury)

These applications have leveraged the assets that have come from advances in both game engine technology and from the unique experience that is fostered from the psychologically involving act of game play. Such USC initiatives may provide hope that innovative methods can be created to advance these areas that have long been mired in the methods of the past. My presentation will begin with an introduction on how and why game assets can be used to create applications in mental health and rehabilitation and then will review the data/status of our various projects.

Contact:
 Albert "Skip" Rizzo
 University of Southern California
 Institute for Creative Technologies
 13274 Fiji Way
 Marina del Rey, CA, 90292
 Phone: 213-610-4737
 Email: arizzo@usc.edu

Presenter: Albert "Skip" Rizzo PhD

FROM TRAINING TO TOY TO TREATMENT: PRELIMINARY RESULTS FROM A VR THERAPY APPLICATION FOR IRAQ WAR MILITARY PERSONNEL WITH COMBAT-RELATED PTSD

Albert "Skip" Rizzo¹, Jarrell Pair, Peter J. McNerney, Ernie Eastlund, Brian Manson, Jon Gratch, Randy Hill, Michael Roy*, Bill Swartout, Ken Graap & Brenda Wiederhold

¹ University of Southern California Institute for Creative Technologies

In 1997, researchers at Georgia Tech released the first version of the Virtual Vietnam VR scenario for use as a graduated exposure therapy treatment for PTSD in Vietnam veterans. This occurred over 20 years following the end of the Vietnam War. During that interval, in spite of valiant efforts to develop and apply traditional psychotherapeutic approaches to PTSD, the progression of the disorder in some veterans severely impaired their functional abilities and quality of life, as well as that of their family members and friends. Prior to the availability of VR therapy applications, the existing standard of care for PTSD was imaginal exposure therapy. Such treatment typically involves the graded and repeated imaginal reliving of the traumatic event within the therapeutic setting. This approach is believed to provide a low-threat context where the patient can begin to therapeutically process the emotions that are relevant to the traumatic event as well as de-condition the learning cycle of the disorder via a habituation/extinction process. While the efficacy of imaginal exposure has been established in multiple studies with diverse trauma populations (Rothbaum & Schwartz, 2002), many patients are unwilling or unable to effectively visualize the traumatic event. With this history in mind, the USC Institute for Creative Technologies (ICT) has initiated a project

that is creating an immersive virtual environment system for the treatment of Iraq War military personnel diagnosed with combat-related PTSD. The treatment environment is based on a creative approach to recycling virtual assets that were initially built for a combat tactical simulation scenario entitled Full Spectrum Command, and later licensed to create the commercially available X-Box game, Full Spectrum Warrior.

Thus far we have created a prototype virtual environment designed to resemble a Middle Eastern city. We intend to use this VE for initial clinical and patient user testing to gather feedback to refine the city scenario and for the future expansion of the system to include other relevant scenarios (e.g. outlying village and desert scenes, etc.) and user perspectives. We have also created an initial version of a "wizard of oz" type clinical interface. This interface is a key element in that it will provide a clinician with the capacity to customize the therapy experience to the individual needs of the patient by placing them in VE locations that resemble the setting in which the traumatic events initially occurred. The interface will also allow the therapist to gradually introduce and control "trigger" stimuli in the environment in real time as is required to foster the anxiety modulation needed for therapeutic habituation. This presentation will discuss the vision, rationale and user-centered development status of the Full Spectrum PTSD treatment system that is currently in progress at the ICT. As well, initial results will be presented from ongoing user-centered design trials that are part of the development of this immersive VR application for this highly relevant mental healthcare problem.

Contact:
Albert "Skip" Rizzo
University of Southern California
Institute for Creative Technologies
13274 Fiji Way
Marina del Rey, CA, 90292
Phone: 213-610-4737

Presenter: Geneviève Robillard MSc

COMPARATIVE STUDY OF IMMERSION TECHNOLOGY FOR A VIRTUAL BICYCLE

Geneviève Robillard, M.Sc.¹, Stéphane Bouchard, Ph.D., & Judith Lapierre, Ph.D.

¹ University of Quebec in Outaouais

Background

Virtual reality (VR) can become a useful tool to overcome obesity, especially for youngsters, considering its similarity to video games. This comparative study aims to assess what type of immersive display is preferred by youngsters for using a virtual bicycle. This is the first step in the development of a program to enhance motivation in obese youngsters to exercise.

Method/Tools

Twenty-one healthy participants aged 10-18 years old (mean age = 12.5, 52.4% male) were immersed three times (three minutes each) in a virtual environment using a different type of technology for each immersion (HMD, projector, television). The order of immersive technology was randomly assigned. The hardware used was a 10-speed bicycle connected to an I-Magic® VR trainer steering with an integrated tracker connected to a Pentium III® 866 Mhz PC. The HMDs used were an I-Visor® for half of the participants and an I-Glass®. An Eiki® LCD multimedia projector and a Sony® 27-inch television were used. Pre-post measures of Immersive Tendencies and the Simulator Sickness were completed. Subjective measures were administered after each immersion for presence, cybersickness, and preferences.

Results

Participant significantly preferred the HMD over the projector and the television. They felt more "present" using the HMD but also more cybersickness. No significant difference was found in the preference for the television vs. projector. Immersive Tendencies correlates significantly with presence when HMD was used.

Conclusion

Results indicate that levels presence, preference, and cybersickness are higher when using a HMD. Considering the purpose of this study, cybersickness has to be acknowledged since obese youngsters will use the virtual bicycle for a longer periods. The projector and television still had a high level of interest for participants and low cybersick-

ness. LCD projectors are the best technology to use as an immersive display for virtual exercises.

Contact:
Geneviève Robillard, M.Sc.
University of Quebec in Outaouais
Cyberpsychology Lab
Gatineau, Quebec J8X 2B7
Canada
Phone: (819) 776-8045
Fax: (819) 776-8098
Email: genevieve_robillard@ssss.gouv.qc.ca

Presenter: Ricardo Ron-Angevin

DEVELOPMENT OF A BRAIN-COMPUTER INTERFACE (BCI) BASED ON VIRTUAL REALITY TO IMPROVE TRAINING TECHNIQUES

Ricardo Ron-Angevin, PhD candidate,
Antonio Díaz-Estrella, Arcadio Reyes-Lecuona

Departamento de Tecnología Electrónica,
Universidad de Málaga

Research Status: In progress.

Background/Problem

A brain-computer interface (BCI) is based on the analysis of the electroencephalographic signals (EEG), recorded during certain mental activities, to control an external device. One of its main uses could be in the field of medicine and especially in rehabilitation. It could help to establish a communication and control channel for people with serious motor function problems but without brain function disorder.

Performance of BCI will depend, especially, on the ability of subjects to control their EEG patterns being necessary to provide suitable training. The vast majority of research in the BCI field puts emphasis on the importance of developing training methods based on bio-feedback techniques that would improve human performance.

Training in BCI consists on carrying out some trials, repeated times, being very important to provide some type of feedback allowing subjects to see their progress [1]. Training protocols must not be chosen at random. On the contrary, in many cases, they must adapt to

the subject to be effective. To design a suitable training protocol, it would be interesting to study possible effects that different type of feedback can have on subjects. Feedback may help subjects to improve their EEG control, but sometimes its effects can be frustrating. Besides, conventional systems of feedback, such as cursor control or horizontal bar extension can prove somewhat boring, leading to a lack of motivation.

Method/Tools

To avoid this problem, feedback must be attractive, motivating subjects to control their EEG signals. For this, a good option is the use of techniques based on virtual reality [2], combining 3D display, sound and isolation. Using these techniques, a more natural interaction can be achieved, isolating subjects from distraction, and providing a more immersed and motivating environment. Based on virtual reality techniques, a new type of BCI system to enable to establish the appropriate feedback allowing subjects to get better control of EEG signals, is developed.

Results

This BCI allows to set parameters related to training paradigm timing (- duration, repetitiveness and pause between trials, - duration of the feedback period, - duration of the session), the type of feedback (continuous or discrete feedback) and the presentation of feedback selecting different scenes. Due to trial repetitiveness, interface were designed to be as appealing and motivating as possible. It was decided to submit subjects to a more familiar environment, such as controlling a car to avoid crashing it into a wall, to avoid logs in the road, or to reach a ramp that would make the car jump. Preliminary results show how this new system can be useful to study and to improve training protocol in BCI.

Conclusions

The new BCI system is very promising, providing an attractive training to the subject and allowing to adapt training protocols to be effective.

Novelty/Discussion

One of the differences of this new system, compared to conventional feedbacks, such as cursor control or horizontal bar extension, is the use of virtual reality to provide feedback with more immersive and motivating effects.

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Contact:
Ricardo Ron-Angevin
Departamento de Tecnología Electrónica
Universidad de Málaga
Campus de Teatinos s/n 29071
Málaga, Spain
Phone: +34-952132897
Fax: +34-952131447
Email: rra@dte.uma.es

Presenter: Michael J. Roy MD MPH

USE OF STANDARDIZED PATIENTS AND COMPUTER-BASED SIMULATION FOR PHYSICIAN EDUCATION ON BIOTERRORISM

Michael J. Roy, MD, MPH

Uniformed Services University, Bethesda, MD

Continuing medical education has historically been provided largely through didactic classroom-style teaching. However, educators have identified this as one of the least effective methods of adult education. Adult learners are far more likely to retain new information that is required through experiential or self-directed learning. In addition, many young adults today have come of age with significant experience with computer-based or "video" games. Comfort with new technologies renders new physicians and physicians-in-training ripe for medical education that engages them through such technologies. Simi-

larly, it provides an opportunity to enhance treatment of their patients through such modalities.

We report our experience with the use of standardized patients (SPs) in educating physicians regarding the diagnosis and treatment of biological and chemical warfare agent exposure. We trained professional actors to serve as SPs representing exposure to the biological agents anthrax, smallpox, botulinum toxin, and staphylococcus enterotoxin B (SEB). We conducted workshops at two national medical meetings, with workshop participants rotating in small groups through a series of teaching stations where they were able to perform a medical history and physical examination, order tests, make a diagnosis, and establish a management plan. Workshop staff physicians then conducted discussions and emphasized key teaching points. In addition, we trained SPs to simulate a mass casualty (MASCAL) incident involving a terrorist spraying a liquid on a city bus, once using sarin, and in another case using hydrochloric acid. All workshop participants worked together to treat MASCAL victims, followed by debriefing and discussion.

We also describe a current project to develop computer-based interactive modules of simulated patients exposed to smallpox, anthrax, and other biological and chemical agents. The nature of the program allows the user to go through the simulation repeatedly, with a different presentation each time, based partly on the questions they pose and the way they ask them, as well as by chance. The program provides feedback on each question and on the overall conduct of the interview.

The advantages and disadvantages of each of these methods will be discussed.

Contact:
Michael J. Roy, MD, MPH
Professor of Medicine
Uniformed Services University
Bethesda, MD
USA

Presenter: Jaime Sánchez PhD

TRAINING BLIND CHILDREN TO DEVELOP MATHEMATICS SKILLS THROUGH AUDIO

Jaime Sánchez, Ph D.

University of Chile

It is well known that mathematics allow us to abstract and understand our surrounding world. Thus an early training to people in mathematics can help to develop better learning skills. People with visual disabilities can not learn mathematics easily. Mathematics is developed, represented, and communicated basically through visual means such as in algebraic expressions, graphs, and geometric figures. A few studies have approached this issue by studying new interfaces for mathematics learning.¹⁻⁴

This research analyses how audio-based technology can be used as a powerful tool to train blind children to learn mathematics concepts. We introduce and analyze three audio-based software products to develop mathematics skills.

AudioMath is an audio-based interactive application that mimics the social board game Memory.^{5,6} The child has to open pairs of tokens in a board with several levels of difficulty to find the corresponding pair of tokens in accordance with the mathematical content such as correspondence and equivalency relationships, memory development, and differentiating tempo-spatial notions.

Theo & Seth is an audio-based interactive virtual environment to enhance learning of number and basic operations with different levels of complexity. The metaphor used resembles a grange with two major virtual environments: the kitchen and the henhouse. The kitchen covers cardinality including the number, the position in the numerical straight line, information about the antecessor and successor; and the introduction of ordinal numbers. The henhouse is a virtual space where learners learn how to do sum and rest.

AudioGeometry is based on Van Hiele's model of geometric thinking and serve as a guide for instruction and evaluation of geometric skills. The software is implemented with a useful scheme to organize content (plane figures, area, and perimeter). AudioGeometry consists of identifying, recognizing, and naming polygons and related elements as well as measuring geometric figures and calculating areas and perimeters of plane geo-

metric figures.

We have tested these audio-based products with twenty blind learners from 7 to 15 years old in a school setting by using tests for mathematics knowledge and thinking, and audio memory. We implemented a case study by doing cognitive introspection during and after each task. Children were exposed to software with formal activities and solved related cognitive tasks during six months. We have preliminary evidenced that the use of audio-based software with related cognitive tasks can help to develop mathematics thinking and knowledge. Blind children have shown positive gains in learning addition, subtraction, multiplication, and division after interaction with audio-based virtual environments. They have improved the development and use of mathematics skills.

A usability evaluation was also implemented during and after the implementation. Children enriched the software after evaluating different modules during implementation and helping us to map their mental models.

Finally, this study adds preliminary knowledge to the field of learning of mathematics in blind children. We are beginning to understand how audio-based interfaces can help to develop mathematics knowledge and skills in blind learners.

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Contact:

Jaime Sánchez, Ph D.
Department of Computer Science
University of Chile
Blanco Encalada 2120
Santiago, Chile

Presenter: Richard Satava MD

ADVANCED TECHNOLOGIES FOR REHABILITATION

Richard Satava, MD

Telemedicine and Advanced Technology Research Center (TATRC)

Numerous technologies, such as virtual reality, brain-machine devices, nanotechnology, intelligent prosthetics, robotics, and artificial organs to name a few, are opening new opportunities for rehabilitation. Current programs which include exoskeletons and intelligent prostheses for rehabilitation will focus mainly on how the engineering sciences are revolutionizing care of the disabled and disadvantaged. Finally we are able to bring new technologies to restore function and sometimes realistic form for those systems which are lost or incapacitated.

Presenter: Richard Satava MD

THE REVOLUTION IN HEALTHCARE ROBOTICS

Richard Satava, MD

Telemedicine and Advanced Technology Research Center (TATRC)

Robotics has moved from industry to health-care, creating a new revolution. The concepts behind this profound revolution are discussed, and the various classes of robots are demonstrated, along with their remarkable capabilities - from 'robotic cells' to replacing entire operating room teams, to moving robotic systems and medevacs on the battlefield, to mobile robots (unmanned vehicles) to make rounds for the doctor and nurse. Finally speculation on the logical future that will emerge once these robotic systems are truly embraced by the medical profession

Presenter: Ben Sawyer

GAMES FOR HEALTH: THERAPY AND BEYOND

Ben Sawyer

Woodrow Wilson International Center for Scholars

In the therapy field the use of virtual reality (VR) and game technologies has been a growing force for some years but the greater health field is just tuning in to the possible uses of games and game technologies. The Games for Health project is a Robert Wood Johnson Foundation effort designed to both explore and identify relevant uses for game technologies and the talents that produce them that could offer breakthroughs in healthcare from training, to health messaging, to direct patient application.

During this presentation Ben Sawyer who leads day-to-day activities on the games for health project will discuss the current trends in the games for health field. With the assistance of several other presenters the session will also highlight the logistical and industrial cultural issues which must be hurdled to further the promise game technologies and approaches have shown.

Attendees will not only get a sense of the current best practices but also get a keen sense of the comparative advantages (and disadvantages) game-based approaches are seeking to offer the health field.

PresenterL Thomas Senn

ISLANDS - E -MENTAL HEALTH - TELEPSYCHIATRY

Thomas Senn

COAT-Basel

An overview of the European project ISLANDS will be provided. Which services are feasible and which are desired, which are promising? The ISLANDS project will be embedded in e-health and e-mental health. The persons involved, the services provided and the tools used will then be explained. Different questions will be touched: How can information of counselling and therapy be formalised for persons that are indirectly involved (informal carer) in the therapeutic process? What are the process dynamics within an online therapy? Which patient - therapist relationships can evolve? Which are the limits of e-mental health service provisions?

Within ISLANDS, a cognitive behavioural approach for the therapy module was chosen; other forms of therapy are imaginable. Details about our approaches will be delivered.

Counselling is part of a comprehensive model that is founded on several assumptions about human development: e.g., individuals achieve optimal functioning when they attain operational mastery of fundamental life skills and neurosis and functional psychosis frequently result from failure to develop certain life skills.

Further an overview of technological means in which ISLANDS can be embedded in the future is given. Visions for the future are outlined.

Contact:
Thomas Senn
COAT-Basel
Basel 4025 CH
Tel: +41613255669
Email: ths@coat-basel.com

Presenter: Takanori Shibata PhD

A PROGRESS REPORT OF LONG-TERM ROBOT ASSISTED ACTIVITY AT A HEALTH SERVICE FACILITY FOR THE AGED

Kazuyoshi Wada¹, Takanori Shibata^{1,3}, Tomoko Saito¹ Kayoko Sakamoto¹ and Kazuo Tanie²

¹Intelligent Systems Research Institute, National Institute Advance Science and Technology (AIST) 1-1-1 Umezono, Tsukuba, Ibaraki 305-8568, JAPAN

²National Institute Advance Science and Technology (AIST)

³PERESTO, JST

Background

We have proposed Robot-Assisted Therapy and Activity since 1996, and have been developing mental commit robots that provide psychological, physiological, and social effects to human beings through physical interaction^{1,9)}. The appearances of these robots look like real animals such as cat and seal. The seal robot, Paro, was developed especially for therapy. We have applied seal robots to therapy of children at pediatric hospitals⁴⁾ and to assisting activity of elderly people at a day service center⁵⁻⁷⁾. Recently, several research groups have tried robot-assisted therapy and activity. Dautenhahn has used mobile robots and robotic dolls for therapy of autistic children¹⁰⁾. Besides, robot-assisted activity that uses commercialized animal type robots (such as AIBO¹¹⁾, Ne-CoRo, etc.) has been tried¹²⁻¹⁴⁾. For example, Yokoyama used AIBO in a pediatric ward, and observed the interaction between children and pointed out that the initial stimulus received from AIBO was strong. However, the long term stability was quite weak, compared with living animals¹²⁾. In this presentation, we will explain the results of the robot-assisted activity for elderly people at a health service facility for the aged for more than *one year*.

Method

In order to investigate the effects of seal robots to the elderly people, we evaluated moods of elderly people by face scales¹⁵⁾ that express person's moods by illustration of person's faces, questionnaires of Geriatric Depression Scales (GDS)¹⁶⁾. Seal robots were provided into the health service facility on two days per a week from Aug. 2003.

Results

The results of face scale and GDS showed that feelings and depression of elderly people

were improved by interaction with the seal robots, Paro. Regarding a case study, Hanako (pseudonym), aged 89, was sociable and comparatively independent. On the first day of the interaction with Paro, she looked a little nervous of the experiment. However, she soon came to like Paro. She treated Paro like her child or grandchild. Her face scale scores after interaction were always lower than before interaction after the first day. Unfortunately, she was hospitalized during Dec. 10 to 26, 2003. When she met Paro for the first time after leaving hospital, she said to Paro "I was lonely, Paro. I wanted to see you again." Her GDS score then improved. To the present, she has continued to join the activity and willingly interacted with Paro. Caregivers commented that interaction with Paro made the people laugh and become more active. For example, their facial expression changed, softened, and brightened. In addition, Paro encouraged the people to communicate, both with each other and caregivers, by becoming their common topic of conversation. Thus, the general atmosphere became brighter.

Conclusions

We have used seal robots, Paro in RAA for elderly people at a health service facility for the aged since August 2003. The results showed that interaction with Paro improved their moods and depression, and then the effects showed up through more than one year. Consequently, the seal robots, Paro were effective for therapy at health service facilities.

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Contact:
 Takanori Shibata
 Intelligent Systems Research Institute
 National Institute Advance Science and Technology (AIST)
 1-1-1 Umezono, Tsukuba
 Ibaraki 305-8568, JAPAN
 Tel.: +81-29-861-5980
 Fax: +81-29-861-5992
 Email: shibata-takanori@aist.go.jp

Presenter: Russell Shilling PhD

THE OFFICE OF NAVAL RESEARCH PROGRAM IN VR THERAPY AND THE USE OF "SERIOUS GAMES" AND ENTERTAINMENT TECHNOLOGIES FOR MEDICAL SIMULATION

CDR Russell Shilling, Ph.D.

Office of Naval Research

Increasingly, virtual reality (VR) and videogame technologies are garnering more interest in the medical community. At the Office of Naval Research (ONR), programs have been initiated which look at treatments for combat-related Post-Traumatic Stress Disorder (PTSD) and also evaluate a wide variety of VR medical training platforms. ONR is also assisting the Defense Advanced Research Project Agency (DARPA) in developing innovative treatment options for amputees using videogame technology. One of the underlying philosophies that unify these different programs is the belief that emotion is a crucial component for effective simulation and that lessons learned from the entertainment industry need to be integrated into the development process. In the entertainment industry, sound design is recognized as a critical component in creating emotional content. Until recently, little effort was made to adapt professional sound design techniques commonly used in the entertainment industry for use in simulation. This talk will summarize programs sponsored by ONR to develop VR therapy applications for treating Sailors, Soldiers, and Marines. These PTSD programs will also be discussed in the context of research and development activities conducted by the author while acting as the sound designer, audio engineer, and research psychologist working on the popular videogame, *America's Army*. In the process of developing

the audio experience for the game, extensive consultations were made with leading experts and engineers from the movie and videogame industry. As a result, the game has received high reviews in the videogame industry for the quality of sound and has helped the game gain over 4-million registered users worldwide. These same sound design techniques and philosophies need to be incorporated in VR therapy applications to help maximize the emotional impact and increase the sense of immersion in the simulation. Important lessons were also learned concerning the videogame development process and how it relates to creating so-called "serious games" with goals other than entertainment. Current trends in the "serious" use of videogame technologies will be discussed, including the "Games for Health" Project which held its first annual conference in Madison, Wisconsin in 2004.

Contact:
 CDR Russell Shilling, Ph.D.
 Biological and Medical Science & Technology Division
 Office of Naval Research
 Arlington, VA 22217
 Email: Shilling85@alumni.wfu.edu

Presenter: Viktória Simon MD

CLINICAL EXPERIENCES IN USING VIRTUAL REALITY (VR) IN PSYCHOTHERAPY

¹Viktória Simon ¹MD, ¹Lajos Simon ¹MD, Phd, , ²Barnabás Takács Phd

¹Semmelweis University Budapest, Department of Psychiatry and Psychotherapy
²DigitalElite, Los Angeles (CA)

This year our team in the department of psychiatry and psychotherapy of Semmelweis University Budapest had the opportunity to create and try VR in treating phobic patients for the first time in Hungary. The programs that are available for us can be used for the therapy of travel-phobia (subway, driving, bus, airplane), acrophobia, claustrophobia. Beside learning the conditions and tools we make the first steps needed for exposition-therapy together with the patient. We teach also relaxation technics. For controlling the relaxation and the process of the exposition we are monitoring real-time the data of

physiological parameters provided by special biosensors.

After this training period, desensitization takes place in a virtual environment under the control of the therapist. In the different environments the therapist can change the parameters in order to get the phobic stimuli stronger or weaker.

Based on our first pilot-cases and experiences we can enforce that desensitization with VR:

- makes the therapy practically easier to carry out, also easier to control
- can be less dangerous than standard desensitization (thinking about acrophobia for example)
- easier to engage patients for therapy
- drop out is lower than in standard therapies
- the stimuli that reach the patient can be controlled more precisely, the reactions given by the patient to the environment can be measured more precisely.

Contact:
Viktória Simon MD
Semmelweis University Budapest
Department of Psychiatry and Psychotherapy
Fax: +36/1/2100-336
Email: simonviktoria@psych.sote.hu

Presenter: Oliver Stefani

NEXT GENERATION VIRTUAL REALITY SYSTEMS: FUTURE CHALLENGES

Oliver Stefani, Dipl.-Ing. Designer

COAT-Basel, Switzerland

Technologies that directly stimulate the brain to simulate reality still are science fiction. Therefore, current VR technologies are bound to the stimulation of the five human physiological senses. This paper discusses the state of the art of current Virtual Reality (VR) Systems and highlights their barriers and problems. The focus will be on stereoscopic display technologies, CAD-VR integration and interface technologies. We will give insights in the trends of new VR technologies which we identified within *VIEW of the Future*¹ and *INTUITION*² and provide some suggestions to improve current VR systems.

Reference

¹ IST-2000-26089

²Contract no.: 507248-2

Presenter: Julie St-Jacques

CLINICAL APPLICATIONS OF VIRTUAL REALITY AND CYBERSICKNESS

Julie St-Jacques Ph.D. candidate and Stéphane Bouchard Ph.D.

Université du Québec en Outaouais

For a few years, virtual reality (VR) has made its entry as a new therapeutic method, and more and more studies are documenting its effectiveness, especially for the treatment of anxiety disorders. Cybersickness is the principal counter-indication with the use of this therapeutic method and are also a major concern for many Research Ethics Boards. Very few studies have documented cybersickness in clinical populations and researchers as report very low symptoms. Moreover, our current knowledge on this question is often based on studies conducted either with very different populations (e.g., Navy pilots or astronauts) or with different tasks (e.g., search and rescue, complex motor tasks). These may not generalize well to clinical populations and therapeutic tasks. It is therefore important to document cybersickness in a way that is useful and applicable to clinical situations.

The goal of this study is to document cybersickness by collecting systematic data in children and adults. The sample of non phobic participants consisted of 23 children and 34 adults. Questionnaire and head motion data were recorded. In order to compare if the cybersickness reported by non phobics are equivalent with those reported by phobic participants, data from adult phobics are also used.

The results revealed few cybersickness symptoms. When comparing children and adults separately, there's no significant difference in cybersickness reported. A significant correlation is found between discomfort related to VR and the amplitude of head movements performed during the VR immersion. Finally, the relatively low level of

cybersickness reported is comparable between phobics and non phobics. The results obtained illustrate that VR is safe when used with healthy participants as well as when all the precautions to ensure their comfort are taken.

Contact:

Julie St-Jacques Ph.D. candidate
 Université du Québec en Outaouais
 23 Pharand Gatineau J9A 1K7
 Canada
 Tel: 1-819-771-7761 X 8392
 Fax: 1-819-776-8098
 Email: juliestjacques@netscape.net

Presenter: Hubert Sulzenbacher MD

TELECOMMUNICATION IN PSYCHIATRY: A NEEDS ASSESSMENT OF DIFFERENT POTENTIAL USER GROUPS IN THE "ISLANDS" PROJECT

Dr. Hubert Sulzenbacher

Department of Psychiatry
 Medical University Innsbruck, Austria

Geography influences access to mental health-care. There are some regions in the European Union with particular geographical characteristics, which are responsible for their being behind the average socio-economic development in Europe. In such regions there is a lack of access to modern health-care facilities, especially psychiatric and psychotherapeutic therapies. Telecommunication technologies, such as the telephone, interactive television, and the Internet, can provide feasible tools for diagnostic, counseling and therapy purposes to improve mental health-care in such disadvantaged areas. One has to differentiate between several users' needs. Persons who are suffering from a certain disorder are looking for different information, seeking different forms and content of help than their family members, partners, or friends do. All of them are involved in the disorder and its consequences. So are professionals who sometimes need advice, especially in state of the art treatment adjusted to their specific environment. "ISLANDS", a project funded by the Commission of the European Union (QLRT-2001-01637), aims to develop services to provide modular, remote psychiatric and psychotherapeutic assistance for remote areas. By these means quality of life of

the users, quality of mental health care and the economic strength of the region should improve and outweigh the costs of implementation and service support. In the project a questionnaire was developed to identify the needs of the potential user groups of such a service. This questionnaire was given to patients, family members, and therapists in five European regions to find relevant differences between urban centers and remote rural regions. The results of this survey showed a dissatisfying situation of mental health-care as well as of diffusion of telecommunication technologies in remote regions. We found little knowledge about and little experience with telepsychiatry and e-mental health, but all potential user groups showed positive attitudes towards the psychiatric use of telecommunication media, and most users were interested having a telepsychiatric or e-mental health service available.

Contact:

Dr. Hubert Sulzenbacher
 Department of Psychiatry
 Medical University
 Anichstrasse 35
 Innsbruck 6020, Austria
 Phone: 004351250423668
 Fax: 004351250423628
 Email: ullrich.meise@uklibk.ac.at

Presenter: Ioannis Tarnanas PhD

AROUSED AND IMMersed: INTRODUCING "VIRTUAL PAIN" INTO AN EXTREME TEAM TRAINING EXPERIENCE

Ioannis Tarnanas PhD

Kozani University of Applied Science, Greece

Biocybernetics approaches for promoting human-system compatibility continuously adjust the challenge level of a task to match the available resources of the human operator based on his/her psycho physiological state. This project expands the scope of biocybernetics to teams. The objective of this project was to test the effectiveness of a selected training intervention enabled by VE technology. The training intervention that was selected was the use of an advanced team human-computer interface to enhance VE training effectiveness. Specifically, this project tested the effects of one operator's psy-

cho-physiological fear and anxiety measures, to another operator's explicit display of control "difficulty", represented in a force feedback Joystick ("virtual pain"), to handle cues in a counter strike wargame simulation. Prior research work indicated that social psycho physiological compliance can predict team performance in a projective tracking task (Tarnanas, et al., 2003). Two instructional VE were presented. One VE was using the explicit biocybernetic interface that challenged the self-efficacy and team decision making of the operators in a crisis situation scenario, by linking their heart rates (ECG), electrodermal activity (EDA) and electromyogram measurements of facial muscle tensions (EMG) with a Force Feedback Joystick of controlled "ease" of movements while engaged in a joint task. The second VE was the same team crisis situation environment as the above, but without the introduction of the advanced biocybernetic interface. In both the scenarios the operators had the freedom to communicate verbally while engaged in the common task. Two performance measures were computed: (a) RMS error, and (b) number of groundings. Analyses of RMS error scores indicate that performance improved over the three repeated runs with each VE, as evidence of specific-channel learning. Similarly, performance improved on the first run from Day 1 to Day 2, as evidence of near-transfer learning. However, the advanced biocybernetic interface provided to the first experimental group, provided an additional important statistical performance improvement relative to the "simple" VE group and the control groups. The mapping between the type of user-operator state and the type of medium response also had an influence on the level of presence. This project suggests that social-psycho physiological measures and team biocybernetics merit further investigation in sociotechnical systems that demand high proficiency and self-efficacy.

Contact:

Ioannis Tarnanas PhD
Kozani University of Applied Science
Thessalonica, 1st Emm. Papa street
55236 Kozani, Greece
Phone: +302310344831
Fax: +302310344810
Email: ioannist@auth.gr

Presenter: Sharon Tettegah PhD

EXPLORING ANIMATED NARRATIVE VIGNETTE TECHNOLOGY TO UNDERSTAND EMPATHY, AGGRESSION AND RACIAL IDEOLOGIES WITH MIDDLE SCHOOL YOUTHS

Sharon Tettegah, Ph.D., Helen Neville, Ph.D.

University of Illinois, Urbana Campaign

Research status: Completed Preliminary Clinical Trials

Background

Relational aggression, such as name calling and other epithets, remain in today's school environments. Despite the effort to reduce relational aggression (name-calling, eye rolling, etc.) in schools, such behaviors continue to pervade our classroom and subject students to forms of unnecessary victimization. This study begins with a personal narrative of an eleven year old African American female, which was developed into a web-based animated narrative vignette (ANV). An ANV is a scenario that expresses a real life experience that mimics a situation (Tettegah, 2002, 2003, 2004). As a research and teaching tool, other types of vignettes tend to be positively received by both scholars and educators and the use of vignettes has been empirically validated to help students achieve educational goals on a variety of technical, social, and behavioral topics (Barter & Renold, 2000; Finch, 1987; Chau et al., 2001; Mosquera, Manstead & Fischer, 2002; Schoenberg & Ravdal, 2000; Slead, Durrheim, Kriel, Solomon, et al., 2002;). Our research leverages the storytelling process of creating an ANV by using technology and will leverage the deliverables of that storytelling process, the vignettes, to understand how students perceive, in this paper, an incident in the classroom (multiple types of ANVs have been created with different foci). This research sought to answer the following questions: Is ANV technology a viable fidelity to measure student responses to social, anti-social and behavioral dispositions?

Method

Participants. One hundred and four middle school students (N= 55 males, N = 45 females, 4 unidentified) in the inner city Chicago area participated in this study. Students

were in the 7th and 8th grade (N= 30, 7th graders and N = 70, 8th graders, 4 unidentified). Qualitative data analysis revealed the following categories:

Racism = acknowledgement of racism or racial prejudice occurring in the vignette (0 = no acknowledgement; 1 = acknowledgement)
 Empathy = participant expressed empathy toward the victim in the vignette (0 = no expressed empathy; 1 = expressed empathy)
 Response = how the participant would respond to the situation. There are three rows representing physical aggression, verbal response, and tell authority. Physical Aggression (first row) -- 1 = response includes some form of physical aggression (e.g., hit, beat up, etc.); 0 = no physical aggression
 Verbal Response (second row)-- 1 = participant indicated verbally responding to Scott (e.g., inquired about his intentions and thinking, insult him, etc.); 0 = no verbal response
 Tell Authority (third row)-- 1 = participant would respond by telling an authority figure (e.g., teacher, principal, parent); 0 = no mention of telling authority
 Affect = self identified affect or personal feelings of the participant (e.g., acknowledging personally feeling mad, angry, hurt, offended, etc.) (0 = no acknowledged affect; 1 = acknowledged affect)

Results

Data analysis suggested that students interpreted the situation using ANV technology as a methodological tool was effective. The student's were able to take on the perspectives of character(s) in the ANV and respond in ways that suggest perspective taking and problem solving.

Novelty/Discussion

Prior work in this area focused on pre-service teachers (Tettegah, 2002, 2003, 2004). Our research provides the first systematic evaluation of the use of an ANV technology as a methodological tool with middle school students to understand how students perceive classroom conflict.

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Contact:

Sharon Tettegah, Ph.D.
 University of Illinois, Urbana Campaign
 383 Education, MC 708, 1310 S. Sixth Street
 Illinois, United States
 Phone: (217) 265-6206
 Fax: (217) 244-4572
 Email: stettega@ad.uiuc.edu

Presenter: Dave Thomas PhD

NIDA'S VIRTUAL REALITY PAIN RESEARCH PROGRAM

Dave Thomas, PhD

National Institutes on Health
National Institute on Drug Abuse

The National Institute on Drug Abuse (NIDA) has an annual budget of about a billion dollars, and is the largest drug abuse research funding entity in the world. NIDA supports basic drug abuse research, clinical trials of anti-addiction medications, and research on community interventions for drug abuse prevention and treatment. NIDA also supports many other areas of research that are related to drug abuse. One example of this is NIDA's extensive pain research program. NIDA's interest in pain research is many fold, and includes research on why many pain killers are addictive, how to make analgesics that are less addictive, and the development of effective non-pharmacological pain treatments. Included in this later category are treatments using acupuncture, transcutaneous electrical nerve stimulation (TENS), and virtual reality (VR). NIDA's VR and pain program is in its infancy, yet a number of projects have been funded that have demonstrated efficacy of VR in the treatment of various types of pain, including dental pain, burn pain, and pain encountered during physical therapy. NIDA is also funding research for the use of VR, along with fMRI imaging, to allow people with chronic pain to control the brain areas responsible for their pain, thereby reducing their perception of chronic pain. At NIDA, VR is envisioned as a powerful tool that can be used to help many of the millions of people living life with chronic pain.

Presenter: Cheryl Y. Trepagnier PhD

VIRTUAL ENVIRONMENTS TO ADDRESS AUTISTIC SOCIAL DEFICITS

Cheryl Y. Trepagnier, Ph.D., Marc M. Sebrechts, Andreas Finkelmeyer, Maya Coleman, Willie Stewart, Jr., Monica Werner-Adler.

The Catholic University of America

Research Status: The paper describes research in progress.

Background

Autistic Disorder is defined by social and communicative impairments and restricted, narrow interests. Impaired motivation is also common.

Several investigators have developed computer-based and virtual environment tools to address various issues in autism(1-5). Four projects at CUA address the social impairment.

Method/Tools

Face Processing: The prediction that autistic face processing impairment involves gaze differences was tested in an eye tracking study using a VR display. A replication in progress uses a monitor.

Early Intervention: A virtual environment, with kiddie-ride, monitor display and eye tracker, is being tested. The goal is to induce young children with autism to attend to faces.

Social Navigation: A joystick-navigable, first-person-perspective shopping mall is presented on a monitor. To locate objects, the user must move either between or around social and non-social obstacles. Data include user comments and path records.

Training in Social Conversation: SIMmersion LLC™ are collaborating with us to develop a social conversation module for adults with Asperger's Disorder. A virtual character remembers the conversation and responds as would an actual interlocutor to the user's speech.

Results

Face Processing: Preliminary results (with headset) confirmed gaze differences(6). The replication is in progress. **Early intervention:** Reliability-testing is being completed.

Social Navigation: Controls describe their avatar's actions in the first person, and refrain from walking between conversing characters. Data collection with persons with autism has begun. **Training in Social Conversation:** Development is in progress

Discussion

The projects described above derive from the hypothesis that failure to establish species-

typical face attention and processing itself undermines cognitive development(7). Accordingly face processing is targeted in young children, and compensatory training is addressed with older individuals. The challenge is to make the technology not only effective, but adequately entertaining to overcome autistic motivational barriers.

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Contact:

Cheryl Y. Trepagnier, Ph.D.,
The Catholic University of America,
Washington, DC, USA
Tel: 1 (202) 319-5780
Fax: 1 (202) 319-6162
Email: trepagnier@cua.edu

Presenter: Mimi M.Y.Tse PhD

AFFECTIVE IMAGES: RELIEVING CHRONIC PAIN AND ENHANCING QUALITY OF LIFE FOR OLDER PERSONS

Mimi M.Y.Tse PhD, RN, Sandra P.Y. Pun, BSN, RN, MHA, Iris F.F.Benzie, DPhil, FIBMS

The Hong Kong Polytechnic University

Background/Problem

With increasing life expectancy, the incidence of chronic illness and chronic pain also increase. Chronic pain robs older people of their quality of life, limits functional mobility and ambulation, and this lead to muscle atrophy. The older persons are reluctant to request pain relief, attempting to endure pain as 'normal' part of ageing. Chronic pain and mobility difficulties interact among older person; causing a negative feedback loop in which reducing physical activity to avoid pain usually ends up a further increase in pain when activity is undertaken. To this end, the innovative non-pharmacological intervention in pain management is appealing.

Method/Tool

Affective images and pictures were used in 15 elderly (12 female and 3 male, ages ranged 60 to 80, median age 71) in chronic pain and needed to perform stretching and standing exercises in their physiotherapy session. The affective picture book was made according to the preference of the older persons. The images included Chinese snack food and dim sum; market areas; landmark of the city; transportation system; flowers and natural scenery as well as images and pictures of previous famous movie stars. There were about 60 images and pictures in the picture book.

Pain scores were measured by Visual Analogue Scale (VAS) and health-related quality of life was measured by Medical Outcomes Study Short Form 36 (SF 36). VAS and SF-36 were taken in week 1 and in week 6. Pain scores were measured during physiotherapy session in following weeks.

Results

Before the intervention, pain intensity was found to be severe (median pain scores was 50 on a 100mm VAS). There was a significant decreased of VAS from week 1 to week 6 ($t = 3.607$; $df = 14$; $p < 0.05$). Also, a significant decreased in VAS when the older persons were watching affective pictures while performing the physiotherapy exercise in the 2nd and 3rd week; but not over the 4th and 5th week. SF-36 had been increased in

week 6 which indicated an increased in health-related quality of life, despite not statistically significant.

Discussion/Conclusion

The study demonstrated a decreased in pain perception and increased in health-related quality of life among the older persons with chronic pain. Before the intervention, pain was severe enough to hinder their activities of daily living, decreasing the desire to participate in exercise and social events.

Regular physical activity is important to health. With the use of affective images and pictures, the older persons tend to report less pain; became more cooperated and increased the mobility level during and after the physiotherapy session. In this regard, affective images and pictures appear to be an effective non-pharmacological intervention in pain management for the older persons, of which, their mobility and quality of life would be enhanced.

Novelty

There has not been any research and application of affective images and pictures as an adjunct to pain relief for older population. Our study adds knowledge to existing pain relief methods.

Contact:
Mimi M.Y.Tse
School of Nursing
The Hong Kong Polytechnic University
Phone:852 2766 6541
Fax: 852 2364 9663
Email: hsmtse@inet.polyu.edu.hk

Presenter: Dimitrios Tzovaras PhD

HAPTIC ACCESS TO VIRTUAL MODELS OF REAL DATA FOR TRAINING THE VISUALLY IMPAIRED

K. Moustakas, G. Nikolakis, D. Tzovaras and M.G. Strintzis

Informatics and Telematics Institute/CERTH

Research Status: Completed.

This paper presents a completed novel frame-

work for haptic interaction with 3D virtual scenes automatically generated from a video captured by a single camera. The system is used for training visually impaired users.

Background/Problem

The combination of two different and complementary modalities like haptics and video is a very challenging research area. The potential benefits of such a combination for the visually impaired people are very high [1], since they will be able to navigate in unknown for them places without risking injuries etc., as will be described in the sequel.

Method/Tools

Initially, bi-directional 2D motion estimation is performed on the video. Rigid 3D motion and structure is recovered using an object based reconstruction approach, which makes use of extended Kalman filtering (EKF), utilizing also a basic knowledge of the scene. The resulting 3D structure data are used to generate the 3D model of the processed scene. This is accomplished either by generating a single mesh of the scene utilizing the generated depth maps, or by applying modeling for the objects of the scene using analytical implicit functions and non-linear least squares minimization. The generated model is used in order to provide haptic access to the processed scene for the blind using haptic devices like the PHANTOM and the CyberGrasp.

Results

In order to evaluate the proposed methods, experiments were performed on 3D real maps of buildings as well as indoor maps. The camera captures the map and the system converts the monoscopic video into a 3D model. Finally, the blind user navigates through the map using the haptic devices [2]. The experiments demonstrated the efficiency of the proposed methods. The system performs in real time and if there exists knowledge about the captured scene, like the case with the 3D maps, the scene can be approximated using implicit functions and computationally intensive processes like collision detection are performed 20-30 times faster, when compared to standard mesh based methods.

Usability Studies

The proposed haptic interaction system has been also evaluated in tests with users of the Blind Association in Thessaloniki, Greece. The system evaluation results have shown that users consider it very innovative and satisfactory in terms of providing realistic and smooth force feedback. The percentage of the satisfied users was reported to be more than 96%. Analysis of variance (ANOVA) test were also performed and illustrated interesting statistical results (i.e. the gender does not affect the performance results of the user, there exists a difference in performance for users which were born blind). These tests are not presented in detail due to space restrictions.

Conclusion

In terms of novelty the proposed framework combines video with haptics in a real time framework for the generation of virtual scenes, which are then used to train visually impaired people, on how to navigate in specific areas. Moreover it extends structure from motion (SfM) methods and combines them with surface approximation schemes using implicit surfaces, thus resulting in an efficient, realistic and user-friendly system.

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Contact:

D. Tzovaras
 Informatics and Telematics Institute/CERTH
 1st km Thermi Panorama Road
 Thermi-Thessaloniki, 57001 Greece
 Phone: +302310464160
 Fax: +302310464164
 Email: moustak@iti.gr

Presenter: Dimitrios Tzovaras PhD

HAPTIC INTERFACE FOR THE PERFORMANCE OF A REMOTE ECHO-

GRAPHY EXAMINATION

K. Moustakas, G. Nikolakis, D. Tzovaras and M.G. Strintzis

Informatics and Telematics Institute/CERTH

Research Status: Completed.

The proposed paper describes a force feedback control system for the performance of remote ultrasound examination.

Background/Problem

During the last few years, there have been a lot of efforts to use and integrate virtual environments in medical applications. Such works have been developed in order to improve the performance of specific medical applications. In our case, a 3D virtual environment is developed to provide the expert with a realistic simulation of remote ultrasound examination. The proposed paper describes the force feedback [1] control aspects of a remote ultrasound examination system. The haptic interface is used by an ultrasound specialist in order to control a robotic system and perform a remote ultrasound examination.

Method/Tools

The PHANToMT [2] fictive probe can provide sufficient data for the control of the robot, which is located at the remote site, and offers the capability to use force feedback to assist the expert performing the echography examination. In the proposed virtual reality 3D environment a menu provides the user/expert with the ability to select between a variety of actions and functionalities. Specifically, the user can view a representation of the workspace. The user in the expert site can simply import appropriate 3D geometries from VRML files. The expert can select the examination working area using the PHANToMT Stylus and start/stop the examination process. When the expert selects the examination area an automatic scaling occurs so that the active PHANToMT workspace size can access all the workspace of the slave robot, using a uniform scale factor. When the expert starts the examination, the force feedback is applied to the expert via PHANToMT depending on the force measured by the slave robot located at the remote station. The 3D model can be also used as an alternative

source for providing this force feedback input to the PHANToMT device, in cases of weak communication links. For safety reasons, if the PHANToMT probe penetrates the 3D graphical model over a threshold value, an alarm sound is activated to warn the expert for possible communication failure. The use of a master probe and slave robot brings up the problem that they have different workspaces. Using scaling can solve the problem of different workspaces. If scaling is applied only to the positions and the forces felt by the human remain the same, as measured at the remote site, then the appearing stiffness of the environment changes due to the scaling factor "s". In order to solve this problem scaling is also performed to the force feedback.

Results

The system was integrated with a communication system for the transmission of ultrasound images and video and it was tested. The results have shown that the doctors appreciated the haptic feedback when the communication bandwidth was good enough to provide feedback to the user without noticeable delay.

Conclusion

In this paper, we presented a new 3D virtual reality environment with force feedback control and inspection of ultrasound examination. The system was successfully integrated and tested to a Tele-Echography environment.

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Contact:

D. Tzouvaras
Informatics and Telematics Institute/CERTH
1st km Thermi Panorama Road
Thermi-Thessaloniki, 57001 Greece
Phone: +302310464160
Fax: +302310464164
Email: moustak@iti.gr

Presenter: Efsia Urru PhD

PROJECT IR

Dr. Efsia Urru

L'Associazione Medica Italiana per lo Studio della Ipnosi (A.M.I.S.I.)

This is a time to venture for hypnotherapy. All things change in a human being. The strange link between us and machines is a reality today. Milton Erickson gives us a lesson for the coming years. His mysterious work, only in this millennium appears as a secret code that will be revealed to the new generation. With the case of "February Man" it is possible for us to give a new interpretation to it. This is a new era for hypnosis. Do we stand by? Our answer is in this work the PROJECT IR in which for the first time hypnosis is utilized with virtual reality. Therapist and patients together live in a virtual program. In this project synthesis there are two possible programs. One is the development of relaxation with a standard program of virtual reality for all people that want to remove themselves out of their daily life. This program is made for a psychologist's clinic or in the future when it will be available as a videogame in personal homes. Two is a specific virtual reality program for grave pathology such as phobias, depression, psychosis, and schizophrenia.

This virtual reality program is made after studying a deep history of patience. Each program has the same key of opening and closure with particularly pictures.

Contact:

Dr. Efsia Urru
L'Associazione Medica Italiana per lo Studio della Ipnosi (A.M.I.S.I.)
Street lamarmora 38
Sardinia Cagliari Italy
Tel: 3477762318
Email: efsia.urr@inwind.it

Presenter: Cecilia Vera MSc

WEARABLE SYSTEM FOR AUTOMATIC EMOTION DETECTION IN EXTREME CONDITIONS

Cecilia Vera MSc

SIEMENS, S.A.

In the recent years the automatic detection of

human emotions has been one of the areas of interest within the scientific community. Most of the studies published so far are based on a combination of two techniques: advanced image-processing and codification of expressions. This second approach is based on the theories that postulate the existence of basic and universal emotions and establish a relationship between these basic emotions and certain facial expressions. Up to now, a good strategy for detecting a subject emotion has been the analysis of facial images to determine the expressions shown by the individual, and the subsequent codification of these expressions in terms of basic emotions. Nevertheless, this abstract brings up an innovative method for the detection and recognition of human emotions: the processing of biomedical signals.

This novel technique has been the origin of the AUBADE project (partially funded by the EC IST programme) that aims to develop an intelligent, multi-sensor and wearable system for the assessment of the emotional state of humans under special or extreme conditions. The emotions are detected after the processing of electromyogram (EMG) measurements obtained from the face of the person to be assessed. Additionally other biomedical signals are considered: heart rate variability, skin conductivity and respiration rate. This approach means an alternative to the traditional image-processing techniques and makes possible the application of the system in a wider number of situations, especially in those where it is not achievable to have facial images available. The project, now in progress, involves the utilization of innovative technologies, such as wearable devices, biosensors, data fusion, medical decision support systems, 3-D animation and telecommunications.

The result of the project will be a modular and multifunctional system to be applicable in diverse areas. In the health sector, it is expected that it will contribute to improve the diagnosis of neurological diseases as well as to get a better comprehension of the psychological status of patients through the emotion detection. It will be used to monitor people under high levels of stress or special conditions, making possible to assess the effects that these conditions produce to their emotional state. The system will also establish relations between facial expressions and certain diseases, helping health professionals to

gain knowledge in this area and increasing the efficiency in diagnosis.

AUBADE project will develop the next generation of the remote emotion's monitoring systems, providing health professionals with an innovative tool that will lead them to a deep study, analysis, understanding, and comprehension of human emotions.

Contact:
Cecilia Vera MSc
SIEMENS, S.A.
Ronda de Europa, 5. Tres Cantos.
Madrid 28070, Spain
Phone: + 34 91 514 45 84
Fax: +34 91 514 47 87
Email: cecilia.vera@siemens.com

Presenter: Erik Viirre MD PhD

ADAPTIVE DISPLAYS: CAN WE PREDICT PERFORMANCE?

Erik Viirre M.D. Ph.D.¹, Tzzy-Ping Jung Ph.D.¹, Bradley Chase Ph.D.², Yi-Fang Tsai³, Shawn Wing³, Christopher Strychacz³

¹ University of California, San Diego

² University of San Diego

³ Naval Health Research Center, San Diego

Research Status: In Progress.

Background

Adaptive displays are often envisioned as systems that respond to state changes in an operator. To date, physiologic measures are typically averaged over a window of some duration, often several minutes, to develop statistical certainty on the onset of a state change. We are interested in determining the possibility of using physiologic measures to more directly predict the onset of performance changes during tasks. To do so, we are examining oculomotor changes as they precede performance on a dual auditory and visual tracking task. In line with previous studies in this area (1,2), we anticipate that a number of oculomotor behaviors will change with performance and that an aggregate measure will have higher predictive power than an individual measure. Our aspiration is to be able to monitor oculomotor activity, perhaps combined with other behavior measures, to detect work overload conditions

where errors might occur. Such approaches would be applicable to situations such as the common driving-while-talking-on-the-phone and could be used to warn drivers that their attention is overloaded.

Method/Tools

Eye movements and head were recorded EyeLink II from SR Research. The interactive STIO fixed-base driving simulator developed by Systems Technology, Inc. with custom visual scenes were used for a curving mountain-driving scenario. Participants were asked to maintain lane position between two moving vehicles a fixed distance apart. The secondary task was a version of the Paced Auditory Serial Addition Test (PASAT). Subjects hear a series of numbers, mentally add a number to the previous number and verbally state the sum. Difficulty is varied as a function of number presentation speed. A typical number presentation rate of 1.8 seconds results in approximately 60% correct responses. The subjects were instructed to perform three ten-minute block trials of driving, auditory, and the dual tasks. Eye movement behaviour characteristics including those of blinks, saccades, vergence eye movements and pupil diameter are all being examined for their statistical relation to the correct or incorrect responses on the audio task and to the variability on the driving performance task.

Results

Preliminary data analysis has progressed to description of overall comparisons of performance on the combined task compared to the individual driving or audio task. Comparison of performance on the auditory task alone versus with driving showed that there was small, non-significant decrease in performance with the dual-task. Blink durations increased in the combined task versus the driving task alone, but actually substantially increased during the auditory task alone. Further, the variability of blink duration showed a similar pattern. Further analyses are ongoing.

Conclusion/Discussion

We hope that this study will provoke discussion as to the feasibility of using physiologic measures as direct predictors of performance as opposed to general indicators of operator state. Improved prediction could lead to advanced adaptive interfaces and direct im-

provements in performance. If predictive measures can be described for our particular tracking/audio task, it will be important to determine how generalizable our model of cognitive overload and our metrics can be for other high work-load conditions.

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Contact:

Erik Viirre M.D. Ph.D.
University of California, San Diego
Department of Cognitive Science
Tel: 858 336-0317
Fax: 858 270 0740
Email: eviirre@ucsd.edu

Presenter: Daniela Villani

VIRTUAL REALITY TO REDUCE ANXIETY IN HEALTHY POPULATION: THE RELAXATION ISLAND

Daniela Villani¹; Francesco Riva²; Eva L. Waterworth, Ph.D.³; John Waterworth, Ph.D.⁴; Jonathan Freeman, Ph.D.⁵; Giuseppe Riva, Ph.D.¹.

¹ Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy

² Center for Communication Psychology, Catholic University of the Sacred Heart, Milan, Italy

³ Tools for Creativity Studio, The Interactive Institute, Umeå, Sweden

⁴ Department of Informatics, Umeå University, Umeå, Sweden

⁵ Department of Psychology, Goldsmith College, University of London, UK

The use of Virtual Reality in therapy is not a novelty [1] and we expect that, combined with different relaxation techniques, it can enhance the relaxation by visually presenting, and thereby enhancing, key images for facilitating relaxation and acceptance, and enabling par-

ticipants to practice, and hence master, relaxation and acceptance techniques in a more realistic context.

The aim of the study is to explore whether the effects on mood, specifically on anxiety and positive and negative states, of a therapeutic narrative enhance through its presentation within a virtual environment [2] in an immersive condition.

To accomplish this goal we use the Relaxation Island in which we apply different relaxation techniques, following a specific protocol that is composed by two sessions. Three phases compose each session: the first is based on immersive navigation in the day, the second on imagination and the third on immersive navigation in the night.

The techniques aim to reduce anxiety linked to active negative thinking through cognitive control and to achieve progressive muscular relaxation following the approach proposed by Jacobson [3] and the breathing techniques. To test the enhance of the effects we compare this procedure with an usually video procedure, a new age DVD with relaxing music, where participants watch a video and have the freedom to imagine any sensory element required. Some of the questionnaires used are *Positive and Negative Affect Schedule* (PANAS), to measure the positive and negative affects [4], and *State Trait Anxiety Inventory* (STAI), to measure the level of anxiety[5]. Participants, University students, were 30 subjects ranging from 21 to 24 years old, split up in two groups. The study is in progress and the results will be ready in march, therefore preliminary outcomes will be presented during the conference.

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Contact:
Daniela Villani
Applied Technology for Neuro-Psychology Lab
Istituto Auxologico Italiano
Via Pelizza da Volpedo 41
Milan, Italy
Ph./Fax +39-02619112892
Email: d.villani@auxologico.it

Presenter: Tamar Weiss PhD

THE VIRTUAL MALL: A FUNCTIONAL VIRTUAL ENVIRONMENT FOR STROKE REHABILITATION

Debbie Rand M.Sc^{1,3}, Noomi Katz Ph.D², Rachel Kizony M.Sc^{1,2,3,4}, Meir Shahar MBA³, Patrice L. (Tamar) Weiss Ph.D^{1,3}

¹ Department of Occupational Therapy, University of Haifa

² School of Occupational Therapy, Hadassah-Hebrew University, Jerusalem

³ Laboratory for Innovations in Rehabilitation Technology

⁴ Dept of Occupational Therapy, Sheba Medical Center, Tel Hashomer

Research Status: In Progress

Background

Patients who have had a stroke constitute a large population with significant needs for rehabilitation. To date, even after long, intensive and costly rehabilitation, these patients still suffer from many impairments leading to severe restrictions of participation in every day life. In addition, there is insufficient training of instrumental activities of daily living (IADL) functioning during the rehabilitation, since it is both time consuming and technically difficult to implement. There is a great advantage to remediate motor and executive function deficits via practicing tasks that are functional, meaningful to the patient, and which can be repeated over and over again in a safe environment. A Virtual Mall (VMall) has been designed to be used for the treat-

ment of patients following a stroke who have motor and/or executive functions deficits (1).

Aims

1) To describe the development of a functional virtual environment, the VMall. 2) To present data from a pilot study of stroke patients which assessed the suitability of the VMall for this population, and 3) To present the data of an initial clinical trial which examines the effectiveness of the VMall environment for the assessment and treatment of executive functions deficits and motor deficits.

Method

Participants: For testing the suitability of the VMall, six patients, aged 50-74 years, who had sustained a stroke more than two years prior to the study were pilot-tested. For the pilot clinical trial stroke patients, aged 50-85 years, who had sustained a stroke at least three months prior to the study will be recruited. The patients all suffer either from a considerable motor impairment of their upper extremity (assessed using the Fugl-Meyer Motor Assessment) and/or from deficits in their executive functions (assessed using two subtests from the Behavioral Assessment of the Dysexecutive syndrome (BADS) (2)). **Instruments:** The VMall (to date one large store with multiple aisles), has been implemented via VividGroup's (www.vividgroup.com) video capture Gesture Xtreme system (GX). The performance of the task provides multiple opportunities to make decisions, plan strategies and multitask, all in a fairly intuitive manner. Shopping for grocery products is done by virtually touching the different items located on shelves in different aisles. Output measures record the user's performance with in the VMall and the kinematics of the patient's movements. **Procedure:** A single case study design (ABA) will be used to assess the effectiveness of treatment using the VMall.

Initial Results/Conclusion

Initial performance data and feedback from the patients suggest that the VMall provides an interesting and motivating task. Detailed results of the initial clinical trial will be presented and further development of the VMall paradigm will be discussed.

Novelty

In comparison to functional virtual environments that are presented on desktop VR systems or those which use a Head-mounted Display, the use of a video capture platform for the development of a virtual functional environment is advantageous since it encourages patients to actively move their affected upper extremity in a relatively functional manner while planning, initiating, and problem solving when engaged in the shopping task.

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Presenter: Marc Wolter PhD

NEUROMAN – A COMPREHENSIVE SOFTWARE SYSTEM FOR NEUROPSYCHOLOGICAL EXPERIMENTS

Jakob T. Valvoda, Torsten Kuhlen, Marc Wolter, Claudia Armbrüster, Will Spijkers, Rene Vohn, Walter Sturm, Bruno Fimm, Martina Graf, Ines Ann Heber, Hans-Christoph Nuerk, Klaus Willmes

Virtual Reality Group, Center for Computing and Communication, RWTH Aachen University

Background/Problem

Virtual Reality (VR) is an established neuroscientific instrument. Several approaches to develop software systems for particular neuropsychological experiments exist, like navigation¹ or driving assessment.² An overview is given.³ In other studies game engines have been used.⁴ These systems are in general limited to a specific field of application. When experimental paradigms are changed, the software has to be re-designed. In neuropsychological studies exact runtime behaviour of the software has to be guaranteed and measured as well as the responses of participants within millisecond accuracy, features that are not provided in most existing

approaches. Finally, some of the systems only allow execution on desktop-based systems, lacking immersive, stereoscopic visualization.

In order to use Virtual Reality in the broad field of neuropsychological research, and to meet diverse needs and requirements of neuropsychological researchers, we have developed the NeuroMan system, a comprehensive software framework. NeuroMan enables the user to describe experimental set-ups and their runtime behaviour in a versatile and easy way and to monitor the responses of participants. With our approach we have handled the challenges of diversity of experimental set-ups, chronological logging, and heterogeneous virtual environments.

Method/Tools

The design of NeuroMan is based on the principle, that a description of the experimental set-up and its chronological performance should be separated from the implementation of VR-methods and their particular implementation on VR-hardware. In NeuroMan experimental set-ups are defined by scripts.⁵ The system generates a virtual experiment with the desired application flow, i.e., a sequence of sessions, blocks, trials and multimodal stimuli, which may be influenced by specified user interactions or system events. The resulting experiments can be executed on a variety of VR-hardware, making use of the VR-toolkit ViSTA, and its multimedia extensions.⁶ Main features of NeuroMan are the possibility to log the overall system behaviour with specific timing characteristics⁷ and to handle large environmental models as visual stimuli. Integration of acoustics, human avatars, and fMRI scanner support are being developed in current projects.

Results

We have conducted several neuropsychological experiments with NeuroMan, e.g., research on mental representations of numbers,⁸ on attentional asymmetries after sleep deprivation⁹ and for the assessment and treatment of disorders of spatial representations. In a further study we investigated distance estimation in VR.¹⁰ Studies concerning the influence of language properties on object manipulation and the modulatory effects of attention on pointing and grasping movements are currently underway. The experi-

ments described have been carried out on table-like displays, on a HoloBench™, in a 5-sided CAVE-like environment and with a head-mounted display. Electro-magnetic and optical tracking systems have been used.

Conclusions

NeuroMan has been used successfully in several neuropsychological studies. The script language with its underlying experimental model is capable of describing various experimental set-ups

Novelty/Discussion

Even though several approaches to the development of software systems for neuropsychological experiments have been utilized, a comprehensive software framework for VR-based experiments has not been established yet. NeuroMan is capable of handling a variety of experiments on a comprehensive and homogeneous basis.

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Contact;

Jakob T. Valvoda,
Virtual Reality Group, Center for Computing
and Communication, RWTH Aachen University
52074 Aachen, Germany
valvoda@rz.rwth-aachen.de
Tel: +49 – 241 – 80-243 76
Fax: +49 – 241 – 80-221 34

Presenter: Christine Youngblut PhD

PRESENCE-- SETTING THE SCENE

Christine Youngblut PhD

Institute for Defense Analyses

Much attention has been focused on feeling a sense of *presence* in a virtual environment (VE). The potential importance of presence is based on an assumption that increasing the sense of presence experienced in a VE leads to improved task performance.

The goal of this informal talk is to set the scene for the following presentations by introducing the presence construct. It will summarize the results of over 120 studies that have been conducted by various researchers over the last decade. Critical outstanding research questions will be identified, along with some recommendations for future presence research.

**Presenter: Brenda K. Wiederhold PhD
MBA BCIA**

**VR FOR BLOOD-INJECTION-INJURY
PHOBIA**

Brenda K. Wiederhold^{1,2}, Megan Mendoza¹,
Tadashi Nakatani¹,
Alex H. Bullinger³, Mark D. Wiederhold¹

¹ Virtual Reality Medical Center, San Diego,
California

² Interactive Media Institute, San Diego, California

³COAT-Basel/UPKBS, University of Basel,
Switzerland, Department of Psychiatry

Virtual reality (VR) exposure therapy has been shown to be successful in treating many types of specific phobias which are mostly visual in nature. However, limited research has been completed on the use of VR therapy for Blood Injection-Injury (BII) phobias, one of the subtypes of Specific Phobia listed in the DSM-IV TR. Since BII phobia may operate by some tactile component, it may respond differently to VR therapy compared to other categories of specific phobias that are largely visually activated. This paper discusses initial development and results from a study on both subjective and objective arousal elicited by a prototype virtual world which has been developed to treat those with BII phobia. The present study evaluated the responses of 20 healthy, non-phobic male and female participants to VR blood and injection stimuli. Initial results are positive and show that the VR world delivers appropriate cues to elicit physiological and self-reported arousal when exposed to the injection scenarios. Correlations between self-reported anxiety and physiological arousal confirm that individuals experiencing greater symptoms of fear in conditions involving blood or injections will exhibit more intense arousal from the virtual stimuli than those who experience reduced symptoms. Findings suggest that the virtual world is an effective method of cue exposure for individuals who experience anxiety in situations related to blood and injections. Future research on the use of VR exposure therapy in the treatment of BII phobia is warranted.

Contact:

Brenda K. Wiederhold
Interactive Media Institute
6160 Cornerstone Court East, Suite 161

San Diego, CA 92121
Ph: (866) 822-8762
Fax: (858) 642-0285

PARIS FRANCE
Phone: + 33 1 42 16 12 59
Fax: + 33 1 53 79 07 70
Email: znaidi@ext.jussieu.fr

Presenter: Feryel Znaïdi

**TOWARDS A COGNITIVE AND SENSO-
RIAL MODEL OF PRESENCE: A
STUDY IN DIFFERENT VIRTUAL SEN-
SORY CONDITIONS**

Feryel Znaïdi, MA, Olivier Warusfel, Roland
Jouvent, IsabelleViaud-Delmon

CNRS UMR 7593

Presence is the experience a person has, when in a virtual environment (VE), of 'being there.' Presence is an important concept to assess the effectiveness of a virtual environment in clinical applications. We designed an experiment in which the importance of different factors that might contribute to the feeling of presence could be evaluated. Three kinds of VEs in which different sensory information were provided to the subjects were tested and compared. Subjects were equipped with a head-mounted display coupled with an electromagnetic sensor system and immersed in a virtual town in which they could move forward by pressing a mouse button. Subjects had to turn on their own vertical axis in order to change the direction of heading in the virtual town. Their task was to locate different landmarks and become familiar with the town. After this virtual navigation, they had to fill in a presence scale, a state anxiety scale, a cyber sickness symptoms scale, and complete several spatial memory tests related to their experience. Subjects had to perform this navigation according to three conditions (Vis, Avis, and A) during separate sessions. In the AVis condition subjects were equipped with the head-mounted display and headphones, which delivered a soundscape updated in real time according to their movement in the virtual town. In the third condition, they were asked to navigate in a soundscape in the absence of vision (A). The sounds were produced through tracked binaural rendering (HRTF) and were dependent upon the subject's movements. During all conditions, skin conductance was recorded.

Contact:
Feryel Znaïdi, MA
CNRS UMR 7593